Motivational and Cognitive Determinants of Attentional Bias for Alcohol-Related Stimuli: Implications for a New Attentional-Training Intervention

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Appendices 1 – 9, pages 284 – 309

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ABSTRACT

This research examined the adequacy of cognitive-motivational theory (Cox & Klinger, 1988, 1990; Klinger, 1995) for integrating cognitive and motivational predictors of alcohol consumption. It did so by evaluating the role of motivational structure and attentional bias for alcohol-related stimuli in predicting drinking behaviour. The study used an abridged version of the Personal Concerns Inventory (PCI), Perceived Stress Scale (PSS), Shipley Institute of Living Scale (SILS), a self-report inventory of alcohol use, two versions of a computerised Stroop test, and a post-Stroop memory test and emotional valence ratings. In Experiments 1-3, 128 university students and 50 inpatient alcohol abusers completed the instruments. Experiment 1 revealed that, after other variables had been controlled in a hierarchical multiple regression model, maladaptive motivation and alcohol attentional bias scores were significant predictors of students' alcohol consumption. Experiment 2 revealed that (a) drinking problems predicted students' Executive Cognitive Function (ECF), (b) students' ECF did not predict their motivational structure, and (c) students' attentional bias for alcohol-related stimuli was independent of their ECF. Experiment 3 revealed that (a) alcohol abusers had a poorer ECF than students, (b) alcohol abusers showed greater attentional bias for alcohol-related stimuli than did students, (c) alcohol abusers had poorer motivation than students, (d) motivational distinctions among different alcohol abusers could be identified, (e) alcohol abusers' ECF impairment predicted their degree of maladaptive motivation, and (f) alcohol abusers' attentional bias for alcohol related stimuli was independent of their ECF. Because there has been a gap between prior research on attentional bias for alcohol-related stimuli and applications of the findings of this research in treatment, a new, computerised training programme called the Alcohol Attention Diversion Training Programme (AADTP) was developed in the current research to help alcohol abusers overcome their attentional bias for alcohol. In Experiment 4, nine detoxified alcohol abusers took part in an evaluation of the training. Results revealed that, after training with the AADTP, the trainees' attentional bias for alcohol-related stimuli, but not their bias for other concern-related stimuli, considerably decreased. Overall, the results of the research indicate that (a) motivational structure and alcohol attentional bias are important correlates of drinking behaviour among non-dependent and dependent drinkers, and (b) AADTP is an effective, alcohol-specific intervention to help alcohol abusers overcome their drinking difficulties.
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DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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CHAPTER ONE

Toward a Motivational Model of Alcohol Use

_Alcohol Abuse: The Problem of Uncontrollability_

Alcohol abuse is a progressive disorder. It is difficult to understand why somebody would drink so much alcohol each day that it would cause him or her serious health problems. Alcohol problems usually start with entertaining or self-prescribing purposes. People start consuming alcohol to feel happier, or to forget their problems. For some people, this pattern of drinking gradually develops into abusive drinking or alcohol dependence.

Recognising a chronic alcohol abuser can be intuitively easy—someone drinking a litre of spirits every day would certainly appear to be an alcohol abuser. However, an exact definition of alcohol abuse is problematic.

There are different criteria for the diagnosis of alcohol abuse and alcohol dependence. Similarly, different orientations emphasise different aspects of alcohol-seeking behaviour (these orientations include behavioural, emotional, cognitive, biological, and neurological). The DSM-IV (1994) focuses on symptoms for its definition of alcohol dependence and alcohol abuse. In terms of the DSM-IV criteria, the presence of any combination of at least three symptoms during a period of 12 months is sufficient for the diagnosis of alcohol dependence. These symptoms are (a) preoccupation with consuming alcohol; (b) drinking more alcohol than the amount intended or for a longer period than anticipated; (c) the development of tolerance; (d) withdrawal symptoms; (e) consuming alcohol to avoid or control withdrawal symptoms; (f) repeated efforts to stop drinking; (g) drinking at inappropriate times; (h) a reduction in social, occupational, or recreational activities in favour of further alcohol consumption; and (i) continued alcohol use despite suffering from social, emotional or physical problems related to drinking.

The DSM-IV defines alcohol abuse as a pattern of alcohol use in which one or more of the following four criteria are present within the prior year. Recurrent alcohol use results in (a) a failure to fulfil major role obligations; (b) the placing of self and others in potentially hazardous situations; (c) legal problems; and (d) persistent or recurrent social/interpersonal problems because of the effects of alcohol.
From a behavioural viewpoint, alcohol abuse is defined as repeated self-administration of alcohol despite the abuser’s knowledge of the adverse effects of alcohol and his or her frequent attempts to stop drinking (Roberts & Koob, 1997).

Some researchers have emphasised the importance of urges—motivational states aimed at the regulation of emotional states: the emotional states may be either positive or negative (e.g., Cox & Klinger, 1988, 1990). Exposure to addiction-related cues can trigger relapse by provoking urges to drink (e.g., Hyman & Malenka, 2001; Monti, Roshesnew, & Hutchison, 2000).

Some posit that addiction requires, or at least is associated with, changes in automatic cognitive processes. This viewpoint is a shift toward the importance of automatic processes. For example, according to Tiffany (1990), frequent drug use causes the development of an automatic chain of drug-seeking behaviour. Thus, according to Tiffany, when dependent drinkers encounter drink-related cues, a chain of automatic processes starts. This chain has drinking as the goal. Craving is a conscious experience when drink-seeking behaviour is blocked. According to Tiffany (1990), the conscious experience of having an urge to drink is neither necessary nor sufficient to explain repeated drug-taking behaviour.

Some researchers emphasise the sole importance of biological factors in alcohol abuse, underestimating the importance of psychological factors. For example, Milam (1992) suggested that alcohol is a selective biological addictive substance, and this selectivity is solely linked to genetic vulnerability, and that there are not various types of alcohol abuse; the only difference to be considered is the different levels of concern and strategies for damage control.

Moreover, Robinson and Berridge (1993, 2000, 2001, 2003) provided evidence that the relationship between drinking and brain changes (and deficits) is reciprocal and leads to impairments of cognitive strategies. These strategies are required in order to avoid drug use or to control behavioural impulsivity (both affecting addicts’ motivation to seek and drink alcohol).

Morse and Flavin (1992) tried to establish a more precise use of the term alcohol abuse [alcoholism] in the light of current concepts in the field. They arrived at a brief definition of alcohol problems; these aimed at scientific validity, clinical usefulness, and ease of understanding by the public. Thus, they defined alcoholism as follows:

Alcoholism [alcohol abuse] is a primary, chronic disease with genetic, psychosocial, and environmental factors influencing its development and manifestations. The disease is often progressive and fatal. It is characterised by
impaired control over drinking, preoccupation with the alcohol, use of alcohol
despite adverse consequences, and distortions in thinking, most notably denial.
Each of these symptoms may be continuous or periodic. (p. 1012)

Considering this and other definitions of alcohol abuse, different researchers (e.g.,
Bowden, Crews, Bates, Fals-Stewart & Ambrose, 2001; Flannery, Roberts, Cooney,
Swift, Anton & Damaris, 2001; McCusker, 2001; Robinson & Berridge, 1993, 2000,
2001, 2003; Tiffany & Conklin, 2000; West, 2001) agree that there is at least one
accepted key criterion in the definition of alcohol abuse. This common feature centres on
the inability of abusers to control their urges to drink alcohol. This means that drinkers
continue in their pattern of excessive drinking despite their knowledge of the hazardous
results of uncontrolled drinking (Heather, 1998). Relapses usually occur in spite of
abusers’ awareness of the negative consequences of drinking and their volitional efforts to
stop the behaviour (Roberts & Koob, 1997). As McCusker (2001) stated, “this may
suggest that there are processes governing addictive behaviours that are outside conscious
awareness and volitional control” (p. 1). The loss of control may be reflected in a
persistent preoccupation with obtaining and using the abusive substance (McCusker,
2001; Roberts & Koob, 1997).

Considering the importance of the above criterion, theorists try to explain the
nature of the phenomenon of inability to control. Theories try to explain why people get
into a behavioural pattern that restricts their freedom of choice and causes many personal
and social problems. The behavioural pattern has led to the conclusion that addiction is a
disorder of motivation (e.g., Bigelow, Brooner, & Silverman, 1998; Cooper, Frone,

To summarise:
Different theoretical views have explored alcohol abuse. A commonly agreed
criterion among different approaches considers addiction to be a problem of
controllability. This definition places alcohol abuse within the broad field of motivational
disorders. However, the concept of motivation as used here arises from other factors;
these include previous learning; attentional and cognitive processes; and affective,
physiological, and neurological states. Furthermore, the relationship between alcohol use
and its motivational components is reciprocal. How do the reciprocal interactions among
alcohol, motivation, and attentional, cognitive, and neurobiological components
determine the uncontrollability of alcohol abuse? This remains challenge for further
research.
Organisation of the Review of the Literature

Within a motivational framework, the thesis investigates relationships between motivational and cognitive processes and drinking. The goal of the first three chapters of the thesis is to address several research questions that concern the interaction between motivational structure, attentional bias, and executive cognitive functions (ECF) of alcohol abusers.

Chapter 1 discusses theories that explain the formation of and changes in the uncontrollable nature of addiction. Next, it examines the most important elements of a general motivational theory. (A critical review of these concepts and their relationships with addiction theories has two potential benefits: first, it provides an immediate background for the motivational model of alcohol use; second, it encourages a better understanding of the conceptual link between different components of a motivational network—e.g., reinforcement, expectations, incentives, and the brain loci). The chapter explains the motivational model of alcohol use and differentiates its conceptual overlaps with similar concepts in the field; it also argues for the theoretical comprehensiveness of this model, and provides evidence from neurocognitive studies. In addition, there is a section on the motivational modulatory system to describe how people make incentive decisions.

Chapter 2 discusses the attentional-bias paradigm, the emotional Stroop, and alcohol-Stroop paradigms.

Chapter 3 explains ECF and unanswered questions about the role of general executive cognitive impairments in alcohol problems, and their relationship with participants’ attentional bias for alcohol.

Addiction and Theoretical Speculations

This section introduces a classification (reductionist in the main) of theories of addiction suggested by West (2001). Each theory deals with one or several aspects of addictive behaviour. This section also discusses and examines the theory of stages of change as an example. The theory of stages of change pertains to the processes through which an addict ceases abusing alcohol; the theory falls within the therapeutically oriented theories of addiction. Finally, the section compares the comprehensiveness of the motivational model of alcohol use with the former theories.

As far as psychology is concerned, explaining the contradiction between drinkers’ conscious knowledge and their uncontrolled harmful drinking has been the subject of much research and theorising. Over the last century, successive theoretical models of
addiction have been developed. These theories have been based on different approaches—psychoanalytic, neurobiological, behavioural, and genetic, for example. These theories have led to much research about the uncontrollable nature of alcohol abuse, and how it can be brought under intentional control.

In a recent article, West (2001) placed most of the theories of addiction (including alcohol abuse) into five categories. The first involves theories and models that try to explain the nature of addiction at a variety of levels, including biological, social, psychological (e.g., drives, incentives, cognitions), or some combination of these factors. The second includes theories that seek to explain the nature of addictive stimuli. These theories address the reasons that increase the likelihood that a substance (such as alcohol) will become addictive. Most of these theories concentrate on the positive and negative reinforcement outcomes of alcohol use, for instance. The third focuses on high-risk individuals who are susceptible to developing addictive behaviours. Although one may notice some overlap between the first and third categories, especially where genetic predispositions are concerned, the latter includes other factors—ethnicity, personality (e.g., antisocial personality, sensation-seeking personality), decision-making, and biological vulnerability differences in reaction to alcohol between men and women. The fourth relates to environmental and social conditions that promote use. These factors may increase the likelihood of alcohol and drug-seeking behaviours in different ways. Cultural norms, accessibility, and availability of drugs, stress, and family history are a few examples of variables in this category. The fifth focuses on recovery, craving, and relapse. Apparently, theories on prevention and intervention are rooted in the first category; therefore, this category is more diverse.

Scientific efforts to fragment the aetiology, symptoms, and recovery of an addictive organism are rather artificial. Recently, several theories that are more generic have emerged in the field of addiction; these try to encapsulate different theoretical constructs into one integrated framework. For example, in the field of treatment, the theory of stages of change (Prochaska, 1979; Prochaska & DiClemente, 1982, 1986, 1992; Prochaska, DiClemente & Norcross, 1992; Prochaska & Velicer, 1997) is a transtheoretical model. According to Prochaska (1979), there were too many theories in the field of psychotherapy. This encouraged him to extract the common principles from the variety of theories. In his book, Prochaska (1979) made a comparative analysis of 18 major theories of psychotherapy and behavioural change. These included gaining insight from the Freudian school of thought, behavioural modification from the Skinnerian
tradition, and helping relationships from the Rogerian school of thought. Accordingly, the term *transtheoretical* describes this integrative approach.

The 18 different systems differ in various ways. There was more agreement, however, on the importance of particular processes in producing change. Following a study of smokers in treatment, Prochaska and DiClemente (1982) suggested six stages of change: pre-contemplation, contemplation, preparation or determination, action, maintenance, and termination. In a later work, Prochaska et al. (1994) suggested common principles of change (in addition to the separate stages of change), again based on the 18 systems of therapy. They identified nine processes of change that can be applied to the level of either the individual's experiences or environmental influences and that produce the change in behaviour: consciousness raising, social liberation, emotional arousal, self-re-evaluation, commitment, countering (or counter-conditioning), environmental control, reward, and helping relationships.

Although some authors admire Prochaska and colleagues' efforts as an advance in the field of addiction (Donovan & Marlatt, 1988, pp. vii and 479), others are critical of the transtheoretical model. For example, Sutton (2001) examined the stages-of-change model and noted a number of problems with it—there are not definite intervals for the stages of change, no one can say how long a stage lasts and when the next stage will start, and there are not discrete stages of change (e.g., one may show characteristics of the pre-contemplation and contemplation stage at the same time). In addition, the stages of change are not always in a fixed sequence.

The above suggests that it is difficult to construct a general and scientifically valid model of addiction and addiction ceasing behaviours (of alcohol abuse, in particular). This problem is rooted in the multi-factorial nature of dependence, its aetiology, its heterogeneity, and its multidimensionality. A comprehensive model, which encompasses most of these factors within a unifying framework, would represent progress in the field. This is what Cox and Klinger (1988) attempted to do in their motivational model of alcohol use. There is a difference between a transtheoretical theory and a comprehensive model. Comprehensive theories do not borrow different constructs from different schools; their comprehensiveness comes from their own conceptual integrity. The motivational model of alcohol use (Cox & Klinger, 1988, 1990) is not based on concepts from other theories; rather, it uses its own constructs. It tries to describe the natural integrative nature (e.g., see Balkenius, 1995) of individuals' motivational systems, leading them to decide to drink alcohol or not to do so. Thus, this motivational model includes independent constructs, integrated within an interactive framework. Each
construct, however, is based on extensive evidence in the field and related to the other constructs (see Figure 1).

Figure 1.1. An abbreviation of the Motivational Model of Alcohol Use.

Note. Some of the relationships shown are to some extent reciprocal, but the arrows show the dominant direction of causality.
The concept of motivation is central to understanding the motivational model of alcohol use as a motivational theory. The concept of motivation explains why an individual selects, moves toward, and persists in achieving specific goals. This theory is one of many that have focused on motives that cause people to be involved in and interact with the external environment (Geen, 1995). The next section describes the main concepts of the motivational model of alcohol use, and compares them with other motivational concepts in the field.

**The Motivational Theory of Alcohol Use**

This section begins by describing the motivational model of alcohol use; then it expands into three parts. First, it discusses how other concepts such as drive, reinforcement, emotion, and incentive are similar to and different from the motivational construct *current concern*. Second, it describes the interactive nature of this theory. Third, it states how interactions between different motivational constructs can determine the motivational structure of a person, and how they can lead individuals to follow adaptive or maladaptive ways of pursuing their goals.

Cox and Klinger's (1988) motivational model of alcohol use can be summarised in terms of a person's making a decision to drink or not to drink on a particular occasion. Nevertheless, this decision is affected by the person's experiences with alcohol, the immediate environment, and current positive and negative incentives for drinking versus positive or negative incentives in other areas of life. Incentives are defined as "objects or events that attract an organism or repel it" (Klinger, 1975, p. 1). According to the model, people are motivated to drink alcohol for different reasons. People drink to enhance positive mood, reduce negative emotions, to avoid social rejection, or to obtain social support. These motives lead to a common pathway for making a decision about drinking; this common pathway has roots in the net emotional gain one can expect from a decision to drink or not to drink. Once a person decides to drink, a goal is formed.

The motivational theory of alcohol use is based on the theory of current concerns. A current concern is an individual's motivational state during any particular goal pursuit, and lasts from initial commitment to the goal until it is reached or relinquished (e.g., Klinger, 1975, 1977, 1987, 1996). A current concern can be described as the motivational component of goal seeking. The theory of current concerns states that human experience is organised around the pursuit of and attainment of incentives.

Various authors have misinterpreted some of the basic principles of the theory. For example, Cooper (1994), Cooper et al. (1995), and Verheul, Van den Brink, and
Geerlings (1999) described the current concern construct as equivalent to the constructs of reinforcement and reward. The next section focuses on clarifying the critical aspects of the theory within the framework of an alcohol abuse model and related research. To do so, a comparative analysis is made. The discussion starts by defining basic motivational terminology, such as drive, reinforcement, and emotion. Next, the concepts of incentives and current concerns are explained in relation to the motivational model of alcohol use.

**From Drives to Current Concerns**

**Drive and Conditioning Theories**

Hull (1943) suggested that when food deprivation, for example, occurs an aversive state emerges. This is a drive state: an internal state of an organism that increases the overall energy for activity. Accordingly, when organisms suffer from pain or distress they are activated to escape from their discomfort. This is an example of drive motivation.

Conditioning models are used in some studies to explain different forms of addiction, including alcohol dependence (e.g., Balkenius, 1995). For example, tension reduction and stress-dampening theories posit that alcohol is consumed to achieve tension reduction. Tension reduction theories are based on less flexible assumptions than other theories. According to the tension-reduction approach, when a drive (e.g., tension reduction) is elicited, an organism, under the effects of a relevant history of conditional learning (e.g., Stewart, de Wit, & Eikelboom, 1984), is motivated toward those stimuli that bring relief.

Most of the research in this field is based on research with animals (see Caplan & Puglisi, 1986). Nevertheless, there is also evidence from human participants. For example, Kalodner, Delucia, and Ursprung (1989) found a significant difference in alcohol consumption between high- and low-anxiety students. However, evidence (e.g., Cappell & Herman, 1972; Hussong, Hicks, Levy, & Curran, 2001; Pohorecky, 1981; Young & Oei, 2000) suggested that tension-reduction theory is not a robust paradigm for explaining the initiation and continuation of alcohol abuse. As Pohorecky (1981) suggested, in spite of evidence in favour of the role of ethanol in improving affective states in humans, this has not been a universal finding. In addition, studies have referred to a number of variables (e.g., the drinking environment, cognitions, personality, prior experience with ethanol, sex, and dose and type of beverage) that can make the effects of
alcohol in humans unpredictable. For example, Hussong, Hicks, Levy, and Curran's (2001) findings support the idea that gender, friendship factors, and the timing of tension reduction behaviour (i.e., weekends vs. weekdays) moderate the relation between affect and alcohol use. These findings may account for the theoretical difficulties with the tension reduction theories of drinking.

As described later, cue reactivity studies are based on classical conditioning principles of behaviour. The cue exposure paradigm posits that if an alcohol abuser is exposed to alcohol-related cues, compulsive craving and subsequent behaviours toward the consumption of alcohol should be elicited. Robinson and Berridge (1993) suggested that neurochemical changes in the brain due to the chemical effects of alcohol sensitise the brain's reward loci and networks to alcohol; this leads to urges to drink alcohol.

Operant theories of addiction stress on the immediate effects of drug use; these theories are based on behavioural consequences. Studies (e.g., Bolles, 1975) have shown that during the course of experience, a more selective direction forms. This selective direction guides the arousal state toward stimuli that are likely to decrease the drive state. Bigelow et al. (1998) described alcohol abuse as learned operant behaviour that is reinforced by the positive effects of alcohol. They viewed addiction as an attraction rather than a compulsion. They suggested, therefore, that incentive-based treatments for drug abuse are usually sufficient to allow addicts to stop their abusive use of drugs. As mentioned, this view falls within the drive-reduction framework; therefore, the same criticisms apply to it.

Evidence that provides a neurological basis for the reinforcing effects of alcohol (e.g., Koob et al., 1998) should be noted. Nonetheless, there are theories that contradict appetitive accounts of alcohol dependence by describing brain mechanisms that convert alcohol consumption into a compulsive disorder (see page 17 for a discussion of the incentive-sensitisation theory of Robinson and Berridge, 1993, 2000, 2001, 2003).

In a recent review, Verheul et al. (1999) discussed three types of drug craving: reward craving, relief craving, and obsessive craving. They assumed that each type of craving has different underlying neuronal circuits. Their review aimed particularly at classifying and synthesising different theories in the field. In suggesting the distinction between reward and relief pathways of drinking behaviour, Verheul et al. (1999) referred to Cox and Klinger's (1988) theory of drinking, which suggests that people drink in order to regulate their positive or negative affect.

Although drive reduction theories partly explain alcohol abuse, evidence shows that applying generalised mechanical accounts from animal studies to human behaviour
renders the theories less valid and reliable. The motivational model of alcohol use also utilises both the concept of reinforcement and neural changes in the brain (Cox & Klinger, 1988). The model posits that previous learning and structural brain changes are relevant to alcohol abuse, but do not provide a complete explanation of appetitive or compulsive alcohol-seeking and alcohol-taking behaviour. As far as reinforcement is concerned, the motivational model of alcohol use considers it to be only one of the major factors which, together with its associated emotions and expectancies, cause alcohol to become an incentive.

To summarise:

The motivational model of alcohol use recognises the role of reinforcement in previous learning. In addition, it depicts the neurological bases of concern-related responses. However, incentive-motivation in this theory does not convey the same concepts as tension reduction theories do. The influence of humans' current concern in the theory is not solely to explain compulsive mechanisms that are rooted in previous associations or neurobiological processes. Reinforcement is important in the sense that it contributes to the emotional component of incentives in goal setting.

Considering the importance of emotions to the concept of current concerns, the following section clarifies the different characteristics of emotions. Moreover, at this point, it is necessary to clarify the prominent role of emotions and affective states in addiction research.

Reinforcement and Emotions

Classical and operant theories share the concept of reinforcement. A reinforcer is defined as a stimulus that either by its presence (positive reinforcer) or by its removal (negative reinforcer) serves to increases the likelihood that a particular behaviour will occur again. According to Rolls (1986) and Gary (1982), when a reinforcing stimulus promotes drive reduction, a relief state occurs: this internal process is called an emotional state. This is not the only definition of emotion. Different authors have emphasised different components in their definition of emotion. These include the following views: evolutionary and physiological, neurological, behavioural, cognitive, and recently, integrative and interactive. Some authors have considered emotion as a single state of general arousal; others have divided it into different basic components (for reviews of definitions of emotion, see (Averill, 1998; Baron, 2003; Candland, 1977; Stein, Leventhal, & Trabasso, 1990; Strongman, 1978).
There is a view that basic emotions exist, such that all other emotions are derived from a few primitive ones. For example, Gerow (1997) provided a few examples from leading theorists: Izard (1977), who proposed nine primary emotions; Plutchik (1980a; 1980b), who argued for eight basic dimensions, each related to survival and adaptation; and Lazarus (1991), who defined basic emotions in terms of the motivation to approach or avoid stimuli.

Ekman (1992) argued that basic emotions are important in that they represent distinct modes of action tendencies and are physiologically distinguishable. Accordingly, Collet, Vernet-Maury, Delhomme, and Dittmar (1997) found that particular autonomic nervous system responses depend on which of the eight basic emotions is experienced. Autonomic response patterns reflecting different emotions are determined by two brain structures: the limbic system and the hypothalamus. The only issue on which various theorists agree is that the valence of each emotion can be classified as either positive or negative. As discussed later, positive and negative affect are independent constructs.

It is commonly believed that emotion is a system. This system affects and becomes affected by other systems. In addition, emotions are conceptualised at different levels. As far as addiction is concerned, recent theories consider emotions as a valuable concept in addiction studies, particularly as related to the interaction of arousal states with cognitive processes (Gerow, 1997). Therefore, there is an interaction between emotions and behaviours. Those stimuli that potentially cause a specific arousal state in an organism (consistent with their function) are labelled emotional stimuli. An emotional stimulus has a particular valence and salience for each organism. A cat is an emotional stimulus for a cat-phobic individual, because it causes avoidance behaviour, and this brings comfort to the person who is afraid of cats. Likewise, alcohol is an emotional stimulus for an alcohol abuser, because it activates a series of goal-related behaviours.

There are different viewpoints about how a stimulus acquires its emotional properties for each organism (see, for example, West’s second category, page 5, this chapter). Some researchers (e.g., Fromme & D’Amico, 1999; Robinson & Berridge, 1993, 2000, 2001, 2003) proposed that alcohol alters neurochemical changes in brain loci and affects memory, learning, and response systems. Other authors have emphasised that emotional stimuli can function as incentives and the object of a person’s goal striving (Cox & Klinger, 1988). The latter criterion requires that those stimuli related to a person’s current concerns become that person’s focus of attention—the person’s attentional system becomes sensitized to incentives in an attempt to achieve the expected
emotional state. Organising attentional processes around a current concern is not necessarily a conscious process (Cox & Klinger, 1988; Man et al., 1998); however, as Nesse and Berridge (1997) stated, positive and negative emotions attached to incentives influence motivation, learning, and behaviour.

Because of their strong interactions with other systems, emotional stimuli have been of special interest in psychopathological research. Some of these studies have considered how the associative importance of emotional stimuli (cues) promote the continuation of alcohol abuse (e.g., Robinson & Berridge, 1993) and relapse following discontinuation (e.g., Rohsenow et al., 1994). Other studies have emphasised emotions within an interactive framework and have considered the motivational modulatory role of emotional stimuli in the context of cognitive and attentional processes (e.g., for a review, see Williams, Mathews, & MacLeod, 1996; Cox, Pothos, & Fadardi, in preparation).

To summarise:

Evidence shows that emotions are a significant feature of a motivated organism. Emotions have been the focus of many psychopathological studies. Nevertheless, there is little agreement on the definition of emotions and the relative importance of their different features.

The next section discusses this issue in an attempt to arrive at a consensual definition of emotions in terms of their most important characteristics.

*Characteristics of Emotions*

Different characteristics of emotions have been suggested. This section focuses on Rolls's (1986) and Gray's (1982) depictions of emotional characteristics. These authors have argued that emotional characteristics are closely related to incentives—this is discussed shortly. The characteristics are depicted in terms of expectancy, situational factors, intensity, and direction.

Consider what people's reaction to an analgesic would be if they were not aware of pain. What would happen if people were hungry but there was no food available? How could seeing some food change people's feelings if they were confident that food would always be available? Greater pleasure would be derived from having food that had not been expected. However, usually expecting a desired stimulus (not necessarily consciously) is a pre-requisite for an affective change. The greater the expectancy is for something, the more attentional sensitivity the person will have for cues related to it in the environment. This is a plausible explanation for people's distraction for desired stimuli. (Of course, people are also distracted by stimuli that are not desired, e.g., feared stimuli.)
Distraction may diminish when a goal is achieved. However, things do not always go people's way. An unfulfilled strong expectancy that performing a certain activity will achieve a given outcome (obtaining an incentive) can lead to frustration and anger. Similarly, if no action is taken to reach some goal, sadness may result. Later, the chapter considers how a blocked expectancy for achieving a goal entails disengagement with its specific cognitive outcomes, according to the current-concerns theory.

As far as pleasure and pain are concerned, another dimension is the intensity of the incentives that leads to these emotions. Some theorists' use of the term incentives (e.g., Skinnerians) implies nothing about emotions. In the non-Skinnerian sense, however, an incentive does not affect the emotional system unless it is converted into sensory or cognitive inputs (Dehaene & Changeux, 1998). Food, for example, does not lead to pleasure unless it is experienced. Sometimes just thinking about food produces pleasure. Thus, seeing, smelling, tasting, chewing, and swallowing food (and sometimes just thinking about it) provides many signals that can change the emotional state. The feeling that one has been rewarded depends on the signals from desirable stimuli. In one theoretical account, these rewarding signals influence learning through the specific neural changes that affect planning and decision-making (e.g., Dehaene & Changeux, 2000). According to this view, a pleasure-seeking organism should always strive to increase the frequency of these signals to receive pleasure.

As mentioned, direction is another property of emotional states. Parkinson and Colman (1995) and Aarts, Dijksterhuis, and De Vries (2001) argued that physical and social needs or motives guide individuals to specific incentives (e.g., water, money, alcohol). Efforts to achieve specific incentives are used as part of the operational definition of motivation. Thus, emotions have a motivating effect on the future; they increase or decrease the likelihood of a later action.

There are other points. First, emotions can motivate an organism directly and independently of the reinforcing effects of the stimulus (Balkenius, 1995). This is one of the reasons that reinforcement is insufficient to explain planned behaviour (e.g., Klinger, 1975). Thus, "emotions exist for the sake of signalling states of the world that have to be responded to or no longer need response" (Frijda, 1988, p. 354). In this sense, positive or negative emotional states convey information about the desirability or undesirability of the inner or outer world. These states signal an organism to take action to resolve the undesirable state; regardless of whether an emotional state is positive or negative, it has implications for information processing. Schwartz (1990) termed this explanation of
emotion *cognitive tuning*. According to Schwartz (1990), positive emotions signal our cognitive system that everything is satisfactory, whereas negative emotions signal that a problem exists and more detailed systematic processing is required. However, some people have learned to use alcohol as a shortcut to resolving their undesirable states. For example, in a mood-induction study with alcohol abusers, Rubonis, Colby, Monti, Rohsenow, Gulliver, and Sirota (1994) exposed alcohol abusers to alcohol beverages before and after an experimental mood induction. Participants' urges and salivary reactivity in response to the alcohol beverage cues increased after the negative mood induction. Additionally, an experimental mood induction study with detoxificated alcohol abusers (Cooney, Litt, Morse, Bauer, & Gaupp, 1997) showed that negative mood induction was followed by increased desire to drink.

In humans, emotional states are under the inhibitory and cognitive influences of the cerebral cortex (Gerow, 1997). Considering the general agreement that all emotions have either positive or negative valence, there is further evidence (e.g., Davdison, 1993; Diener & Emmons, 1984) that two separate and independent anatomical systems mediate positive and negative affect. In terms of the brain structures involved, the frontal lobes of the right hemisphere have been implicated in inhibition and negative affect; whereas the frontal lobes of the left hemisphere have been implicated in positive affect (Davidson, 1993). This finding supports research that suggests that positive and negative affect influence drinking behaviour differently (as discussed in the next section).

Another view describes emotions as the evaluative component of a motivational system. Due to their evaluative property, emotions interact with basic action systems for approach, avoidance, and attack. This is because emotions relay on the significance of actions for the future for which they contain basic schemas for what one should do about reality (Klinger, 1996). This definition of emotions accords with that of Clore, Ortony, and Collins' (1990) theory of emotions as cognitive appraisals. According to this theory, people's emotions depend on what they focus on. The motivational model of alcohol use also posits that emotions have a reactive nature, and this is either positive or negative. As described later, the model does not view emotions as solely reactive nor as sufficient to account for goal-directed behaviours.

To summarise:

Emotions constitute a prominent characteristic of motivational systems. Among different definitions of emotion, one that focuses on its evaluative role encompasses other
characteristics. When discussing emotions, the theory of current concerns refers to the reactive, evaluative, and behavioural aspects of emotions. It also recognises the interaction of the emotional system with other parts of the motivational system, including information-gathering and information-processing activities (Klinger, 1996). For example, Bock and Klinger (1986) found that the influence of current concerns on retrieving information from memory is mediated by emotional arousal.

Incentives and Current Concerns

Incentives. The term incentive is one of the most frequently used in motivational theory. The definition of incentives needs careful explanation. Traditionally, an incentive has been defined as an external stimulus that has the capacity to reduce a particular need. This definition is based on drive-reduction theory. However, in the theory of current concerns and the motivational model of alcohol use, incentives are defined as "objects or events that attract an organism or repel it" (Klinger, 1975, p. 1). As discussed earlier, this is a broader definition in the sense that it is not limited to drive reduction. The concept of emotion is tied to the definition of incentives: it can explain the continuation of behaviour even in the absence of a drive or need.

Because the concept of emotion is tied to the concept of incentives, incentives are also classed as positive or negative. Positive incentives are associated with positive emotional changes; negative incentives are associated with negative emotional changes. These kinds of evaluations come from the person's current and prior learning, which in part is affected by brain neurochemical activities. In this sense, people may learn to use alcohol to regulate their emotional states to compensate for the lack of more adaptive ways of coping. Theory and research suggest that people's desire to regulate their affective experiences is an important motive underlying alcohol use—people work to achieve those incentives that they expect will be followed by positive feelings or the reduction of negative feelings. For example, MacAndrew (1983) suggested that reward-seeking and punishment-avoidance are the two main characteristics of problem drinkers. Cabanac (1971, 1979) believed that pleasure seeking is the most parsimonious account to summarise humans' motivational system. He suggested that the goal to obtain pleasure can account for the particular behaviours that people are motivated to perform. Similarly, Alexander (1990) stated that addictive behaviours can be the optimal behaviour for maximising survival and overcoming life's miseries. However, some followers of the disease model, such as Miller and Gold (1990), criticised Alexander's (1990) adaptive
theory of addiction. On the other hand, Abbey, Smith, and Scott (1993) found that perceived stress and social influences of consuming alcohol (e.g., receiving support from friends) were main reasons for drinking. Therefore, people may drink for two reasons: to enhance their positive emotions or to reduce their negative emotions, or for both reasons.

Cooper et al. (1995) showed that drinking to enhance positive emotions is a different kind of motivation than drinking to regulate negative emotions. Some authors believe that positive and negative emotions are different in their motivational consequences (e.g., Carver & Scheier, 1990). Cooper et al. (1995) found that negative emotions lead to stronger motivational consequences for eliminating negative incentives than do positive emotions for acquiring positive incentives. Cooper et al. labelled the two drinking motives enhancement and coping and found that people drink for both reasons. Some people drink mainly to increase positive affect, but some people drink mainly to reduce or prevent negative affect. Similarly, Cox and Blount (1998) demonstrated that, among a sample of university students, expectations of reducing negative affect after consuming alcohol were stronger predictors of the amount of alcohol consumed than were expectations of increasing positive affect.

Resorting to alcohol to regulate affective states can lead to deterioration in adaptive coping. This can increase psychological dependency on alcohol (Cooper et al., 1995). In this case, alcohol acquires a strong incentive value for alcohol abusers. They try to regulate their emotional state through alcohol in an effort to compensate for the lack of more adaptive ways of regulating their emotional states.

Robinson and Berridge termed this type of compulsive alcohol seeking and drinking as alcohol wanting—as opposed to alcohol liking. According to them, organic changes mediate associative learning and are responsible for unconscious compulsive urges to drink. They proposed an incentive-sensitisation theory, suggesting that traditional hedonic accounts of addiction are unnecessary and insufficient for explaining the compulsive drug-seeking and drug-taking behaviours. Instead, they suggested that drug-relevant stimuli trigger a conditioned motivational state; this acts as an incentive to search for drugs (incentive salience), and leads to drug taking. Robinson and Berridge (1993, 2000, 2001, 2003) suggested a neuropharmacological account of their theory to clarify the neural basis of learned drug reaction in humans. They proposed that (a) addictive drugs produce long lasting adaptations in the brain’s neural system; (b) these systems are involved in the process of incentive motivation and reward; (c) the brain reward systems become hypersensitive to drugs and drug-associated stimuli; and (d) the sensitised brain systems do not mediate the pleasurable effects of drugs (drug liking)—
instead they mediate a subcomponent of reward that these authors termed *incentive salience (drug wanting)*. They believed drug-related stimuli can trigger drug wanting, as a compulsive urge.

Robinson and Berridge (1993, 2000, 2001, 2003) suggested that, once addiction has developed, *desirability* has nothing to do with drug-seeking behaviour. In contrast, they suggested that those brain structures that mediate the incentive value of drug-seeking behaviour become independent of the drug’s hedonic value. This causes compulsive motives for drug-seeking and drug-taking behaviour to emerge, and may act outside addicts’ conscious awareness.

Robinson and Berridge’s (1993, 2000, 2001, 2003) account of incentive-sensitivity (explaining the compulsive nature of drug wanting) can explain reasons that underlie alcohol abusers’ cue reactivity and attentional bias for alcohol stimuli on an alcohol-Stroop test. In contrast, Tiffany (1990) argued that cues or feelings of craving per se are not necessary for drug-seeking and drug-taking behaviour to occur; he discounted the exclusive role of the classical conditioning and cue reactivity theories in the field. The neurological tenets of incentive-sensitisation theory are inconsistent with operant explanations, because operant theories are based on appetitive rather than compulsive points of view.

As stated, according to Cox and Klinger (1988, 1990), the relative strength of the various incentives, from alcohol and other areas of life, underlie a person’s final decision to drink or not to drink. When a person makes such a decision in favour of the positive outcomes of drinking over other activities, a goal to drink is established and a current concern begins. The consequences of forming such a concern have been partly studied in two experiments from a neurological viewpoint (but still within an interactive framework). Considering the importance of cellular and neural processes in the brain, there is evidence from ERP studies that brain reacts to emotional stimuli within 100-300 ms after being exposed to the emotional cues (Klinger, 1996). The findings suggest that the activity of brain loci in processing concern-related stimuli starts at a non-conscious level and produce near-threshold response. Recently, Ingjaldsson, Thayer, and Laberg (2003) reported that alcohol abusers (but not control participants) showed strong heart-rate decelerations in response to a masked alcohol-stimulus (but not to a control one) presented for 30 ms. The results of the above studies suggest that commitment to a goal causes automatic recognition of the goal-related cues before conscious semantic analysis of the cues occurs. Thus, when goals are established, their influence begins so early in cognitive processing that they can direct all cognitive processing toward a person’s goals:
goals presumably have the capacity to determine an individual’s inner world by automatising goal-related perceptual activities (Klinger, 1996).

Klinger (1996) suggested that this automaticity might occur through conditioning of structural features of goal-related cues to some form of concern-related brain responses. Perhaps commitment to a goal automatically sensitises people to respond to structural configuration of concern-related stimuli, including words, with enhanced non-conscious processing (E. Klinger, April 12, 2002, personal communication).

To summarise:

Incentives are those objects or events that a person values. However, because something is valued does not imply it necessarily causes behaviour to occur. Each incentive becomes a goal only when the individual makes a commitment to pursue it (Petri, 1998). When this happens, the incentive becomes the goal that the person tries to achieve, and the ultimate goal might be divided into various sub-goals. As an example, getting an advanced scientific degree might be a person’s ultimate goal, which might include many sub-goals, such as getting basic degrees.

The next section explains how incentives are tied to current concerns.

**Current concerns.** When an individual decides to pursue a goal, a distinctive motivational state begins. This state starts with the person’s initial commitment to the goal and terminates with achieving the goal or disengaging from it. This motivational state is termed current concern (Cox & Klinger, 1988; Klinger, 1975). It becomes part of a network of experiences, current situations, and future expectations, and it is related to different neurobiological, cognitive, and attentional features of the person’s thoughts and behaviours. Finally, despite its apparent connotation, the term concern in this theory conveys a “hypothetical construct referring to a non-conscious process” (Man et al., 1998, p. 1093). Although a current concern influences the contents of consciousness through its manifestations in desires, expectations, memories, intentions, and attentions, the person is not normally consciously aware of its impact.

Because a current concern lasts for a finite period (i.e., between commitment and achievement or disengagement), there might be some kind of underlying brain processes that maintain it, causing behaviour to persist in the direction of goal attainment. A current concern resembles system-monitoring software in a personal computer, where system accuracy is the ultimate goal. During the activation of other programmes, or even when the computer is in a stand-by or sleeping condition, the process of monitoring the accuracy of the system continues. A different current concern for this computer software aims to detect viruses and to neutralise them. This analogy builds the first characteristic
of the current concern as a time-binding process. Thus, brain processes serving a current concern are goal-specific and last until the goal is either reached or relinquished. In this way, a PC's monitoring system is different from a person's current concern: the former is not dedicated to emotional signals or appraisals but the latter is.

To summarise:

The traditional concepts of drive and reinforcement are not sufficient to explain the sequences of goal-directed behaviour. Nevertheless, incentives, which are tied to the concept of emotions, are both necessary and sufficient for explaining the goal-directed behavioural sequences. The concept of current concerns is prominent in the motivational model of alcohol use. Current concerns are based on the pursuit of incentives. A current concern is the motivational state of an individual during the time that the person is involved in a goal pursuit (Klinger, 1975; Cox & Klinger, 1988). It is evident that each current concern functions neither as an isolated system nor as an abstract concept without applications to the real life situation. In short, the current concern, as a construct, functions differently from other motivational constructs, such as drive reduction and reinforcement.

Interaction Among the Constructs: the Outcome

A second prominent characteristic of the motivational model of alcohol use is the theoretical interaction among different elements. The elements include various areas within an individual's life. These elements build major factors encompassed by the model—historical, situational, neurobiological, cognitive and idiographic (incentives, emotions, cognitions, expectancies, etc.), and chronological (past, present, future) factors. The product of the interaction among the different motivational variables is summarised into four categories of variables: historical, current, cognitive mediating (e.g., thoughts, perceptions and memories), and expectancy (see Figure 1).

The model pays specific attention to the interaction among these categories of variables. The interaction is vital in the sense that it determines an individual's decision (consciously or unconsciously) to drink alcohol or not to do so on each occasion. The decision results from weighing the net expected affective change from either enhancing positive affect or reducing the negative affect, or both, after consuming alcohol (Cox & Klinger, 1988, 1990). The process depends partly on the previous direct and indirect learning about the effects that consuming alcohol can have. Sometimes the expectancy of affective change comes from the direct pharmacological effects of using alcohol, but sometimes the expectancy of affective change comes from the instrumental effects of
using alcohol. A person who drinks to diminish feelings of anxiety counteracts negative affect by means of alcohol's direct chemical action. At other times, the expectancy of affective change comes from the indirect effects of drinking on other incentives that a person finds hard to achieve without alcohol. In this case, alcohol is used as a way to enhance positive affect through instrumental means. For example, for some people, gaining the approval of their peers is achieved through alcohol-related socialising.

Expectancies about alcohol-related affective changes can be divided into four categories (Cox & Klinger, 1988): (a) alcohol enhances positive affect; (b) alcohol decreases positive affect; (c) alcohol decreases negative affect; and (d) alcohol increases negative affect. Testing Cox and Klinger's (1988, 1990) model, three studies (Carey & Correia, 1997; Cooper, 1994; Cooper et al., 1995) found support for the predictive values of positive-motives versus negative-motives for drinking. Both kinds of motives were correlated with drinking; however, negative motives were better predictors of drinking; an avoidance style of motivation to avoid harm and undesirable feelings seems strongly associated with heavy drinking.

Individuals’ expectancies of affective change are not limited to the effects of alcohol. Each individual has goals in his or her life and expects affective changes from achieving these goals. Thus, another interaction is between the two sources of affective changes: consuming alcohol versus pursuing other incentives in life. If the degree of expected relief or positive affect from consuming alcohol outweighs the relief or expected positive affect from other areas of concern, the likelihood of a decision to drink alcohol increases.

To summarise:

The decision to drink or not to drink depends upon a variety of variables. Different parts of the motivational system interact with each other and lead an individual to make a decision about drinking. The different constructs jointly influence the individual’s ways of thinking, decision-making, and pursuit of goals.

The next section describes motivational structure, and it includes examples of interactions between different parts of a person’s motivational system that are reflected in that person’s motivational structure.

**General Motivational Structure**

People’s motivational structure for achieving their goals is the third prominent feature of the motivational model of alcohol. Motivational structure is a product of the interaction between different factors in the model. It seems to be a more stable construct.
than is (a) each current concern and (b) some of its factors contributing to it—culture, situational factors, and expectancies, and so on—but it seems less stable than factors such as biological predisposition and personality. An interaction between the more stable and less stable factors render the motivational structure moderately stable. This suggestion needs more corroboration. This section provides a few examples of real-life situations and the results of research studies as a means of illustrating what is meant by motivational structure.

The conceptualisation of incentives and current concerns has applications to real-life situations, especially within an interactive framework of incentives, expectancies, cognitions, and emotions. According to Klinger (1977), pursuing incentives gives meaning to humans' lives; deprivation of such incentives renders life meaningless. People do not need extraordinary incentives to make their lives meaningful. Family, work, and personal relationships are the most common sources of meaning for many people. As Cox and Klinger (1988) suggested,

If a person does not have satisfying positive incentives to pursue or is not making satisfactory progress toward reaching goals that produce positive incentives, weight will be added to that person's expectations that he or she can better enhance positive affect by drinking. (p. 174)

Different types of incentives affect people differently. People have various goals that they are continuously pursuing. Among these goals, some are of great importance for people (a goal to become a good musician, skilful cook, famous author, etc.). Such goals help to determine people's definitions of themselves. Furthermore, for most people, feelings about the self depend on their area of definition of themselves. For example, some people's definition of themselves is based on their ability to write (i.e., a good writer), whereas some see themselves as talented musicians. This relates to how and why they see themselves as worthy (Aronson, Wilson, & Akert, 1999). If people's self-definition is threatened by some external factor (e.g., by a friend who plays the piano much better), they will be motivated to preserve their self-esteem. Some may tend to do so by engaging in other activities (e.g., exercise); others may do so by criticising their friend (Aronson et al., 1999). The first reaction might be adaptive; the latter one might be maladaptive.

Some people have current concerns centred on unpleasant emotions, such as jealousy (Exline & Lobel, 1999), ambition (Kivimaki, Kalimo, & Julkunen, 1996), and hostility. Such goal pursuits function differently from incentives directed toward self-developing, altruistic, and constructive goals. Degenerating incentives reduce the
meaning of life. These can be unhealthy and dysfunctional goals—heavy drinking or addictive gambling, for instance. Negative incentives may lead to ongoing feelings of anxiety, stress, frustration, depression, and other negative emotions that might lead an individual to use alcohol in an effort to cope. For example, Kalodner et al. (1989) found that high-anxiety students drank significantly more alcohol than did low-anxiety students.

The influence of current concerns is neither temporary nor superficial. Individuals’ preoccupation with achieving their goals is an important determinant of their inner world. The cognitive processes related to a current concern are not conscious: they are automatic and hard to resist (Klinger, 1996; Ingjaldsson et al., 2003). These processes have the capacity to direct other cognitive processes toward a person’s current concerns (Klinger et al., 2001, Cox & Klinger, 2004). Cognitive processes are intertwined with other factors in the motivational system. Considering the healthy or the unhealthy nature of incentives (family vs. gambling), the cognitive orientation can either foster or deteriorate the goal directed processes. If goal-directed activities are centred on unhealthy goals, a vicious cycle is expected. The cycle may gradually influence more stable ways of intrapersonal and interpersonal communications. This, in the long term, can influence humans’ temperament and personality.

Early studies demonstrated differences in personality characteristics between alcohol abusers and non-abusers, including emotional reactions and temperament (e.g., Cox, 1983, 1987, Cox & Klinger, 1987). The most commonly cited personality characteristics of alcohol abusers are psychopathy and social non-conformity (Smith & Newman, 1990), risk taking (Soderstrom, Ballesteros, Dischinger, Kerns, Flint, & Smith, 2001), sensation seeking (Finn, Earleywine, & Pihl, 1992; Finn, Sharkansky, Brandt, & Turcotte, 2000), and low harm avoidance (Cloninger, Sigvardsson, & Bohman, 1988). Townshend and Duka (2001) found that heavy social drinkers had stronger expectations of socialising and sexual activity from drinking than did occasional drinkers, and they scored lower on the personality traits of self-directedness and persistence than did occasional social drinkers.

Different parts of the motivational system differ among different people in their relative contributions to decisions about drinking. For example, different people have different predispositions to the chemical effects of alcohol. The predisposition may be affected by other parts of an individual’s motivational system. Zeichner, Giancola, and Allen (1995) compared the stress-response-dampening effect of alcohol in hostile and unhospitable men; they found that hostile men were more likely than unhospitable ones to
experience the stress-response-dampening effects of alcohol, thus perhaps being predisposed to consume alcohol when they are under stress.

Kohn and Coulas (1985) studied frequent and infrequent drinkers' evaluations of the stimulant, depressant, and neutral effects of alcohol. The results indicated that among frequent drinkers the stimulant effects of alcohol were more appealing than the depressant effects; by contrast, infrequent drinkers showed the opposite pattern. Rohsenow et al. (1989) investigated the relationship between alcohol abusers' different irrational beliefs about alcohol dependence. They found that alcohol dependence was most strongly associated with the irrational belief that avoiding a problem is better than challenging it.

Some of the personality characteristics of alcohol abusers are mediated by biological factors. For example, Gerra et al. (1999) investigated the neurobiological basis for novelty seeking and reported that norepinephrine might be responsible for the development of this personality characteristic. This view is consistent with the motivational model of alcohol abuse (Cox & Klinger, 1988), which suggests that neurochemical changes can mediate people's urges to drink.

The examples above illustrate how an individual's personality, beliefs, attitudes, and biological factors contribute to his or her behavioural decision-making. The person's corresponding motivational structure is individualised; this can predict that person's susceptibility to abusive drinking. Therefore, it is expected that the motivational model of alcohol use can distinguish clinical groups (e.g., alcohol abusers) from normal non-clinical groups.

In the Motivational Structure Questionnaire (MSQ; Klinger, Cox, & Blount, 1995), participants are asked to describe the content of their concerns. They do so in various areas of life, including Home and Household Matters, Relationships, Love, Intimacy and Sexual Matters, Self-changes, Finance and Employment, Leisure and Recreation, and Health and Education. Next, participants are asked to rate their views about each goal on 10 scales—there is one additional scale where alcohol is concerned. The scales are Action Word (whether the goal is one of approach or avoidance); Active Role (the extent of the person's activity in trying to reach the goal); Commitment; Joy (anticipated joy from attaining a goal); Unhappiness (anticipated displeasure from achieving a goal); Sorrow (anticipated sadness if a goal is not attained); Subjective Probability of Success if the person takes action; Subjective Probability of Success when No Action is taken; Time Available (before having to start an action to achieve the goal); Goal Distance (length of time until the goal is reached); and, where applicable, Alcohol Instrumentality (the extent to which alcohol helps or hinders goal attainment). Because
participants rate themselves on various goals by use of the above scales, it is possible to calculate mean scores for each participant. The mean scores can be used to depict an individual’s motivational profile.

There is a brief version of the MSQ technique for assessing people’s motivational patterns: the Personal Concerns Inventory (PCI; Cox & Klinger, 2002). In an abridged study version of the PCI, participants are not asked to describe the content of their concerns, but only to think about the most important concerns in each area of life and rate how they feel about achieving their most important goals on the above dimensions (see Chapter 4).

Cox, Blount, Bair, and Hosier (2000) administered the MSQ to substance abusers entering treatment. They identified two primary factors: adaptive motivation and maladaptive motivation. Maladaptive motivation is distinguished from adaptive motivation with respect to two dimensions: the type of incentives selected for pursuit (e.g., gambling vs. exercising) and the corresponding choices on the rating scales (that were described above). Different studies have obtained somewhat different factor loadings. However, research (e.g., Cox et al., 2002; Cox & Klinger, 2002; Fadardi & Cox, 2002) has found that people with a maladaptive motivational structure are those with: (a) less positive incentives, (b) less appetitive but more aversive motivation, (c) less hope in achieving their goals, (d) less anticipated happiness from achieving their goals and less sorrow from loosing them, (e) longer expected distances from goal attainments, (f) less commitment in pursuing their goals, (g) less personal control in achieving their goals, and (h) less information about their goals.

Man et al. (1998) reported that MSQ indices distinguished an alcohol abuser sample from a demographically similar sample of university students. The clinical sample reported (a) 40% percent fewer concerns than the university students, (b) less commitment to their goals (they needed stronger incentives for commitment than did the students), and (c) feeling little control over goal attainments. Recently, Fadardi and Cox (2001) administered the research version of the PCI and the Irrational Beliefs Scale (Schutte & Malouff, 1995) to undergraduate psychology students (N= 69, 90% female, mean age = 24.2). Results indicated that maladaptive motivation was positively correlated with having irrational beliefs (e.g., “It is an absolute necessity to be loved by others”; “Everybody needs a stronger source to rely on”) (r = .36, p = .001). In addition, adaptive motivation was negatively correlated with irrational beliefs (r = -.247, p < .05).

Not all the incentives that people would like to have lead to satisfaction. Lack of satisfaction can come from two sources: (a) sometimes “things do not go our way”
because of external obstacles that are out of our control; (b) sometimes having a maladaptive motivational structure does not enable the individual to achieve his or her goals. This might happen because of misguided decision-making or because of the manner in which the person pursues the goals (i.e., having a maladaptive motivational structure). For example, a person who attributes strong emotional value to his or her goals but does not feel strongly committed to pursuing them often interrupts the goal-seeking behaviour prior to achievement (Man et al., 1998). The disengagement might lead to frustration and desperation, perhaps causing the person to resort to alcohol in an attempt to cope. A frequently observed characteristic of alcohol abusers is their novelty seeking and their desire for unconventional experiences, as opposed to commitment to long-range goals likely to bring enduring emotional satisfaction (Finn et al., 1992). Klinger (1975) described the emotionally unpleasant disengagement cycle that people might go through as they give up pursuing goals that they have desired. The stages of the cycle include invigoration, primitivisation, aggression, and depression.

Invigoration is characterised by increased vigour, taking the form of increased activity to achieve the goal that is being lost; this may result in over-involvement with the disengaged goal and decrease the value of other incentives, by comparison. However, if the obstacles to goal attainment continue, the frustration-aggression stage will begin. This stage can turn into an internally disruptive condition, in which undelivered aggression can lead a person to feel depressed. The situation may become worse because of (a) the low value of other incentives available to the person, and (b) the altered perceptions of the person during the depression. The latter arises from an interaction between the person’s emotions and cognitive processes, such that the depressed person is less able to recall past events and interpret new ones in productive ways. Some people are unable to compensate for their dampened emotions in adaptive and productive ways. They may resort to alcohol or other drugs to alter their depressed emotional states (Klinger, 1975; Nesse & Berridge, 1997).

Another danger that might threaten a person suffering from a prolonged cycle of disengagement is forming a hopeless belief about his or her destiny. Such a person may lose his or her sense of controllability over life challenges. A maladaptive motivational structure might cause the person to withdraw from difficult but potentially meaningful tasks and quickly take up a new one in the hope of greater success; this is likely to be followed by another cycle of disengagement and enhanced motivation to try to cope by consuming alcohol. Among alcohol abusers, Rohsenow et al. (1988) found that having
the irrational belief of being “doomed by the past” was the strongest predictor of
frequency and quantity of drinking after detoxification.

To summarise:

Affective change from other goals in life is dependent on two sources. First, it
depends on the nature of these goals (e.g., family vs. gambling); second, it depends on the
person’s motivational structure. The motivational structure comes from interactions
among different parts of the motivational system and reflects a person’s more stable ways
of approaching goals.

Section Summary

In the motivational model of alcohol use, a hypothetical interplay is depicted
among individuals’ previous learning, biological predisposition, current life situation,
personality characteristics, cognitive processes, emotions, alcohol expectancies, and
current concerns for drinking or not drinking. In addition, a hypothetical link joins past
and present contributing variables. These interactions affect, and become affected by,
individuals’ motivational structure. These mutual interactions culminate in an
individualised motivational system based on an affective cost-benefit ratio: each person
decides whether to drink in an unhealthy manner or to adjust in more adaptive ways to
achieve satisfying affective changes instead of drinking abusively. The cost of the latter
approach is the perceived physical and psychological effort a person must endure in
different areas of life to achieve and maintain a satisfying level of positive affect; the
positive affect thereby derived is the benefit.

It is misleading to think of any theory as a panacea for resolving a particular
human problem. Nevertheless, a good theory should be able to generate novel hypotheses
that can lead to testable and useful predictions (West, 2001). This is expected especially
from comprehensive theories.

Thus far, this chapter discussed reasons supporting the comprehensiveness of
motivational theory of alcohol use. In addition, it explained how this theory and its main
constructs are in some respects similar to, but in others ways different from, other
motivational concepts in the field. The discussion noted how concern-related stimuli can
activate cognitive processes in the brain and how they may affect a person’s inner world.

One point needs further explanation. The discussion described the view that a
considerable part of humans’ motivational system is under the direct and indirect effects
of unconscious and automatic processes. The alternative view is that humans have
freedom, volition, and choice. Which viewpoint is the more successful in explaining
humans' addictive behaviours? Is there any way to reconcile these two polarities? What kind of system could do so? How can the phenomenon of uncontrollability affect volition? And how can volition affect automatic processes? As discussed, the motivational model of alcohol use is an alternative to the first of the two views. To explain how this reconciliation is possible, some additional concepts need to be discussed.

The next section explains the modulatory role of a motivational system, and discusses how it might bring together the two polarised forces (volition vs. automaticity) that affect the decision to drink.¹

**The Motivational Modulatory System**

In everyday life, an organism has to deal with different needs, drives, incentives, and goals. This involves different behavioural requirements. Apart from constant drives (e.g., to maintain homeostasis), an organism is capable of dealing with only one motivational aim at a given time (Savage, 2000; Balkenius, 1995). Thus, a central selection system is needed; one that allows the performance of a particular behaviour at a particular time. As explained, one point of view to account for the selection is based on mechanisms such as classical and operant conditioning. The previous discussion (*Drives and Conditioning Theories*, page 9) suggested that classical and operant conditioning models of learning provide evidence to explain cue-reactivity phenomenon in alcohol abuse.

In addition to these conditioning viewpoints, traditional ethological concepts, such as instinct and ethos, are considered reactive accounts of motivation (Savage, 2000). There have been various attempts to explain the nature of such reactive behaviour. For example, Pfaff's (1982) reductionist model was based on distinctive neural and hormonal mechanisms for each class of motivational system. Within his framework, motivated behaviour can be tracked in causal neurophysiological structures and processes. These cause homeostatic requirements to be satisfied. In a recent study, Aarts et al. (2001) linked basic needs and motives, such as thirst, with higher cognitive processes, such as decision-making. The authors' goal was to determine whether inducing feelings of thirst increases cognitive accessibility of drinking-related cues. They assumed that the frequent and habitual execution of a specific behavioural goal (such as drinking a cold beer) to regulate the physiological changes that typify thirst, increases the association between

¹ See also the discussion on how two components of the non-conscious processes, namely, attentional bias (Chapter 2) and executive cognitive functioning (ECF) (Chapter 3) help to explain the role of non-conscious processes.
thirst state and habitual execution of thirst quenching behaviour. Once this relationship is established, thirst can prime action-relevant stimuli, increasing their accessibility as cues. Thirst can increase the cognitive accessibility of stimuli (e.g., a glass or a bottle) that are instrumental in satisfying the desire to drink. Aarts et al. illustrated that this occurs through a change in a person's perceptual readiness; thirsty participants responded faster to drinking-related stimuli in a lexical task than did non-thirsty ones. These researchers concluded that selective attention to incentives related to thirst and drinking can be explained by the person's having directly or indirectly set a goal to change a physiological state.

As discussed, although reactive theories posit that an organism strives to attend to its most important need, this does not seem to be a sufficient account of human behaviours; neither does it mean that the optimal behaviour is guaranteed (Tiffany, 1990). Thus, the next class of psychological theories of motivation to be discussed have suggested more interactive accounts (e.g., Toates, 1986; Bindra, 1978).

This latter category of theories posited a higher information processing system, one that seeks optimal selections (e.g., Bolles, 1975). An optimal selection requires an attentional mechanism that, in collaboration with other cognitive processes, lets the organism weigh up its needs, its emergencies, and its relative goal distances (Balkenius, 1995). These are dependent on the concept of expectancy. This is a significant addition to the reactive concept of motivational selection. According to Epstein (1982), motivated behaviour is different from an instinctive activity. Unlike instinctive behaviour, motivated behaviour has the following three characteristics. First, motivated behaviour is largely based on learning; therefore, it is both flexible and adaptive. Second, it is highly related to the role of expectancies, including the formation of memories related to the goal of the motive; because this kind of learning is highly individualised, it helps to form each person's pattern of goal-seeking behaviour. Third, a motivated behaviour is accompanied by an affective state. Epstein (1982) defined affect as specific patterns of somatic and autonomic nervous system activity that are correlated with instances of motivated behaviour. This is a biological version of the definition of emotion (e.g., Gary, 1982; Rolls, 1986) and is the major characteristic of a motivational system (Klinger, 1996). Thus, another addition to the reactive theories emerged, namely, emotions.

In the motivational model of alcohol use, current concerns act as humans' motivational modulatory system; they are intertwined with the evaluative influences of emotions. Based on the evaluative role of emotions, a current concern was defined as a non-conscious, time-binding, and goal-lurking mechanism. Accordingly, learning
processes, incentive value, and certain neurobiological changes in the brain sensitise the perceptual system to concern-related stimuli. Consequently, the sensitised mechanisms to concern-related stimuli influence a current concern. Ingjalddson et al., (2003) found evidence that goal lurking for concern-related stimuli starts in the brain about 30 ms after a stimulus has been presented. These responses did not occur to solely emotional words without any concern-relatedness. This finding implies that, in humans’ modulatory system, concern-relatedness is a stronger predictor than emotional valence per se. If something is concern-related, it will embrace both emotional valence and emotional evaluations; this corresponds to a cognitive-emotional motivational model in which cognitions interact with emotions. An organism’s motivational system gives more value to those stimuli that are related to a current concern than those stimuli which are unrelated. This intertwined relationship is discussed in more detail under Emotions and Current Concerns, below.

Although a current concern acts as a prominent schema in modulating attention to and selection of desirable stimuli, it is not a supervisory system by itself. This is because current concerns change from one point in time to another; nonetheless, the underlying mechanism, which allows non-conscious, time-binding, and automatic effects of current concern, remains stable across time.

It seems that the concept global workspace, first introduced by Baars (1988) and later elaborated by others (e.g., Dehaene & Changeux, 2000; Dehaene, Kerszberg, & Changeux, 1998), provides a neurological explanation for the mechanisms by which current concerns influence decision-making. This influence is in addition to the primary, non-conscious effects of current concerns through the sensitised perceptual properties of the stimuli. The global workspace is defined as a co-working supervisory system that is responsible for task managing and novel learning for the duration of brain imaging of cognitive tasks (Baars, 1988; Dehaene & Changeux, 2000; Dehaene et al., 1998). Baars defined the global workspace as a collection of neural mechanisms that organise and regulate the brain’s activities through a group of modules. The workspace does not correspond to a specific area of the brain; it is a neurological metaphor. A group of modules compete to reach the global workspace to become the focus of attention. These modules comprise outputs of the perceptual system, needs (drives) and goals (current concerns), and their relative importance. These outputs compete to enter the workspace arena to become the focus of conscious attention and behaviour. Once a module acquires its priority in the workspace, it remains there either to be accomplished or dominated by another, now ascendant, module. According to Baars, this selection depends on multi-
mutual excitatory and inhibitory connections within the workspace; the result is based on the urgency of the requests, with each module inhibiting the others. There is a strong competition for ascendancy within different modules. According to Baars (1988), in this competition, current goals are usually non-conscious, and they interact with more specialised processes. The concept of specialised processes resembles neural mechanisms, which Robinson and Berridge (1993, 2000, 2001, 2003) described as incentive-sensitised neurons. The optimal outcome of the global workspace falls within the function of consciousness. The decision-making or executive functioning is based on a combination of conscious and non-conscious votes for or against a decision.

Dehaene and colleagues' (1998, 2000) model is an elaborated model of the Baars' (1988) workspace model. They suggested a neural model of reward-dependent learning. In their model, planning behaviours and decision-making originate from changes in neuronal networks, which occur following a reward or punishment. The model posits that clusters of active neurones in the prefrontal cortex code tentative rules of behaviour. These clusters (and rules) depend on the evaluations of the reward system, which are influenced by the neurotransmitter dopamine (also see Robinson & Berridge, 2000, 2003). The mesencephalic dopaminergic system has many interconnections with these clusters in the prefrontal lobe, and acts as a global modulatory agent for the prefrontal synapses by facilitating or destabilising the current chain of active rule-coding clusters. These clusters are the neural locations of cognitive representations. When this system of rule-coding clusters confronts an error or another form of negative reinforcement, it loses its stability. Subsequently, spontaneous activity is required to discover or learn a rule to maintain the stability. The activity of neural locations of cognitive representations is influenced by reward signals. This kind of variation in the selective activity can be seen in several tasks. These include the Delayed-Response Test, the Wisconsin Card-Sorting Test, the Stroop Colour-Naming Test, and the Tower of London Test, all of which require prefrontal integrity. Nevertheless, this kind of reward effects in channelling the selective neural activity is not limited to external resources.

Dehaene and Changeux (2000) suggested an internal reward system to supplement external reward inputs, especially in dealing with more complex tasks. This system is a built-in reward system with short-circuit connections to the recent and previously memorised sources of the exterior reward network. It allows a covert evaluation of behavioural outcomes through internal mental simulation of events. According to Dehaene and Changeux (2000), this process gives rise to a new model that explains the integrity of the two earlier centres (i.e., prefrontal and reward systems) in
conscious, demanding tasks through two computational spaces within the human brain: a unique global workspace and a set of specialised processes.

The first computational space comprises distributed and heavily interconnected neurons with long axons. The second computational space comprises specific and modular processes responsible for perception, motion, evaluation, and attention. In some tasks where specific modulatory processes are not sufficient, the global workspace starts its activity. Through a top-down relationship with each other, the two systems form discrete though variable spatio-temporal patterns that are subject to modulation by vigilance and reward signals.

The importance of this co-activation is revealed in a computerised format of the modified Stroop task—one that requires intentional concentration on novel tasks. Dehaene and Changeux (2000) showed that, during completion of the Stroop task, workspace activation increases to sustain the active execution with the least possible number of errors; this co-working supervisory system is responsible for task management and novel learning. This model uses spatio-temporal activation patterns to explain those conditions that require the joint activation of the dorsolateral prefrontal cortex and the anterior cingulate (both of which are involved in the Stroop task), the relationship of cognitive processes with the reward system, and the specific reaction during error processing. Chapter 3 discusses how the dorsolateral prefrontal cortex and anterior cingulate are the areas responsible for the executive cognitive functions of the brain.

How can a current concern be related to the concept of workspace? There are five main types of processes connected to the global workspace: (a) the perceptual system (the present); (b) long-term memory (the past); (c) evaluative systems (values and emotions); (d) the attentional system (or focusing, primarily a product of executive cognitive functions) and (e) the motor system (action in the future). All potentially concern-related stimuli in the immediate environment pose a cognitive task in the global workspace to evaluate their suitability for goal-lurking, goal-focusing, and goal-achieving behaviours. It seems that any time-binding goals require specific cognitive nodes, which in their relationship with other systems compete to find their feasible priority for being fulfilled. It is reasonable to expect that malfunctions of the global workspace or its subsystems might affect the pursuit of goals; in this event, the motivational structure would be maladaptive.

To summarise:

Each motivation corresponds to an incentive state during a goal pursuit, but different incentives are not of equal value. An individual can be surrounded by different
incentives in its immediate environment. Nevertheless, it is not possible for more than one concern-related motivation to become the focus of attention at a given time. Therefore, when competition occurs within the motivational system, a selection process gives priority to a specific goal that becomes the focus of attention and increases the efficiency of the goal pursuit. People have the capacity to quickly shift their attention from one goal to another. The efficiency of this system depends on both the content of the incentive and the procedure it adopted for reaching the goal.

The preceding discussion demonstrates the prominent role of cognitive processes and emotional evaluations in motivational systems. This role needs further clarification. The following section discusses the relationship between emotions and cognitions.

**The Relationship between Emotions and Cognitions**

The relationship between emotions and cognitions is interactive. The motivational construct of current concerns explains how the emotional properties of incentives can affect an individual's inner world and direct his or her motivational system toward goal achievements, including the goal of consuming alcohol. Such a cognitive orientation suggests that the person will become preoccupied with concern-related stimuli. Preoccupation means that individuals continually pay attention to stimuli or easily be distracted by stimuli related to their current concerns. This phenomenon is called *attentional distraction, attentional bias, or selective attention* (MacLeod, 1991). It is the cognitive manifestation of the loss-of-control phenomenon that characterises alcohol abuse.

Because of the importance of the loss-of-control phenomenon in alcohol abuse and other psychological disorders, covert attentional distraction for stimuli related to particular psychopathologies has been the subject of experimental investigation (e.g., Cox, Blount, & Rozak, 2000; Williams & Broadbent, 1986; Mathews & MacLeod, 1985, 1986; Stewart, & Samoluk, 1997; for a review see Williams et al., 1996). The following section summarises a series of research findings about the relationships between the emotional properties of the current concerns and cognitive processes.

**Emotions, Cognitions, and Current Concerns**

Evidence for a causal relationship between emotions and cognitions is inconsistent. Zajonc (1980) believed that emotional and cognitive properties of stimuli are relatively independent of each other and are based on different processing mechanisms in the brain. Ladavas, Cimatti, Pesce, and Tuozzi (1993) provided support
for Zajonc's view through their study of split-brain patients. The patients' reactions were consistent in identifying the emotional valence of pictures presented at either subliminal or supraliminal levels to each hemisphere. However, the patients' ability to name, to classify, and to recognise the pictures later was limited to the supraliminal level of presentation, with the left hemisphere functioning better than the right. These results indicated that (a) there are different pathways for processing emotional and semantic aspects of stimuli, and (b) emotional features require less time for processing than do semantic ones. As mentioned, Ingjaldsson et al.'s (2003) finding suggest that the non-conscious detection of concern-related stimuli (goal-lurking) can occur in the brain as early as 30 ms after presentation of a concern-related stimulus. The researchers suggested that this speed of detection is too fast to allow semantic processing to occur. In other studies, Klinger and colleagues (e.g., Bock, Klinger, & Schneider, 1992) confirmed that rapid emotional responses are independent of semantic contexts. It can be concluded that emotional primacy governs the cognitive system and decision-making.

Klinger (1996) suggested that these rapid reactions reflect sensitised responses to structural features of stimuli. Nonetheless, what instigate these sensitised reactions are the protoemotional properties of the motivational system. Protoemotions are preconscious forms of emotions that are not necessarily accompanied by physiological responses (Klinger, 1996). They closely resemble a goal-sensitive antenna at a non-conscious level that screens perceptual inputs on a relevant-irrelevant or critical-noncritical basis.

The above viewpoint is consistent with the preattentive (i.e., prior to conscious awareness) processes and selective attention suggested by Williams, Watts, MacLeod, and Mathews (1997) and recently further supported by Ingjaldsson et al. (2003) while testing alcohol abusers (see above). The evidence suggests that presentation of stimuli related to a psychological disorder (e.g., general anxiety disorders or addictive disorders) cause the person with the disorder to set a goal to actively avoid threatening stimuli or to approach appetitive ones. At the preconscious level, emotional or addictive disorders are characterised by a permanent hypervigilance for pathology-related stimuli at the level of preattentive processes that feed into selective attention.

Bargh (1997, 1999) suggested that environmental events activate three automatic interactive but distinct psychological systems—perceptual, evaluative, and motivational. These automatic reactions to environmental events affect people's reactions to their social environment. In addition, Bargh (1997, 1999) distinguished three forms of automaticity—preconscious, post-conscious, and goal-dependent. He suggested that
precognitive effects are not dependent on any specific conditions: they are prepared
cognitive states, and are easily triggered by the presence of specific environmental events.
Nevertheless, conscious, goal-dependent effects are specific mental states reacting only in
the presence of specific triggering events. Pendry and Macrae (1996) ascertained that
goal-dependent automaticity is an outcome of the individual’s frequent experience of the
goal. The automaticity leads to immediate cognitive processing in the presence of
triggering stimuli.

Bock and Klinger (1986) used a recall task comprising different kinds of words. They asked participants to rate the words in various ways, including their relevance to each participant’s current concerns and their emotional potency. Results indicated that the effects of current concerns on retrieving the words from memory were affected by participants’ judgements of the words’ emotional arousal; words with stronger emotional appraisal were recalled more easily. Similarly related to the theory of current concerns, Miall (1989) assessed the emotional valence of a narration given to participants and based on its relevance to their current concerns. On the assumption that self-relatedness increases emotional arousal, he predicted that stronger affective states would increase participants’ recall of self-relevant materials. Finding support for his hypothesis, Miall suggested that, in the usual course of events, emotion acts as a primer; it increases humans’ readiness to screen their environment for concern-related information. In Miall’s terminology, emotion acts as a primer within a motivational system, with appraisal or stimulus check-up as its function. He concluded that memory is not triggered so much by the informational content; it is more—and often better—triggered by the emotional properties of stimuli. This suggests that emotional and cognitive processes are closely related (for a review, see Williams et al., 1996).

According to the global workspace theory (Baars, 1988; Dehaene & Changeux, 2000; Dehaene et al., 1998), different modules compete with each other within the virtual network of the specific and global workspaces. These interfaces are based on mutual excitations and inhibitions, and are fuelled by the emergency of needs. Finally, the winning module enters consciousness.

Attention plays a pivotal role in the equation described above. Wilson and Gottman (1996) discussed the role of attention as the shuttle between cognitions and emotions; the authors suggested that the role of attentional processes is to organise emotional and cognitive processes. The main functions of attention are to smooth the progress of a fast and accurate flow of perceptual judgements and actions and to maintain processing resources on selected stimuli inputs. The attentional system underlies the
detection, selection, and monitoring of stimuli that are vital to the individual's needs, incentives, and goals.

Thus, the cognitive-motivational model of alcohol use is consistent with other cognitive theories of emotions. Cognitive theories of emotions propose that cognitions have the priority in etiology and maintenance of emotional states (Williams et al., 1997). This priority is not considered a one-way relationship between cognitions and emotions. Rather, the interactive viewpoint in the field has received the greater emphasis (e.g., Williams et al., 1997; Schooler & Eich, 2000).

Conclusions

The relationship between the cognitive and emotional properties of a current concern can be summarised as follows:

First, having a current concern causes the emotional salience of concern-related stimuli to develop. Second, this salience sensitises early perceptual pathways for analysing structural features of input stimuli; this analysis is limited to a global emotional evaluation (i.e., important vs. not important or critical vs. not critical); this is equivalent to goal lurking. Third, those stimuli that are evaluated as emotionally significant become the focus of attention as the executive shuttle between cognition (in this context, semantic processing) and further emotional evaluation; this level of attentional activity is not necessarily conscious, although it might be the threshold level for selective attention. Fourth, the product of these emotional and cognitive processes may be manifested in conscious cognitive and behavioural decision-making. Klinger (personal communication, April 12, 2002) has confirmed the above conclusion about the relationship between the current concerns and executive functioning of the brain.

When a stimulus is embedded within the requirements of a current concern, it acquires a degree of emotional salience. Considering the guiding goal of humans' motivational system to enhance positive affect and decrease negative affect, one can say that emotional regulation is the risk variable linking attention and psychopathology (Wilson & Gottman, 1996).

* * *

There are different methods to study the influences of emotionally salient stimuli on attentional processes. In addition, attentional processes are influenced by specific loci and processes in the brain that are responsible for executive cognitive functioning. To
expand the above discussions, Chapter 2 and Chapter 3 deal with attentional bias and executive cognitive control. The research questions that were addressed are presented at the end of Chapter 3.

Chapter 2 briefly explains the Stroop (1935) paradigm and its diverse methods of administration and scoring systems, and subsequently focuses mainly on the emotional Stroop task and the alcohol version of this test. The chapter discusses validity and reliability issues related to the emotional Stroop paradigm. It reviews theoretical accounts of and empirical results on attentional bias for emotionally valenced stimuli. Alcohol-Stroop studies are reviewed at the end of the chapter.

Chapter 3 encompasses a review of the executive cognitive functioning, its brain systems, its relationship with motivation and alcohol consumption, and its various assessment procedures and instruments. It also discusses the Stroop test as the instrument of choice for the assessment of ECF in the research of this thesis. Finally, the chapter presents the specific research questions that the present thesis was designed to answer.
CHAPTER TWO

Attentional Bias for Emotional Stimuli

Many aspects of humans' everyday life (thinking, feeling, and behaving) are automatic. As Jastrow (1906) pointed out, individuals are only conscious of what they need to be conscious of. New behaviours require attention to each component. With practice, components intertwine with higher-order units that require progressively less attention, such that eventually they fall out of consciousness; thereafter, they act as automatic behavioural chains.

Current features of the immediate environment, such as objects, settings, and people, can activate automatic patterns of responding and behaving. Automatic cognitive processes mediate the environmental features; therefore, conscious thoughts and reflections become less necessary. As explained in Chapter 1, according to Bargh (1997), three sources of automatic behaviour are (a) automatic perception (i.e., the perception-behaviour link), (b) automatic evaluation (i.e., approach-avoidance), and (c) automatic goal-oriented behaviour and motivation (i.e., auto-motivation). A comparison between the theory of current concern and Bargh's theory reveals that there is considerable similarity between these two theories in predicting automatic stages of the human's perceptual, cognitive, and behavioural activation.

Attention is an essential element in interacting successfully with the environment. As far as the cognitive system is concerned, attention allows an individual to filter in or filter out environmental events (MacLeod & MacDonald, 2000). It is reasonable to suppose that any automatic activity would be channelled through the gate of attention. This informational channelling can lead to the formation of attentional distraction or attentional bias for emotionally salient stimuli in the environment. These automatic processes (i.e., the attentional bias) play an important role in sustaining various types of human psychopathology (Williams et al., 1996), including alcohol abuse.

Psychopathological attentional bias has been most frequently studied within cognitive models. There are different approaches to the study of attentional bias for alcohol-related stimuli. Examples include association tasks (e.g., Stacy, 1997), word coding tasks (e.g., Craik & Lockhart, 1972), and abstract knowledge acquisition; the last uses the idea of artificial grammar learning (e.g., Pothos & Cox, 2002). All these approaches have been used to study cognitive processes that affect addictive behaviour in a covert way.
According to Williams, Mathews, and MacLeod (1996), experimental investigations for studying the attentional bias fall within two broad categories. The first category comprises experimental paradigms that are based on the facilitation effect. The facilitation is reflected by decrements in attentional and sensory thresholds for concern-related stimuli. The second category comprises experimental paradigms that are based on interference effects. Interference reflects how performance can suffer from selective attention to those stimuli that should be ignored during a task. Within the second category, a modified version of the classic Stroop test (Stroop, 1935), called the emotional Stroop test, is particularly sensitive to attentional bias for emotionally salient stimuli (Williams et al., 1996).

Before discussing the emotional Stroop paradigm as applied to alcohol abuse, a few other issues need explanation.

This chapter now continues with a brief history of reaction time studies, and then describes the original Stroop (1935) tasks. It explains different versions of the test, and then gives a few examples of the emotional Stroop task, including the alcohol-Stroop test. Next, it discusses the validity and reliability issues related to the classic and emotional versions, and it reviews some theoretical accounts of, and findings on, the attentional bias for emotionally valenced stimuli. Last, it reviews smoking-related Stroop and alcohol-Stroop studies.

**Reaction Time**

Reaction time has been a major area of study in the field of experimental psychology since the middle of the nineteenth century. For example, Donders (1868) showed that reaction time increases with increasing task complexity. Cattell (1886, cited in MacLeod, 1991) reported that object naming and colour naming take longer than reading their corresponding words.

Welford (1980) and Luce (1986) classified reaction-time experiments into three domains. First are simple reaction-time experiments; these employ only one stimulus and one response, such as asking a participant to press a key in reaction to a visual or auditory stimulus. Second are recognition reaction-time experiments; these employ at least two kinds of stimuli at the same time, one of which should be responded to and the other should be ignored. Usually participants are required to memorise the first set of stimuli so that they can distinguish them from a distractor set. Symbol recognition and tone recognition experiments are examples of this category. Third are choice reaction-time experiments; these present different stimuli one at a time, for each of which there is only
one correct response among a few predetermined responses (e.g., four colour-tagged keys). This task requires participants to selectively respond to a target stimulus when it appears on the screen. Task requirements put the Stroop task within this category (personal communication, Luce, May 2002).

Donders (1868) showed that a simple reaction time is fastest and recognition reaction time is slowest. A simple stimulus leads to a shorter reaction time than does a complex stimulus (Luce, 1986). Miller and Low (2001) demonstrated that the time for motor preparation and motor response is the same for all types of reaction-time experiments. They suggested that any differences in reaction times are due to processing requirements.

**The Original Stroop Task**

Stroop (1935) described three experiments conducted for his Ph.D. thesis. In these experiments, he assessed interference, which to him was comparable to inhibition (Stroop, 1935, p. 643). Stroop designed the first experiment to assess the interference of colours on word reading. In his first experiment, he administered two cards each consisting of 100 words. The first card consisted of colour words written in black ink; the second card consisted of colour words written in a colour different from the colour's name (e.g., the word red written in green). These words were red, green, blue, yellow, and brown; these appeared twice in a row in an incompatible colour, repeated 10 times through the card. In his first experiment, he aimed to measure the interference of colours on participants' reading of the colour words. The task was word reading. He asked his participants to read the words on the first and the second cards as fast and accurately as possible. They were instructed to correct any error before reading the next word. On average, his participants took 2.3 seconds longer to read the colour words of the incompatible card than did to the compatible card.

In his second experiment, Stroop assessed how incompatibility between colours and words affects colour naming. In this experiment, he used a card containing coloured squares to establish a baseline for his participants' general performance on colour naming. Again, he used the incongruent card from the first experiment as the second card. This time, however, he asked his participants to name the colours and to avoid reading the words. He arbitrarily added twice-average time per item to a participant's total score, if an error was left uncorrected. On average, participants were 47.0 seconds slower on the second card.
In his third experiment, Stroop examined the effect of practice on interference. He asked his participants to practise the colour-naming task on the incompatible card (consisting of 50 words) for eight days. At the end of eight days, reaction times had decreased from 49.6 to 32.8 seconds. He concluded that practice can reduce interference. MacLeod (1991) suggested that this may be due to a general practice at learning or "learning-to-learn effect" (p. 165). In addition, Stroop noticed that practicing colour naming develops interference for word reading (i.e., second card in his first experiment). At the end of eight days of practice with colour naming, interference from reading the incongruent colour words increased for 15.4 s (from 19.4 before to 34.8 after). This is termed the reverse Stroop effect (Henik, 1996). In addition, Stroop found that, although reaction times on the second card became slower, the interference was not stable (MacLeod, 1991) and disappeared in a second post-test.

The second experiment has been widely used by different researchers, although many have changed the baseline stimuli from coloured squares to coloured Xs, or congruent colour words. According to Demetriou and Spanoudis (2002), the processes involved in the various Stroop tasks, such as attention, speed of processing, and interference control have made this task a suitable tool to use in various areas of psychology. These include general intelligence (e.g., Jensen, 1998), developmental changes in thought processes (e.g., Case, 1992a), self-concept, the ability to control socially irrelevant stimuli (e.g., Demetriou & Kazi, 2001), and the ability to control psychopathologically relevant stimuli (William et al., 1996, p. 19-21).

Various Versions of the Stroop Task

MacLeod (1991) examined various versions of the Stroop task. First was the standard Stroop Colour-Word Test. This version employs the procedure that Stroop (1935) used in his second experiment: naming the colour patches on the first card versus colour naming on the incongruent card. The interference score is the difference between the average reaction times on the two cards. Although the second card (i.e., incongruent colour words) normally constitutes the permanent component of the interference task, researchers have employed congruent colour words to establish the baseline scores (e.g., Barch, Carter, Hachten, Usher, & Cohen, 1999; Carter, Krener, Chaderjian, Northcutt, & Wolfe, 1995; Swick & Jovanovic, 2002).

The second category is distinguished by a methodological feature—individual (single) presentation of stimuli—though the task may include variations of the original Stroop tasks. Different researchers have used the single presentation method for different
purposes; however, the advantage of this procedure is that single reaction times are recording for each stimulus—this increases the researchers’ opportunity for using various kinds of analysis. This has encouraged many researchers to modify or add new additions to the original stimuli (MacLeod, 1991). Computer software (e.g., Psycscope, E-prime, and SuperLab, and other researcher-written programs) has facilitated the single presentation of stimuli. Kindt et al. (1997) administered card and single presentation versions of the Stroop test to a group of children. These versions included the classic Stroop and spider versions of the test. They reported a lower interference score for the single trial-version. However, the intertrial interval for the single presentation method was 1500 ms. This long inter-trial interval may be responsible for the reduced interference on the single-trial presentation (Sharma & McKenna, 2001). After all, as MacLeod (1991) concluded, single presentation is currently dominant in the field.

The third taxonomy embraces sorting and matching versions of the Stroop Colour-Word task. These versions do not require participants to read or name stimuli; they require them to sort stimuli into relevant categories. MacLeod (1991) credited Tecce and Happ (1964; cited in MacLeod, 1991) as originators of this method. Generally, it has been reported that, on various versions of this task, sorting congruent stimuli requires less time than sorting incongruent stimuli.

The fourth category comprises the Picture-Word Interference Tasks. MacLeod (1991) believed that, because of the influence of Cattell (1886; cited in MacLeod, 1991) who suggested slower reaction times for picture-word than colour-word tasks, researchers were not inclined to employ this version until the 1970s. This format provides the opportunity to invent many manipulations of the task, which are not possible with the colour-word version of the test. Generally, investigating the semantic relationships between words and pictures constitutes the pioneering trend in using the picture-word version. Although the size of interference is smaller for non-words and non-pronounceable non-words than for words and pronounceable non-words, the source of interference on the colour-picture format is not the same as the colour-word format (e.g., de Houwer, Fias & d’Ydewalle, 1994); this needs further investigation (MacLeod, 1991).

MacLeod referred to Auditory Analogues of the Stroop Task as the fifth category. This analogue employs simultaneous competing auditory stimuli; although employing the neutral auditory stimuli has always been a challenge (MacLeod, 1991). Jerger, Elizondo, Dinh, Sanchez, and Chavira (1994) using a male voice saying mommy, ice cream, or daddy to create incongruent, neutral, and congruent conditions. McClain (1983) found that response modality is crucial in auditory versions of the Stroop test. Notably, many
studies have found that mean reaction time to auditory stimuli is faster than to visual stimuli; the difference is about 40 ms (Welford, 1980).

**Factors Affecting Reaction Time on the Stroop Test**

This section reviews factors that are most relevant to the topic of this thesis. It does not include variables with considerable discrepancy about their influence (e.g., stimulus set size). Mainly MacLeod's (1991) review was consulted to make such judgments. The selected factors for this section are *stimuli proportion and composition, trial sequence, the effect of practice, response modality, format, time pressure, and a few demographic variables.*

MacLeod (1991) concluded that the *proportion* and *composition* of the sets of stimuli set are important. Proportion and composition influence participants' strategy for responding (e.g., Lowe & Mitterer, 1982). It is important to have an equal number of congruent and incongruent trials, and to present them in a mixed-randomised procedure. This helps to divide attention over two dimensions and increase the interference.

Another dimension to consider is *trial sequence.* MacLeod reported studies that showed the importance of sequential effects in the Stroop task. As mentioned, negative priming is a result of serial interference when the target colour is the distractor in the immediately preceding trial. Therefore, when the target colour is the same as the name on the previous trial, RTs on the target trial increase. Conversely, when the target name is the same as the colour on the preceding trial, RT decreases and facilitation occurs. Similarly, if the target name is the same as the name on the preceding trial, interference decreases; this is because responding to the word has been suppressed. Various studies have used this procedure to study inhibitory processes (e.g., Laplante et al., 1992; Salo, Robertson, & Nordahl, 1996; Salo, Robertson, Nordahl, & Kraft, 1997; Sudevan & Taylor, 1987; West & Alain, 2000).

The priming effects of the sequential trials are not limited to the colour words. In a Stroop test, these effects can result from semantic properties of other, non-target stimuli. For example, Warren (1972) demonstrated that, if the target trials (i.e., those for colour naming) are primed by a word from a similar semantic category (e.g., animals), reaction times on the subsequent trials temporarily increases, but this does not affect reaction times to control words.

Another factor that can affect the results of a Stroop test is *practice.* The effect of practice is not straightforward. MacLeod (1991) reported studies that have demonstrated the effect of practice on decreasing interference, but some studies have
failed to demonstrate such an effect. On the other hand, response modality makes a
difference, with manual responses giving lower interference scores through practice than
vocal responses.

MacLeod (1998) conducted two experiments on the effects of practice on
facilitation and interference. He used two formats of the Stroop test: integrated (red in
green) and separated (a green asterisk above a red word). Across 5 and 10 days of
practice, it differentially affected interference and facilitation, with a greater reduction in
reaction times for the integrated category.

Clinical and non-clinical groups' performance on a Stroop test may be
differentially affected by practice. Spikman, Timmerman, Zomeren van, & Deelman
(1999) compared the performance speed of 66 patients with closed-head injury with a
control group on multiple occasions during one year. Although both groups showed
faster reaction times with practice, the patient group showed a greater retest improvement
than did the controls. This was independent of age or occupation.

Feinstein, Brown, and Ron (1994) administered a series of visual and auditory
tests, including the Stroop test to 10 healthy participants, to examine the practice effect.
Participants completed the test during eight sessions over two to four weeks. A linear
improvement in performance on the Stroop test occurred, which was discernable at the
eighth session. The researchers suggested that this finding should be taken into account
when interpreting the results of serial attentional tasks in healthy people.

Merrill, Lewandowski, and Kobus (1994) did not find such an effect of practice
among experienced or inexperienced sonar operators. They presumed that an experienced
sonar operator has attentional allocation skills similar to the requirements of the Stroop
task. They repeated the Stroop task four times on both groups and noticed that the
experienced group did not differ significantly in speed or accuracy of Stroop performance
from the inexperienced group. Based on the data, Merrill et al. suggested that attentional
skills developed through sonar experience do not generalise to other tasks such as the
Stroop. Relevant to this discussion is their finding of no effect for Stroop practice over
four sessions.

In summary, findings on the effect of practice are not consistent. It seems that the
effect of practice is largely dependent on the version of the Stroop task and the
experimental manipulations used (MacLeod, 1991). However, the effects of practice on
the classic Stroop test are more consistent. As a general conclusion, MacLeod stated that
practice in processing one of the dimensions of a multidimensional stimulus can affect the
interference, and this depends on the degree of practice.
The next factor to be taken into account is **Response modality**. It refers to whether participants make an oral or manual response to the Stroop stimuli. Manual responses slightly decrease the size of interference, but it is still significant (MacLeod, 1991). Many studies with the manual mode of response have reported significant results (e.g., Monahan, 2001). Some researchers have used both response modes (i.e., saying a word and pressing a key) to increase the size of interference (e.g., Barch et al., 2001). Sharma and McKenna (1998) reported that semantic aspects of colour words play a role only when the response is vocal. However, a reanalysis of their data by Brown and Besner (2001) revealed that semantics also plays a role when responses are manual. As MacLeod (1991) concluded, the Stroop effect is not dependent on the response mode or the interaction between response mode and stimulus. The effect is not rooted “at the finish line” (p. 183).

Another issue in a Stroop test is **time pressure**. Time pressure comes from the intertrial interval, or the time between two adjacent trials on the single presentation format of the Stroop test. Sharma and McKenna (2001) demonstrated that on the emotional Stroop, time pressure is important in two respects: (a) it determines whether there is any interference, and (b) it determines the magnitude of the interference. According to Sharma and McKenna, the optimal interval is about 32ms. They found interference for an 160 ms intertrial interval, but not for an 80ms one. Considering other studies which have reported considerable interference scores with 1000 or 1500 ms intertrial intervals (e.g., Kindt, Birman, & Brosschot, 1997), it is difficult to draw a firm conclusion on this issue.

As far as **gender** is concerned, MacLeod (1991) presented evidence in support of faster reaction time for females. However, this is inconsistent with other research, which suggests that males generally have faster reaction time on choice experiments (e.g., Adam, 1999). However, what is theoretically important on a Stroop test is not the raw reaction time; it is the interference score. MacLeod’s (1991) review of gender differences on the Stroop test ended with a strong conclusion: as far as interference is concerned, there are no gender differences in the Stroop test between males and females. In contrast to MacLeod’s conclusion, Melarski, Cutmore, and Suboski (1996) reported that men were 46 ms slower than were women, but the difference was not significant. It is noteworthy, however, that they tested a small number of participants (6 men and 8 women). Recently, Daniel, Pelotte, and Lewis (2000) tested groups of 7-to-8 year olds, 9-to-10 year olds, and 18-to-24 year olds of both genders; their findings support MacLeod’s conclusion. Daniel et al. suggested that the inconsistency in findings was due to differences in the response
modality (whether participants made an oral or manual response to the Stroop stimuli), rather than a gender difference in interference scores.

There is evidence for age differences on the Stroop test. Neyens and Aldenkamp (1997) reported good reliability for the card format of the Stroop test on a group of Dutch children in the age range of 4.4-12.3 years. Interference depends on the ability to read colour names. Thus, before developing the ability to read, studying the interference phenomenon by using the classic Stroop test seems impossible. However, some effort has been made to develop modified versions of the Stroop test for younger children. For example, Wright (2000) used an animal-Stroop test (consisting of pictures of animals) to assess the inhibitory processes of children with traumatic brain injury in the age range of 3-to-16 years. Recently, Verhaeghen and de Meersman (1998) conducted a meta-analysis of 20 studies comparing younger and older adults on Stroop interference. Their findings suggested that the apparent age sensitivity of Stroop interference is merely a pseudo-reflection of a general slowing-down with age. Little and Hartley (2000) confirmed the above equivalence between younger and older adults. They used different versions of the Stroop test and noticed that general slowing down did not affect age equivalence when they controlled the effects of different versions of the Stroop test.

Sources of Interference on the Classic Stroop Test

Stroop’s (1935) interpretation of the interference effect addressed the differential associations between word reading and colour naming, with a stronger association between words and reading responses than between colours and naming responses. In his account, the strength of association is dependent on the speed of the corresponding responses. This account means faster reading words than naming colours, which causes slower reaction times on the incongruent card. This theoretical account fits into the theory of relative speed of processing, and is compatible with the automaticity view (MacLeod, 1991). The theory of relative speed of processing addresses the assumption that Stroop interference is a result of past learning. The stronger habit has priority for entering the single-capacity channel of response output, so that interference arises from the relative speed of associations at the stage of response output. Nevertheless, evidence demonstrates that priority is not a satisfactory account of the source of the Stroop interference. For example, previewing (giving priority to) a slow dimension of the stimulus by using Stimulus Onset Asynchrony (SOA) methods does not lead to a reverse Stroop effect. Using the SOA with a group of normal people and those with schizophrenia, Schooler, Neumann, Caplan, and Roberts (1997) reported support for the
theory of relative speed of processing and the response output stage. However, Cohen, Dunbar, Barch, and Braver (1997) suggested that there are theoretical and empirical problems with Schooler et al.'s conclusion. After reviewing findings on the theory of speed of processing, MacLeod (1991) suggests that the theory lacks enough empirical support. "Today most psychologists think of the Stroop task as a hallmark measure of attention, not learning" (MacLeod, 1991, p. 187).

The second proposal with respect to the locus of Stroop interference is the automaticity account. MacLeod (1991) credited Cattell (1886) as the first author to propose this point of view. In Collins Compact English Dictionary (1998) automaticity is defined as "the ability of activating or regulating itself . . . doing something without conscious thought . . . occurring as a necessary consequence" (p. 48). When something is cognitively automatic, the attention is immediate, and less is required to regulate the cognitive activity. In this account, the interference occurs because reading words is more automatic than naming colours; colours need more attention in order to be named. This is different from the previous account in the sense that the more automatic dimension always interferes with the less automatic one, but the reverse is not possible—unlike the speed account (MacLeod, 1991).

For some cognitive tasks, automaticity is not a fixed process, because after enough practice tasks previously governed by automatic processing might come to be governed by controlled processing. The opposite process is also true. Automaticity is relative and its relativity depends on the amount of practice and training. MacLeod and Dunbar (1988) demonstrated that automaticity is on a continuum. After having enough practice with colour naming (green, pink, orange, or blue), participants learned to call each of four arbitrary shapes by a different colour name. Therefore, each shape acquired a new name (a colour name). At three intervals, the researchers presented each shape in a neutral colour, a colour that matched its new name, or a colour that was different from the name. The task was to name the shape or its colour. With a small amount of practice with arbitrary names (colours as the name of the shapes), interference occurred for shape naming when it was presented with an incompatible colour. However, the name of the shapes did not affect colour naming. With moderate and extensive practice, colour naming became slower, but it was still faster than shape naming. Based on these findings, MacLeod and Dunbar concluded that, on a classic Stroop test, word reading seems more automatic than colour naming (although it was more automatic than was shape naming, which approached automaticity with extensive practice).
Thus, MacLeod and Dunbar (1988) asserted that interference results from contrast between a better-learned and a less-well-learned mental activity. This explanation is different from that attributing the increased speed of processing to practice, in the sense that a better-learned but slow process can interfere with a less-well-learned but fast process "because interference arises through the course of processing, not just at some late response stage" (MacLeod, 1991, p. 190).

The third theoretical account of Stroop interference is in contrast to the two above accounts. (The above accounts assume that the interference arises at some point later in the processing of the two stimulus dimensions.) The third viewpoint proposes that Stroop interference arises from early encoding at the perceptual level. MacLeod (1991) credited Hock and Egeth (1970) with proposing the idea that incompatible information from a colour word postpones the perceptual encoding of ink-colour information. In other words, semantic aspects of the word act as a distractor and disturb identification of the colour.

Other researchers (e.g., Dyer, 1973c; cited in MacLeod, 1991) have criticized this interpretation. There is no compelling evidence that the role of post-perceptual-encoding processes in the Stroop effect is underestimated. The reason for rejecting the perceptual encoding viewpoint is that the presentation of congruent colour words does not produce any interference; rather it leads to facilitation. This finding equally underestimates the fourth theoretical account of the Stroop paradigm. It states that the distractor word may impede the semantic encoding of the target dimension of stimulus—i.e., the colour (Morton & Chambers, 1973; Seymour, 1977). According to this account, interference arises because of the ambiguity between closely related concepts in semantic memory.

According to MacLeod (1991), the relative speed of processing, automaticity, and perceptual-encoding accounts of the Stroop effect depend on a sequential or additive account of the effect. In these accounts, within each stage of processing, there is a shortage of space for the two competing components. Many researchers currently hold this viewpoint. For example, according to Sayette et al. (2000), increased latencies on a Stroop task are mainly due to the limited capacity of cognitive processes. When more cognitive resources are required on the first task, there remains less capacity available for the second task; therefore, reaction time increases.

The connectionist model of Cohen, Dunbar, and McClelland (1990) provides an alternative. According to MacLeod (1991), this model encompasses many of the advantages of the relative speed and automaticity models without suffering from their potential problems. Cohen et al. suggested that automatic processes are dependent on
attention as a continuous phenomenon—as opposed to the stage-like accounts. Thus, they believed that any study to understand the uncontrollability phenomenon (i.e., automatic processes) should be addressed within the concept of attention. They presented a model of attention that deals with these issues within the parallel-distributed processing framework. Within this computational model, they suggested that the attributes of automaticity are a function of the strength of a processing pathway and that this strength increases with training. Based on findings with the classic Stroop effect, they concluded that the automatic processes are continuous and emerge gradually with practice. Accordingly, the interference phenomenon can be interpreted as a difference between two sources of relative automaticity: colour naming and word reading.

Therefore, in the parallel-distributed processing model, there are two sources of relative strength (Demetriou & Spanoudis, 2002). The first source relates to the strength of each dimension (word reading or colour naming) prior to the task. The second source of strength relates to the task and attentional sources (i.e., attentional focus, which is under the influence of the current goal of processing word reading or colour naming). However, there is another mechanism involved in controlling the task process and channelling it toward the task requirements (Lovett, 2002). Thus, the connectionist model predicts a continuum of automaticity that depends on the strength of the intervention from the supervisory executive system in the brain.

There are two other parallel models that are similar to the Cohen et al. (1990) connectionist model; these are the Phaf, Van der Heijden, and Hudson (1990) model and the Roelofs (2000) model. These two models differ from the Cohen et al.'s model in that they do not include any intermediating mechanisms that can explain the effects of learning and practice. Phaf et al.'s (1990) account of the Stroop effect is based on a general model of visual attention; this model suggests a direct relation between visual stimuli and word reading only (input-output connection), not for colour naming. Thus, this kind of direct connection does not account for any type of interference (e.g., semantic) to occur between input and output. The Roelofs model is a language theory of the Stroop effect that is based on the competition between lemmas (i.e., syntactic properties of the words). The model specifies separate processing stages for lemma retrieval, word-form encoding, and so on. According to this model, word reading requires fewer processing stages than does colour naming. However, like Phaf et al.'s model, it does not account for how practice can lead to faster input-output connections for words but not for colours.
Demetriou and Spanoudis (2002) have recently conducted research that revives the additive stage view of the Stroop effect. They suggested an account of the parallel models of the Stroop effect that does not address the simultaneous processing of units of information; rather it addresses the notion of processing each unit of information at a time. Within this account of the parallel models, Demetriou and Spanoudis presented a formula in which the Stroop effect (SE) goes through three additive sequential stages: dimension selection (D1), dimension identification (Da), and interference control (Ic); that is, SE = D1 + Da + Ic.

Dimension selection is equal to attentional processes that are necessary for focusing on the task-relevant dimension—a decision-making process that is necessary to encode and follow the relevant aspect of the task (for example, to read the word or name the colour). Dimension identification occurs after D1 and refers to the activity of encoding the relevant dimension; this is a meaning-making activity. Therefore, when there is no compelling dimension to be selected (e.g., no decision making is necessary when the task is reading congruent colour words), the Da should be at its highest speed; this is an index of the speed of processing. The Da is considered to be an important factor in problem solving by cognitive (e.g., Anderson, 1983; Cohen et al., 1990), psychometric, and developmental theorists (Demetriou & Spanoudis, 2002).

Interference control refers to the process of inhibiting the task-irrelevant dimensions; this is a goal-protecting activity. In cognitive, psychometric, personality, and developmental theories, Ic is an important index of self-directed thinking and behaviour. This is because it enables people to keep working on their goals until they achieve them (Anderson, 1983; Cohen et al., 1990). Ic is the difference between time to colour name in the incongruent and congruent categories. A zero or negative difference of Ic reflects perfect control of interference.

Recently, Lovett (2002) introduced a hybrid model of the Stroop effect that integrates important accounts into one. He termed this account Not Just Another Model of Stroop (NJAMOS). There are three features for this model. First, it is a computational model. It is a revision of the theory of Atomic Components of Thought (ACT-R) proposed by Anderson and Lebiere (1998). The ACT-R is a cognitive architecture of thought that takes into account past and present factors affecting a cognitive task. Second, it takes into account the role of previous learning; thus, it embraces learning the materials and those performance mechanisms that are essential for performing a Stroop task. Third, it takes into account the role of current factors that may affect a Stroop task; it embraces the application of previous and immediate knowledge and strategic
mechanisms in performing the current task. This third feature partly explains the individual differences that originate from strategic variability and flexibility; these are differences between individual participants or between individual trials—from one trial to another. The third feature is peculiar to the NJAMOS model; it is not included in other accounts of the Stroop effect (Lovett, 2002).

To summarise:
There are various accounts of the source of the Stroop effect. Among other accounts, the connectionist model of Cohen et al. (1990) that explains automaticity as a continuum and depends on different sources of strength in explaining the Stroop effect still seems the most widely accepted model. However, there are more recent explanations of the effect: Demetriou and Spanoudis' (2002) model revives the additive stage view of the Stroop effect which does not address the simultaneous processing of units of information, and suggests that each unit of information is processed at a time. Lovett's (2002) NJAMOS model takes into account the role of individual differences in the Stroop effect; these differences originate from strategic variability and flexibility, as Lovett suggests.

The Emotional Stroop Test

In cognitively oriented psychopathological studies, investigators have modified the Stroop test to study psychopathological attentional bias. Such modification involves using emotionally valenced stimuli (usually words) in different colours to explore interference in colour naming caused by emotionally salient stimuli—i.e., the task is to ignore the semantic aspects of the stimuli. For example, participants might be asked to name the colour in which words such as dead or glorious appear. The participant's reaction time to such emotional words would be compared to their reaction times for colour naming neutral words, such as chair or container.

Many studies of psychopathology have used a modification of the Stroop test called the emotional Stroop test (Williams et al., 1996). In recent years, studies examining cognitive and attentional processes underlying addictive behaviours have used this paradigm. They include studies of alcohol abuse (e.g., Bauer & Cox, 1998; Stormark, Laberg, Nordby, & Hugdahl, 2000), smoking (e.g., Gross, Jarvik, & Rosenblatt, 1993; Wertz & Sayette, 2001), heroin dependence (Franken, Kroon, Wiers, & Jansen, 2000), and compulsive gambling (McCusker & Gettings, 1997).

Typically, studies have found that participants take longer to colour-name words related to their particular concerns (e.g., alcohol) than they do to colour-name matched
neutral words. This is usually explained in terms of participants devoting more attention to the task-irrelevant activity of processing the semantic content of the affectively valenced stimuli than to the task-relevant activity of colour naming (Mathews, 1988).

The next section discusses various explanations of the sources of attentional bias for emotionally salient stimuli.

Sources of Interference on the Emotional Stroop Test

The emotional Stroop test does not use words that are the names of colours (red, green, etc.). This means that conflict between the colour and semantic aspects of the words cannot be responsible for colour-naming delays. Therefore, suggestions for other sources of the interference in an emotional Stroop have been made.

The mood accounts. One theoretical account postulates that emotional words—such as alcohol words for alcohol abusers—make participants feel agitated or nervous when they encounter words related to their disorder. This distracts them from full allocation of their attentional resources to the colour-naming task (e.g., Faunce & Job, 2000). Pincus, Fraser, and Pearce’s (1998) results supported this view. They conducted two experiments in which they compared the role of mood states (anxiety and depression) on attentional bias for pain-related stimuli between a group of chronic pain patients and controls. Neither experiment revealed an attentional bias for pain words when the results were corrected for mood states. Considering this and other similar findings, Pincus et al. concluded that attentional bias in chronic pain patients is under the influence of their mood states rather than their pain.

Nonetheless, the Stroop effect has been obtained in other studies, in which mood was controlled. For example, Crombez, Hermans, and Adriaensen (2000) used a computerised format of the emotional Stroop test. To assess chronic pain patients’ attentional bias for pain-related words, they used three categories of these words: sensory-pain, affective-pain, and injury-related words. They also assessed participants’ pain severity, pain-related fear, and negative affect. After controlling for mood, they found an attentional bias for sensory-pain words that was positively related to participants’ current pain intensity.

In another study, de Ruiter and Brosschot (1994) found that attentional bias in clinical samples was not limited to mood-congruent stimuli. For example, their study of panic and depressed participants showed interference for emotionally positive words—in addition to threat words. Kinderman (1994) studied self-relevant cognitive processes associated with persecutory delusions. Participants with depressed or normal mood...
completed an emotional version of the Stroop test containing neutral, positive, and negative trait words. They showed considerable interference for both positive and negative trait words, regardless of their current mood. In addition, Spinks and Dalgleish (2001) found that SAD patients' mood states during winter (depressed) or summer (remitted) did not affect their performance on the emotional Stroop test. Moreover, Riemann and McNally (1995) used a mood induction technique to induce positive, negative, or neutral mood states in their participants before performing an emotional Stroop test. Words were positive or negative current-concern related or neutral. Participants showed interference for both positive and negative current-concern words under all three induced moods.

Some additional evidence in support of the above finding comes from the single presentation format of the Stroop test. In this procedure, emotional words are intermixed with control words. According to Sharma, Albery, and Cook (2001), this procedure does not allow mood to be aroused resulting from trial-by-trial carry-over effects from emotional words, because the emotional and control words are intermixed. There is evidence that because of its validity in the study of psychopathological interference, the trial-by-trial Stroop procedure constitutes the predominant method in the field (Williams, et al., 1996).

To summarise:

In an emotional Stroop task, mood states cannot account for the interference arising from the emotional words. In addition, findings are in contrast to explanations of interference only for negative emotional words (e.g., McKenna & Sharma, 1995), or those related to threat (e.g., Martin, Williams, and Clark, 1991).

The connectionist account. Among the other accounts, the connectionist model of Cohen et al. (1990) has encountered fewer theoretical problems. This model proposes different sources of strength of association between stimuli to explain the automaticity nature of the Stroop effect. In Cohen et al.'s view, automaticity has two characteristics: it lies on a continuum and it is influenced by practice. Viewing the alcohol-Stroop within this framework, one can presume that alcohol abusers and non-abusers have about the same amount of experience with colours. It follows then that because of alcohol abusers' frequent experience with the alcohol-related stimuli, naming the alcohol words is more automatic for them than it is for non-abusers. This stronger automaticity for alcohol stimuli causes alcohol abusers to show interference with the colour-naming task, as measured by slower reaction times. However, Cohen et al. suggested that the automaticity account of attention does not provide a complete picture of attentional bias.
Any attentional bias is a function of both automatic and non-automatic processes. Delayed responses on a Stroop test reflect (a) the strength of the automatic response tendency competing with the correct response, and (b) the level of the voluntary effort made to suppress the competing response.

In reference to the connectionist model of Cohen et al. (1990), Williams et al. (1996) concluded that practice and expertise as the only explanation cannot be a robust account of the relative automaticity of the colour-naming response on an emotional Stroop test. Accordingly, they suggested two explanations. First, there is a higher resting level of activation of input (i.e., a lower threshold) for emotional stimuli that are concern-related than for non-emotional stimuli. This means more sensitivity to the emotional words and stronger output activation. Second, any activation input is subject to control by a neuromodulatory system that can affect the responsivity of the neural flow in the intermediate units, especially if a stimulus conveys threat—increasing the sensitivity to certain (concern-related) stimuli increases the resting activation level or causes stronger connections in the neural pathways for those stimuli. This higher activation output competes with other output activation that originates from colour naming. Because the capacity of intermediate units is limited, the stronger flow of information from concern-related stimuli increases colour-naming latencies.

To summarise:

The connectionist model encompasses a computational viewpoint that functions at a non-conscious level of processing. However, there are other viewpoints that go further than the computational accounts, although they embrace them within a broader and reciprocal model. The theory of current concerns provides an explanation of the Stroop effect that occurs in both clinical and non-clinical groups (Williams et al., 1996), regardless of whether the emotional valence of the concern-related stimuli is positive or negative.

*The attentional bias accounts.* Earlier discussion (see the emotional properties and current-concerns sections in Chapter 1) illustrates how current concerns are a prominent feature of humans' cognitive system. Because of the perceptual sensitisation of related systems in the brain, there is a non-volitional sensitivity to all concern-related stimuli. This perceptual sensitivity can be tuned further by the emotionality of the stimuli and the person's evaluation of them. Attention, as the executive part of this system, interconnects cognitive and emotional components of incentives; these are influenced by a person's current concerns directed toward achieving his or her goals.
The above viewpoint closely resembles the Self-Regulatory Executive Function (S-REF) model of Wells and Matthews (1996, 1999). In the S-REF model, there is a lower level of processing and a higher one, but there is a permanent interaction between them. The lower-level one contains stimulus-driven information. The higher-level one embraces self-knowledge and goals. The interconnecting agent between the two levels of processing is the executive cognitive functions, or attentional resource. In the S-REF model, monitoring the important stimuli (e.g., threat stimuli) is responsible for attentional bias and influences the dynamics of affective reactions. This strategy sensitises the system to threat (i.e., concern-related) stimuli and helps improve the self-preservation cycle of detecting and monitoring vital stimuli. According to Wells and Mathews (1999), "Bias in selective attention is embedded within the system as a whole and cannot be understood without reference to both executive functions, specified computationally, and the person's goals and self-knowledge" (p 184).

There is not a contradiction between the current-concern and automaticity viewpoints. The difference between them is that the theory of current concerns is more comprehensive. This theory includes both attentional bias and automaticity accounts. Moreover, the automaticity account cannot always explain the attentional bias phenomenon based on a history of practice. As Williams et al. (1996) stated, attentional bias seems to disappear after successful treatment of the psychopathology. For example, Mogg, Bradley, Millar, and White (1995) reported that only patients who were successfully treated for their general anxiety disorder showed less interference on an emotional Stroop post-test than at baseline. Although the therapeutic intervention required frequent exposures to the pathological stimuli, the same reduction did not occur in control participants who were not treated. Watts, McKenna, Sharrock, and Trezise (1986) showed that parallel forms of an emotional Stroop test were sensitive to therapeutic interventions in a group of spider phobics. In addition, Robinson and Berridge's (1993) research showed that addictive substances produce structural changes in the brain, so that exposure to substance-related stimuli automatically triggers drug wanting without drug liking (see Chapter 1, pp. 17, 31).

To summarise,

In alcohol-Stroop studies, attentional bias for alcohol-related stimuli is attributed mainly to the salience or emotional valence of these stimuli (Cox, Pothos, & Fadardi, in preparation; Williams et al., 1996). Nonetheless, these studies have not evaluated the possible effects of general deficiencies in executive and inhibitory processes of abusers on the attentional bias (Williams et al., 1996). The classic Stroop test, which is frequently
used to assess executive cognitive functions (ECF) and inhibitory mechanisms, and the alcohol-Stroop test, which is used for the assessment of attentional bias for alcohol stimuli, are based on the same phenomenon: interference. Although earlier research suggests that the interference on an emotional Stroop emanates from the attentional bias (while on a classic Stroop it originates from automaticity), the ECF plays a pivotal role in managing novel stimuli and all tasks that employ attentional resources. To investigate this issue is one of the goals of this thesis.

Because the Stroop paradigm is popular in investigations of selective attention, the next section explores the psychometric properties of this test. The consistency of the attentional-bias results in the study of psychopathology depends on the validity and reliability of the measuring instrument.

*The Stroop Test's Reliability and Validity*

Appraisals of the robustness of the Stroop paradigm are inconsistent. Jenson (1956) concluded that Stroop results have generally been shown to be reliable. MacLeod (1991) described the task as reasonably valid and reliable. One’s interpretation of these appraisals, however, needs to take into account the particular format of the Stroop task that was used, and the criterion of its validity that was selected (MacLeod, 1991). This section examines the issue in more detail.

Because all versions of emotional Stroop are modifications of the original Stroop colour-word test (Stroop, 1935), it is reasonable to first discuss the reliability of the original test. There are a few studies on this topic. Most of the work is based on test-retest reliability. One potential problem with the test-retest method is that, if the interval between the two tests is too short, there will be practice effects, which may adversely affect the reliability estimations. Kindt, Bierman, and Brosschot (1996) reported that the test-retest reliability of both the standard Stroop task and the emotional version was low, even though in their study there was a three-month interval between the two administrations. At the other hand, Bardi, Hamby, and Wilkins (1995) administered a set of neurological tests, including the Stroop Colour-Word test, to a group of patients who were HIV positive. They reported very good reliability for the colour-naming, word-reading, and colour-word tasks at different intervals (6, 12, and 18 months). Neyens and Aldenkamp (1997) administered a wide battery of tests, including the card format of the Stroop Colour-Word test to 59 Dutch children aged 4.4 – 12.3 years, with test-retest intervals of six months. They reported excellent reliability.
Several researchers (Franzen, Tishelman, Sharp, & Friedman, 1985; Conner, Franzen, & Sharp, 1988; Sacks, Clarck, Pols, & Geffen, 1991; Siegrist, 1997) have employed test-retest procedures with different time intervals to assess the reliability of the classic Stroop test. These researchers reported acceptable reliability of the Stroop Colour-Word Test across the periods tested. In addition, investigating internal consistency, May, Cooper, and Kline (1986) reported that the Stroop Colour-Word Test is reliable. Siegrist (1995b) gave a computerised single-stimulus presentation version of the Stroop Colour-Word Test to 55 Swiss-German participants to evaluate the reliability of different facets of this test and found high internal consistency. In sum, there seems to be good evidence for the reliability of the Stroop Colour-Word Test. As MacLeod (1991) indicated, the popularity of the Stroop Colour-Word Test is due to its "reliability, size, and apparent simplicity of the effect" (p. 165).

The search for studies on the reliability of the emotional Stroop tests (using PsycINFO, Medline, and Zetoc) brought to light only two studies by Siegrist (1995b, 1997). Siegrist (1995b) used a series of taboo words as emotional stimuli and presented them with non-emotional words to a group of normal participants. His single stimulus presentation method made it possible to estimate the internal consistency of interference of the taboo words, which was acceptable (Cronbach alpha = .80). In his second study, Siegrist (1997) again investigated the reliability of a version of emotional Stroop test and the Stroop Colour-Word Test. Although the correlation between the test and retest reaction times on the emotional Stroop test were significant, "interference scores" were not. Further, a factor analysis yielded one factor explaining 89.0% of the total variance. Siegrist concluded that the emotional valence of stimuli on an emotional Stroop is neither a distinctive feature responsible for reaction times to emotional words nor to neutral words. Instead, he suggested that "one principal component related to the general ability to ignore irrelevant stimuli is sufficient to explain the total variance" (p. 6). Data collected for the present thesis and reported later were used to replicate (a) Siegrist's (1997) test-retest procedure and (b) Factor Analysis (n = 122) with classic and emotional Stroop tests and obtained similar results. However, submitting the mean reaction times to Principal Axis Factoring with Varimax rotation and Direct Oblimin (see Chapter 4 for a description of various factor analysis methods) revealed that although one factor explained 95% of variance extracting two factor solutions was also possible. There were significant bivariate correlations (p < .05) between factor scores (Factor 1 from Direct Oblimin and Factor 1 and 2 from Varimax rotation) and mean reaction times for all word sets. However, as far as interference
scores are concerned, there was a significant correlation between factor scores and only classic-Stroop interference scores. Therefore, although there may be a single factor responsible for reaction time to all word categories, it does not seem to apply to interference scores, suggesting that emotional valence does make a difference.

There are a few problems with the test-retest paradigm as a method of choice for evaluating the reliability of the emotional Stroop test. As Williams et al. (1996) indicated, "the problem with this sort of experimental design is the unknown extent to which general practice effect on the emotional Stroop task may reduce colour-naming interference on the second occasion of testing" (p.16). In addition, participants in Siegrist's (1997) study were a non-clinical sample and, as he suggested, it is necessary to do the same evaluation on a clinical group. As Sharma and McKenna (2001) pointed out, although a few studies have been able to show the emotional Stroop effect with non-clinical participants, with this group the amount of interference is usually smaller and even more difficult to demonstrate than is with a clinical group. This outcome with non-clinical participants may help to explain the lower stability of results on Stroop retests. Using other methods to estimate the reliability of the emotional Stroop may lead to better results. For example, Siegrist (1995b) reported strong results using internal consistency as the index of reliability.

Apart from the reliability issue, there is sufficient evidence in favour of the validity of the emotional Stroop test. As the evidence shows, the emotional Stroop test is able to distinguish between clinical and non-control groups (Williams et al., 1996). This may help to resolve the issue of reliability. As Thomdike (1982) stated, there is usually a point at which one can find overlap between reliability and validity. Ebel (1999) stated that, if there is enough theoretical evidence to support the practical applicability of an instrument, statistical outcomes implying antagonistic evidence for its reliability and validity should be treated with caution.

Finally, as is the case for almost all psychological tests, the specific conditions under which the various versions of the Stroop test are administered must be taken into account. For example, the Stroop Colour-Word Test has been modified as a neuropsychological test to assess impairments in attention and cognitive functioning (e.g., Dodrill, 1978; Lezak, 1995). The Dodrill-Stroop format (Dodrill, 1978) is a measure of perceptual interference and an index of changes in frontal lobe function. For example, in using this format on repeated occasions, as Sacks, Clarck, Pols, and Geffen (1991) suggested, there could be a minimum of one practice trial to counteract any artificial symptomatic effects.
In conclusion, when adequate attention is given to administration and scoring issues (e.g., Henik, 1996; also see Neurocognitive Variations of the Stroop Task: Different Administrations and Scoring Methods, Chapter 3, this thesis) there remains little doubt about the validity and reliability of the classic and emotional Stroop tests.

**Addiction-Related Stroop Studies**

Except for those related to addictive behaviours, Williams et al. (1996) selectively reviewed psychopathological studies that used the emotional Stroop paradigm to examine the underlying automatic cognitive processes involved in pathological behaviours. Their reason for excluding addiction studies was that few of them had been conducted at that time. Instead, they focused mainly on studies of anxiety and depression disorders and did not try to cover other forms of psychopathology. This was done in order to avoid dealing with various etiological and conceptual diversities. McCusker (2001) later reviewed studies of addiction specifically. However, his review was mainly directed at exploring major theoretical models and methods of investigating addictive behaviours. McCusker documented anomalies in traditional methods of studying addiction. In his account of different methodologies, he suggested that implicit methods are the approach of choice because of their better ability to predict addictive behaviours. Emotional-Stroop test falls within the implicit methods of studying the attentional bias for addiction-related stimuli. This section next provides a brief review of addiction-related Stroop studies, with an emphasis on alcohol abuse.

The number of addiction studies using the Stroop paradigm is small. At the time of this review, the PsycINFO, Medline, and Zetoc databases revealed 14 studies that had used the alcohol-Stroop paradigm (Bauer & Cox, 1998; Cox, Blount, & Rozak, 2000; Cox, Brown, & Rowlands, 2003; Cox, Hogan, & Kristian, 2000; Cox, Yeates, & Regan, 1999; Johnsen, Thayer, Laberg, & Asbjornsen, 1997; Ryan, 2002, Sharma et al., 2001; Stetter, Ackermann, Bizer, Straube, & Mann, 1995; Stetter, Chaluppa, Ackermann, & Straube, 1994; Stewart, Hall, Heather, & Birch, 2002; Stewart, & Samoluk, 1997; Stormark, et al. 2000). There was one study of opiate—viz., heroin—abuse (Franken, Kroon, Wiers, & Jansen, 2000) and six studies using a smoking-related Stroop (Gross, Jarvik, & Rosenblatt, 1993; Johnsen, Thayer, Laberg, & Asbjornsen, 1997; Rusted, Caulfield, King, & Goode, 2000; Waters & Feyerabend, 2000; Wertz & Sayette, 2001; Siegrist, 1995; Zack, Belsito, Scher, Eissenberg, & Corrigall, 2001). Finally, there was one Stroop study on compulsive gambling (McCusker & Gettings, 1997). In these studies, like the other disorder-related Stroop paradigms, the rationale is that a current
concern for consuming alcohol (e.g., a highly valued goal) manifests itself as an attentional bias for alcohol-related stimuli. The next section reviews smoking- and heroin-Stroop studies. It is followed by a review of alcohol-Stroop studies.

**Smoking- and Heroin Stroop Studies**

Rusted et al. (2000) demonstrated that attention tasks are the best methods for demonstrating the effects of the nicotine-related performance effects on human cognitive processes. These tasks can be general ones or selective attention tasks, as shown in this section.

Gross et al. (1993) randomly assigned adult male smokers to two groups. The first group \( (n = 10) \) was instructed to remain abstinent from nicotine for 12 hours; the second group \( (n = 10) \) could smoke as usual. On the emotional Stroop test, the abstinent group took significantly longer to colour name the smoking-related words than the neutral words. The non-abstinent group, however, showed a significant interference in the opposite direction. Although the selective attention of the abstinent group for cigarette words is consistent with the theory, the reversed interference by non-abstinent group is difficult to interpret. One interpretation lies in the lower momentary significance of smoking words for the non-abstinent group. Perhaps frustration arising from not smoking for 12 hours increased the emotional valence and goal-lurking properties of the stimuli for the first group. In addition, the lower momentary significance of smoking stimuli for the non-abstinent group could have increased the probability of "adopting a conscious strategy to override the effect of the salient stimuli by increasing the task demand" (Williams et al., 1996, p. 20).

The above findings are interesting because abstinence decreased the ability to ignore the meaning of smoking-related information and caused a content-specific shift in attentional focus onto the stimuli. According to Gross et al. (1993), the results for the non-abstinent group cannot be attributed to nicotine effects on general cognitive ability. This conclusion is consistent with the findings of Rusted, Caulfield, King, and Goode (2000), who found no significant positive effects of smoking on the classic Stroop task.

Johnsen et al. (1997) recruited three samples to a smoking-related Stroop study: active smokers \( (n = 11) \), abstinent smokers \( (n = 11) \), and non-smokers \( (n = 11) \). The task comprised verbal colour naming of incongruent colour-words, smoking-related words, and neutral words. For increasing the task difficulty (and interference size), manual responses were required before verbal responses, but only verbal responses were recorded. The active smokers showed longer reaction times for smoking-related words
and neutral words than the other groups. The active smokers’ reaction times on the classic Stroop test were not different from their reaction times to the other word categories, but the opposite was the case with the other two groups.

Johnsen et al. (1997) interpreted the non-differentiated pattern of the active smokers’ responses as a function of their lack of ability to modulate attentional processes. The authors linked this inability to the active smokers’ irregularities in cardiac vagal control, which is related to the ability to regulate attention. However, abstinent smokers showed longer reaction times than did active smokers and non-smokers. In addition, Johnsen et al. found a significant negative correlation between attitudes against smoking and reaction times to the smoking-related words. Johnsen et al. interpreted the latter finding as arising from the impeding effect of negative mood on reaction times. However, interpreting the negative attitude toward smoking as synonymous with negative mood was not supported by further evidence.

Cardiac vagal control is also relevant. It is an index of heart-rate variability: the greater the heart-rate variability, the greater the ability to regulate attention (Friedman, & Thayer, 1998; Porges, 1992). Evidence indicates that alcohol consumption decreases the heart-rate variability and the ability to sustain attention (e.g., Suess, Newlin, & Porges, 1997).

Rusted et al. (2000) investigated the effects of smoking one cigarette in the laboratory on smokers who abstained for a self-determined period of not less than two hours, while monitoring similar effects on analogues of smokers’ everyday life. The analogues measured sustained attention and performance in a dual task, a telephone directory search task, and a map search task. Remaining abstinent from smoking for just two hours increased performance on the various sustained attention tasks. However, both abstinent (for at least two hours in the laboratory) and non-abstinent smokers (recently having smoked one cigarette) showed significant colour-naming decrements on a smoking-related Stroop task.

Zack et al. (2001) investigated the effects of abstinence and smoking in novice adolescent smokers (n = 16; age range = 14-18 years). Participants were asked to stay abstinent from smoking after their last cigarette on the evening before their test session. Before starting the pre-test session, abstinence was measured by collecting a sample of saliva (that showed levels of salivary cotinine and salivary nicotine) and recording participants’ heart rate while responding to the Fagerstrom Test of Nicotine Dependence (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). As they smoked, participants’ intake of smoke and heart rate were assessed separately. Next, participants had a post-test
session, during which they took the classic and smoking-related Stroop tests and a test of vigilance (Rapid Information Processing task). For the heavier smokers, abstinence increased and smoking decreased reaction times for smoking-related words. In conclusion, greater feelings of subjective withdrawal were accompanied by more intrusiveness from the smoking-related words. Daily frequency of smoking was a predictor of the degree of the classic Stroop effect, with a greater post-smoking decline in RTs (i.e., faster RTs) as frequency of daily smoking increased. Zack et al. interpreted this finding as reflecting the smokers' improved inhibitory information processing. The improvement is presumed to increase the ability to sustain attention on challenging tasks. However, it should be noted that heavier smoking was associated with greater abstinent-induced impairment and, therefore, greater post smoking-induced recovery.

In addition to the studies above, Zack et al. (2001) investigated the relationship between the classic Stroop and smoking-related Stroop. They found general improvement in selective attention after smoking. That is, the overall ability to inhibit (assessed by the classic Stroop test) did not mediate the relationship between daily frequency of smoking and interference scores. However, when the frequency of daily smoking was partialled out, the relationship between the classic and the smoking-related Stroop was significant. Accordingly, Zack et al. suggested that responses on the two versions of the Stroop task tap a common construct. They did not explain the nature of this common construct, but if they meant it to be the general ability to inhibit, then the latter interpretation—the common construct—would be in contrast to the first—the effects of abstinence from smoking. Moreover, they mainly focused on reaction times rather than interference scores.

Waters and Feyerabend (2000) investigated the attentional bias of 96 smokers by using computerised formats of either a smoking-related Stroop or a withdrawal-Stroop test. They used both a blocked format (smoking and neutral words presented in separate blocks) and a mixed presentation format (smoking and neutral words presented randomly). Participants were randomly divided into two groups. The first group performed the blocked and the second group, the mixed presentation format. Participants were further divided into two groups. One group was instructed to abstain from smoking for 24 hours, whereas the second group was allowed to smoke normally before the colour-naming tests. Waters and Feyerabend reported that the block format was capable of showing the attentional bias to smoking-related words in the abstinent participants. They then concluded “with confidence that the blocked and unblocked formats are different instruments” (p.119). In addition, they found that the degree of attentional bias
predicted the latency to the first cigarette of the morning. Stronger interference was correlated with earlier cigarette smoking.

There are two points that underscore Waters and Feyerabend's "firm" conclusion about the two formats (i.e., blocked and mixed randomised) as different instruments.

First, each single RT in the block format is not a pure reflection of the attentional bias for a particular stimulus: it carries over effects from the previous trials as well. In block presentation, a semantic network builds up, and this is considered to be responsible for longer reaction times in block presentations. Therefore, each single trial in this format belongs to a larger semantic network; accordingly, RT on the trial is affected by the network. On the other hand, in the block presentation the carry-over of any mood state plausibly affects the results. This adds a source of contamination to seemingly independent trials.

Second, Waters and Feyerabend's (2000) study used environmental words as the neutral words; however, 11 words out of 18 (e.g., ocean, bush, streams, and barn) are closely related to the colours in the response set. This name-and-colour association cause falsely inflated reaction times to the control words. Considering the latter point and elimination of the sources of inflation in reaction times in the mixed presentation method discussed earlier, it is difficult to conclude that the difference between the two formats of the modified Stroop test in this study results from their constructional differences.

Wertz and Sayette (2001) re-examined Zack et al.'s (2000) suggestion that the unblocked format of the emotional Stroop test is constructively different from the block format. Wertz and Sayette selected 18 words for each category of their smoking-related Stroop stimuli. Among the control words, only one word (i.e., tomatoes) was closely associated with a specific colour. Using a mixed presentation procedure, they found that smokers showed attentional bias for smoking-related stimuli. The results also showed that the opportunity to smoke affected smokers' attentional bias for smoking-related stimuli. Participants who were allowed to smoke during the experiment (after about 12 hours of abstinence) showed a greater interference than those who were told they would not been able to smoke during the study. Wertz and Sayette concluded that, after a period of abstinence, the opportunity to smoke increases the salience of smoking-related stimuli. Moreover, Wertz and Sayette found that smokers' reported urges were not correlated with the interference effects. This is consistent with Tiffany's position that self-reported motivation to take a drug can be independent of craving-related changes in cognitive processing.

To summarise:
Smoking-related Stroop studies demonstrate that the emotional Stroop is a reliable tool for investigating smokers' attentional bias for smoking-related stimuli. The applicability of the smoking-related Stroop for investigating cognitive shifts in smokers is independent of its particular format (i.e., blocked or mixed randomised). Abstinence and perceived opportunity to smoke can increase active smokers' attentional bias for smoking-related stimuli.

The next study was a modified Stroop test to investigate attentional bias in heroin abusers. Franken et al. (2000) considered addiction to be abnormal, motivated behaviour. They believed that, within a motivational framework, the study of attentional bias helps better to understand the abnormal appetitive system; also, it helps to make a link between attentional and biological processes. They compared the attentional bias for heroin-related stimuli in a group of 21 recently abstinent heroin abusers with a group of 32 control participants. They presented the stimuli in a mixed randomised order using computerised versions of supraliminal and subliminal Stroop tests. A microphone recorded the participants' verbal responses to the stimuli. In addition to the Stroop tests, Franken et al. collected information from the experimental group on the severity of their craving for heroin during the prior week using a heroin-research version of the Obsessive Compulsive Drug Use Scale. Results revealed a significant attentional bias among the heroin abstainers for heroin stimuli on the supraliminal—but not the subliminal—versions of the Stroop test. In addition, the severity of craving for alcohol was a significant predictor of the degree of attentional bias on the Stroop test.

**Alcohol-Stroop Studies**

Fourteen studies have used the alcohol-Stroop paradigm. Stetter et al. (1994) and Johnsen et al. (1994) conducted the earliest studies. Stewart et al. (2002) and Ryan (2002) published the latest alcohol-Stroop study. Among these studies, 12 have demonstrated attentional bias for alcohol-related stimuli. Two studies have failed to find the effect: one study was Stetter et al. (1994), which did not find a significant difference between experimental and control groups' interference scores; the second was Ryan (2002), which found no between-groups difference for the interference scores of in-patient abusers and a groups of a detoxification unit as controls, but he found that alcohol consumption self-reports predicted alcohol-Stroop interference for both groups. These studies are summarised in Table 2.1.

In the alcohol-Stroop studies, there is a diverse range of formats—e.g., card vs. computerised, different intertrial intervals (ITI), and duration of presentation of the
stimuli—controlled variables, methodology, participants, and number and type of stimuli (see Table 2.2 and Table 2.3). Therefore, no alcohol-Stroop study is an exact replication of another. The variations can be responsible for differences in effect sizes among these studies.

Studies using the alcohol-Stroop test have shown that it is a robust paradigm for assessing cognitive and emotional processes underlying alcohol use and abuse. It has been used to assess attentional bias in both heavy social drinkers (e.g., Cox et al., 1999; Cox et al., 2003; Stewart et al., 1997, 2002) and alcohol abusers (e.g., Bauer & Cox, 1998; Cox et al., 2000, 2002; Johnsen et al., 1994; Ryan, 2002; Sharma & Albery, 2001; Stetter et al., 1995, 1994; Stormark et al., 2000). The salient findings can be summarised as follows. Alcohol abusers usually show greater attentional bias for alcohol-related stimuli than do non-abusers, and the degree of alcohol abusers' attentional bias is a significant predictor of their ability to reduce their drinking (Cox et al., 2002). Heavy social drinkers also show this bias (unlike light drinkers and non-drinkers), and this can be augmented by alcohol-cue exposure (Cox et al., 1999) and negative mood inductions (Stewart et al., 1997). Finally, drinkers’ attentional bias for alcohol stimuli is accompanied by physiological reactions, including increased skin conductivity and heart-rate deceleration. The physiological reactions reflect participants' inability to ignore alcohol stimuli and disengage their attention from them (Stormark et al., 2000).

The empirical findings on drinkers' uncontrollable distractibility for alcohol-related stimuli are consistent with clinical observations about the nature of alcohol abuse. Specifically, the well-known observation that problem drinkers are unintentionally preoccupied with alcohol despite their knowledge of its adverse consequences is the first criterion for defining alcohol abuse in the DSM-IV classification scheme (American Psychological Association, 1994; see also Morse & Flavin, 1992; Roberts & Koob, 1997).

It can be argued that with alcohol at the focus of the person's attention, alcohol-related stimuli act as triggers for cognitive, emotional, and behavioural responses; these responses may be inconsistent with the person's conscious, rational decision not to drink. According to Tiffany (1990), when habitual drinkers encounter drink-related stimuli, automatic cognitive processes are set into motion. These processes activate alcohol-seeking behaviours that go beyond the drinker's original intention not to drink. With repeated practice, the act of drinking becomes increasingly automatic, so that the person is unaware of the chain of actions leading to drinking after he or she has come into contact with the triggering stimuli.
### Table 2.1. Summary of alcohol-Stroop studies.

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants and controlled variables</th>
<th>Mean (SD) RT on Alc. Ctg for Exp. Grp</th>
<th>Mean (SD) RT on Contr. Ctg for Exp. Grp</th>
<th>Str. Int. (Exp.) Sec / ms</th>
<th>Mean (SD) RT on Alc. Ctg for Contr. Grp (p)</th>
<th>Mean (SD) RT on Contr. Ctg for Contr. Grp (p)</th>
<th>Str. Int. (Contr.) Sec / ms</th>
<th>Group(s) showing Int. On target vs. Contr. words/ group(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnson et al. (1994)</td>
<td>inpatients (18) social drinkers (18) Contr. for age</td>
<td>1370 (7)</td>
<td>1120 (7)</td>
<td>750 (7)</td>
<td>1040 (7)</td>
<td>1000 (7)</td>
<td>30 (7)</td>
<td>Impatient: (Alc. / Contr. words)</td>
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<tr>
<td>Satter et al. (1994)</td>
<td>inpatients (30) social drinkers (20) Contr. for age and IQ</td>
<td>89.2 (27.3)</td>
<td>81.5 (18.8)</td>
<td>7.7 (7)</td>
<td>72.0 (11.8)</td>
<td>70.5 (10.7)</td>
<td>2.3 (7)</td>
<td>none</td>
</tr>
<tr>
<td>Satter et al. (1995)</td>
<td>inpatients (40) social drinkers (40) Contr. for age and verbal IQ</td>
<td>80.5 (160.1)</td>
<td>76.0 (20.2)</td>
<td>62.0 (80.8)</td>
<td>770.5 (130.2)</td>
<td>750.3 (130)</td>
<td>20.2 (70.3)</td>
<td>Impatient: (Alc. / Contr. words)</td>
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<tr>
<td>Stewart et al. (1997)</td>
<td>students (32) divided according to: a) food deprivation = FD / No FD b) restraint conditions high / moderate / low Contr. for age, gender, race, Verbal IQ, and Restraint Scale scores</td>
<td>Alc. = 82.00 (11.43) (n = 11)</td>
<td>Food = 79.09 (10.89)</td>
<td>Int. Alc. = 7.09 (3.47)</td>
<td>Alc. = 72.50 (12.21) (n = 10)</td>
<td>Food = 72.01 (12.48)</td>
<td>Int. Alc. = 3.20 (9.86)</td>
<td>In HR Grp. (Alc. / Contr. words) and (food / Contr. words)</td>
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<td>High Restrain Grp (HR)</td>
<td>Low Restrain Grp (LR)</td>
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<td></td>
<td>Alc. = 76.45 (14.26) (n = 11)</td>
<td>Food = 78.00 (13.54)</td>
<td>Int. Alc. = -1.09 (4.78)</td>
<td>Alc. = 4.05 (3.54)</td>
<td>Food = 77.55 (15.73)</td>
<td>Int. Alc. = -0.01 (5.97)</td>
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<tr>
<td>Bauer and Cox (1998)</td>
<td>inpatients (20) social drinkers (20) Contr. for age, brain injury, depression, anxiety, and emotional valence of the stimuli</td>
<td>711.60 (79.88)</td>
<td>RT Neu = 689.27 (90.26)</td>
<td>Int. Alc. = 22.33 (23.13)</td>
<td>653.32 (83.27)</td>
<td>RT Neu = 640.32 (73.83)</td>
<td>Int. Alc. = 13.68 (28.49)</td>
<td>Both groups were slower on alcohol and emotional words</td>
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<td>RT Pos. Em. = 703.15 (96.26)</td>
<td>Int. Pos. Em. = 13.84 (16.90)</td>
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<td></td>
<td>RT Neg. Em. = 696.27 (95.21)</td>
<td>Int. Neg. Em. = 7.20 (20.64)</td>
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<tr>
<td>Cox et al. (1999)</td>
<td>heavy drinkers students (30) light drinkers students (30) exposed to Alcoholic or music cues Contr. for (7)</td>
<td>Grp / Ctg &gt; stimulus heavy / Alc &gt; Alc = 740 (109) heavy / Alc &gt; Msa = 733 (108) heavy / Alc &gt; Neu = 715 (92) heavy / Alc &gt; Xa = 681 (102)</td>
<td>Grp / Ctg &gt; stimulus heavy / music &gt; alc = 639 (81) heavy / music &gt; Msa = 645 (88) heavy / music &gt; Neu = 635 (73) heavy / music &gt; Xa = 617 (77)</td>
<td>heavy drinkers / Alc. cues Alc. - Max. = 7.9 (59) Alc. - Neu. = 25.9 (44) Alc. - Xa = 59.6 (70) heavy drinkers / music cues light / Alc &gt; alc = 641 (79) light / Alc &gt; Msa = 666 (86) light / Alc &gt; Neu = 643 (84) light / Alc &gt; Xa = 630 (86)</td>
<td>Grp / Ctg &gt; stimulus light / music &gt; alc = 643 (96) light / music &gt; Msa = 664 (84) light / music &gt; Neu = 636 (86) light / music &gt; Xa = 584 (89)</td>
<td>light drink / Alc. cues Alc. - Max. = -25.3 (65) Alc. - Neu. = -2.5 (57) Alc. - Xa = 10.3 (49)</td>
<td>heavy drinkers exposed to alcoholic or music cues (heavy / alc) were slower on the Stroop task than the other groups</td>
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<td></td>
<td>heavy drinkers / music cues Alc. - Max. = 5.77 (47) Alc. - Neu. = 4.1 (46.5) Alc. - Xa = 22.3 (65)</td>
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<td></td>
<td>light drink / music cues Alc. - Max. = -20 (52) Alc. - Neu. = 6.6 (63) Alc. - Xa = 59.2 (59)</td>
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</table>

Continued
Table 2.1. Summary of alcohol-Stroop studies (continued).

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants and controlled variables</th>
<th>Mean (SD) RT on Alc. Ctg. for Exp. Grp</th>
<th>Mean (SD) RT on Contr. Ctg. for Exp. Grp</th>
<th>Med Int (Exp.) Sec./min</th>
<th>Mean (SD) RT on Alc. Ctg. for Contr. Grp</th>
<th>Mean (SD) RT on Contr. Ctg. for Contr. Grp</th>
<th>Str. Int (Contr.) Sec./min</th>
<th>Group(s) showing Int. on target vs Contr. words / group(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cox et al. (2000)</td>
<td>In-patients (17) students (88) Contr. for word frequency</td>
<td>Alc. = 1.27 (0.30) concern = 1.25 (0.31)</td>
<td>Neut. = 1.24 (0.24)</td>
<td>Int. Alc. = 1.50 (11.23) concern = 0.59 (9.24)</td>
<td>Alc. = 1.90 (0.19) concern = 1.93 (0.22)</td>
<td>Neut. = 1.86 (0.14)</td>
<td>Int. Alc. = 0.03 (0.21) concern = 0.07 (0.22)</td>
<td>Alc. Absurers were slower on Alc. Categ.</td>
</tr>
<tr>
<td>Stornack et al. (2000)</td>
<td>In-patients (24), social drinkers (24) Contr. for colour blindness</td>
<td>1522 (246)</td>
<td>Neut. = 1450 (276) Neg. Em. = 1523 (329)</td>
<td>Int. Alc. = 72 (162) Neg. Em. = 73 (181)</td>
<td>1213 (254) Neg. Em. = 1219 (266)</td>
<td>Int. Alc. = -7 (142) Neg. Em. = -20 (133)</td>
<td>Alcoholics (Alc. &amp; Em./Contr. words) Alcoholics were slower on all word categories</td>
<td></td>
</tr>
<tr>
<td>Jones and Schulze (2000)</td>
<td>Students, staff of university, and general public (60) Grp A= Alc. sip primed Grp S= non Alc. sip primed</td>
<td>positive Alc-related (P-AR)=? (7) negative Alc-related (N-AR)=? (7) positive Alc-unrelated (P-AU)=? (7) negative Alc-unrelated (N-AU)=? (7) Xs = ? (7)</td>
<td>positive Alc-related (P-AR)=? (7) negative Alc-related (N-AR)=? (7) positive Alc-unrelated (P-AU)=? (7) negative Alc-unrelated (N-AU)=? (7) Xs = ? (7)</td>
<td>From fig. 1 (6-291)</td>
<td>high AUDIT = 917.6 (-115.74) low AUDIT = 973.6 (-175.67)</td>
<td>high AUDIT = 896.2 (-114.87) low AUDIT = 968 (-170.27)</td>
<td>high AUDIT = 21.33 (43.88) low AUDIT = 7.91 (57.44)</td>
<td>CAS &amp; high AUDIT groups showed slower RTs to the alcohol-related words CAS group sig. slower on alcohol words than high &amp; AUDIT groups</td>
</tr>
<tr>
<td>Sharma et al. (2001)</td>
<td>High / low Alc. students using AUDIT (20) / (20) in-patients (CAS) (CAS=20) Contr. for (7)</td>
<td>1268.32 (199.61)</td>
<td>1107.74 (-122.5)</td>
<td>160.58 (125.54)</td>
<td>high AUDIT = 917.6 (-115.74) low AUDIT = 973.6 (-175.67)</td>
<td>high AUDIT = 896.2 (-114.87) low AUDIT = 968 (-170.27)</td>
<td>high AUDIT = 21.33 (43.88) low AUDIT = 7.91 (57.44)</td>
<td>CAS &amp; high AUDIT groups showed slower RTs to the alcohol-related words CAS group sig. slower on alcohol words than high &amp; AUDIT groups</td>
</tr>
<tr>
<td>Cox et al. (2002)</td>
<td>In-patients (14) Staff (16)</td>
<td>948.23 (264.19)</td>
<td>19.96 (56.31)</td>
<td>713.75 (107.40)</td>
<td>high AUDIT = 917.6 (-115.74) low AUDIT = 973.6 (-175.67)</td>
<td>667.55 (97.29)</td>
<td>46.20 (36.27)</td>
<td>Int. Alc. = 38.47 (62.93)</td>
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<td>962.13 (277.13)</td>
<td>13.90 (31.99)</td>
<td>706.02 (98.32)</td>
<td>7.31 (30.58)</td>
<td>637.25 (97.09)</td>
<td>38.47 (62.93)</td>
<td>Non-completed treatment group showed increased Alc. Int. between Time 1 and Time 2</td>
</tr>
<tr>
<td>Cox et al. (2003)</td>
<td>students (80) divided to heavy / light drinkers (Khawari test) exposed to Alc. or Non. cues Contr. for colour blindness sober from alc. For 6 hrs</td>
<td>728.26 (87.96)</td>
<td>53.04 (55.70)</td>
<td>669.08 (102.85)</td>
<td>41.09 (36.40)</td>
<td>678.64 (110.79)</td>
<td>41.39 (54.47) For heavy drinkers exposed to Alc. Cues attentional bias was predicted by the amount of Alc. drinking</td>
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</tbody>
</table>

continued
### Table 2.1. Summary of alcohol-Stroop studies (continued).

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants and controlled variables</th>
<th>Mean (SD) RT on Alc. Ctg. for Exp. Grp</th>
<th>Mean (SD) RT on Contr. Ctg. for Exp. Grp</th>
<th>Str. Int (Exp)</th>
<th>Mean (SD) RT on Alc. Ctg. for Contr. Grp (s)</th>
<th>Mean (SD) RT on Contr. Ctg. for Contr. Grp (s)</th>
<th>Str. Int (Contr.)</th>
<th>Group(s) showing Int. on target vs. Contr. words / group(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stewart et al. (2002)</td>
<td>students (48) divided into:</td>
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<tr>
<td></td>
<td>a) enhancement motives</td>
<td>Grp / prime &gt; target</td>
<td>Grp / prime &gt; target</td>
<td>Int. scores for CM Grp.</td>
<td>Grp / prime &gt; target</td>
<td>Int. scores for EM Grp.</td>
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<tr>
<td></td>
<td>(EM drinkers = 24)</td>
<td>CM / Pos &gt; Alc. =</td>
<td>CM / Pos &gt; Contr. =</td>
<td>*</td>
<td>CM / Pos &gt; Alc. =</td>
<td>CM / Pos &gt; Contr. =</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>835.17 (190.58)</td>
<td>799.71 (152.43)</td>
<td>35.46 (74.31)</td>
<td>875.62 (173.93)</td>
<td>809.68 (122.56)</td>
<td>41.94 (64.43)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) coping motives</td>
<td>CM / Neg &gt; Alc. =</td>
<td>CM / Neg &gt; Contr. =</td>
<td>33.53 (72.13)</td>
<td>836.25 (133.88)</td>
<td>809.79 (120.73)</td>
<td>26.46 (72.43)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(CM drinkers = 24)</td>
<td>CM / Neut &gt; Alc. =</td>
<td>CM / Neut &gt; Contr. =</td>
<td>24.66 (74.10)</td>
<td>848.91 (143.33)</td>
<td>802.54 (96.29)</td>
<td>46.39 (70.75)</td>
<td></td>
</tr>
<tr>
<td>Ryan (2002)</td>
<td>inpatients (34)</td>
<td>Trial 1</td>
<td>Trial 1</td>
<td>Trial 1</td>
<td>Trial 1</td>
<td>Trial 1</td>
<td>Trial 1</td>
<td>No between groups</td>
</tr>
<tr>
<td></td>
<td>detox staff (33)</td>
<td>48.0 (13.1)</td>
<td>41.72 (11.3)</td>
<td>102 (7)</td>
<td>39.6 (7.8)</td>
<td>36.12 (8.3)</td>
<td>68 (7)</td>
<td>difference, but alcohol consumption self-reports</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trial 2</td>
<td>Trial 2</td>
<td>Trial 2</td>
<td>Trial 2</td>
<td>Trial 2</td>
<td></td>
<td>predicted alcohol-Stroop interference for both groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41.7 (10.0)</td>
<td>34.67 (8.2)</td>
<td>37.7 (7.9)</td>
<td>34.31 (7.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

Table 2.2. Alcohol and neutral words used in alcohol-Stroop studies.

<table>
<thead>
<tr>
<th>Study</th>
<th>Method and responses</th>
<th>Content of word stimuli</th>
<th>No. of sum. per Categ. trials</th>
<th>Alcohol words</th>
<th>Neutral words</th>
<th>Control words (1)</th>
<th>Control words (2)</th>
<th>size of the stimuli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnsen et al. (1994)</td>
<td>Computer (vocal, manual)</td>
<td>Alcohol, Neutral</td>
<td>(100)</td>
<td>bar, beer, consume, drink, gas, intoxication, larger, pint, pub, liquor-store, shot, liquor, red wine, drink, vodka, white wine, whisky, beverage</td>
<td>telephone, shoe, que, lamp, watch, box, call, key, floor, mirror, building, case, windproof, invitation, house, mail, carpet, window</td>
<td>?</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Stetter et al. (1994)</td>
<td>Card</td>
<td>Colour words, Alcohol, Neutral (household things)</td>
<td>20 (100)</td>
<td>(e.g., beer black-out, drunkenness, wine)</td>
<td>Not mentioned</td>
<td>*</td>
<td>*</td>
<td>?</td>
</tr>
<tr>
<td>Stetter et al. (1995)</td>
<td>Card</td>
<td>Colour words, Alcohol, Neutral (household things)</td>
<td>20 (100)</td>
<td>(e.g., beer black-out, drunkenness)</td>
<td>Not mentioned</td>
<td>uppercase 6 mm</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Stewart et al. (1997)</td>
<td>Card</td>
<td>food, Alc &amp; Cent. (Leisure activities)</td>
<td>20 (100)</td>
<td>barley, liquor, liqour, bourbon, mail, champagne, drunk, hops, bar, vodka, sherry, shooters, jam, chocolate, coke, screw, alcohol, scotch, brandy, gin, rum</td>
<td>pizza, cookie, honey, oeing, chips, flashlight, spaghetti, peas, pretzels, martini,shakes, pudding, fudge, jam, chocolate, cake, pastries, waffles, donut, pancakes, snooze, ski</td>
<td>Skunk, relating, surfing, bowling, meats, golf, gardening, rowing, cycling, camping, monopoly, canoeing, shark, hiking, knitting, cheetahs, hockey, sailing, dancing, shopping</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Bauer and Cox. (1998)</td>
<td>Computer (vocal)</td>
<td>Alcohol words</td>
<td>10 (40)</td>
<td>alcohol, bombed, beer, drunk, hangover, high, liquor, shaker, tanked, withdrawal</td>
<td>fun, fumes, folder, piler, notebook, portion, reported, sound, sewing, shift</td>
<td>charm, dear, devotion, joke, peace, playful, excited, pleasant, sweet, startled</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Cox et al. (1999)</td>
<td>Computer (manual)</td>
<td>Alcohol, Music, Neutral</td>
<td>20 (100)</td>
<td>alcohol, alcohol, bar, beer, beer, beer, beer, drink, drink, gin, shotgun, pint, beer, sherry, shot, spirits, stout, vodka, whisky, wine</td>
<td>shoe, que, key, box, building, mouse, cape, carpet, red, card, watch, mirror, window, dials, telephone, lamp, floor, boot, windproof, avionics</td>
<td>bass, violin, oboe, guitar, trumpet, maracas, voice, flute, bagpipes, trombone, recorder, drums, clarinet, bass, cello, lorgne, pan pipe, harmonica, piano, keyboard</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Jones and Schulze (2000)</td>
<td>Computer (manual)</td>
<td>Alcoholic, Concern-related, Neutral</td>
<td>72 (24)</td>
<td>(e.g., beer, gin, vodka, bartender, jigger, tavern)</td>
<td>(e.g., box, card, region)</td>
<td>personal concern, (e.g., weight, dog)</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Stomark et al. (2000)</td>
<td>Computer (manual)</td>
<td>Alcohol, Neutral (house), Negative emotional</td>
<td>4 (16)</td>
<td>beer, drink, sport, wine</td>
<td>shoe, car, house, boat</td>
<td>death, sick, sad, anxiety</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>
Table 2.2. Alcohol and neutral words used in alcohol-Stroop studies (continued).

<table>
<thead>
<tr>
<th>Study</th>
<th>Method and responses</th>
<th>Content of word stimuli</th>
<th>NO. of Words (trials)</th>
<th>Alcohol words</th>
<th>Neutral words</th>
<th>Control words (1)</th>
<th>Control size of the stimuli</th>
</tr>
</thead>
</table>
| Sharma et al. (2001)      | Computer (manual)    | Alcohol, Neutral                            | 25                    | alcohol, bar, beer, beer
bourbon, brew, brewery, cider cocktail, drunk
gin, liquor, liquor meal, port, pub saloon, Scotch
sherry, spirits
stout, tavern whiskey, wine
hollow, hole ocean, tree, toilet
tunnel, cave pubbie, crag
bridge, lighthouse
g, plain, swim
trench, woods
beg, cliff, swamp
man, leaves
canal, geyser
meadow, valley |

| Cox et al. (2002)         | Computer (manual)    | Alcohol, Neutral Control (environmental features) | 10 (logo) | archers, catling
Guinness, cocktail
boul, lambamus
Malts, miller strongbow
woody, beer
vodka, shorts whiskey, bar
slopping, stout cocktails, spirits
alcohol |
|----------------------------|----------------------|-----------------------------------------------|--------------|-------------------------------------------------|---------------|-------------------|-----------------------------|
| Cox et al. (2003)         | Card                 | Alcohol, Soft drinks, Cleaning-related words, Xs | 20          | fans, spirits
rhema, tier
pepsi, tango
Robinson's perine, vamto
schwepes, squash, juice
espresso, tea
coffee, milk
water, custard
milkshake |

| Stewart et al. (2002)     | Computer (vocal)     | Alcohol & Control                            | 20          | gin, rum, shooters
beer, beers, wad, bocai, liquor,
champagne cooler, mosky,
whiskey, alcohol drank*, snooty*,
*smashed*,
plastered* (**2** were excluded from analysis) |
|----------------------------|----------------------|-----------------------------------------------|--------------|-------------------------------------------------|---------------|-------------------|-----------------------------|
| Ryan (2002)               | Card                 | Alcohol & Control                            | 5            | alcohol, addiction, drunk, relapse, 
dependence
fireplace, chair, 
balcony, kitchen, 
cubboard |

Note: a few studies have not reported all used words. Other words that are not mentioned in a given article are attained through personal communication with the authors.
Table 2.3. Frequency of words used in the alcohol-Stroop studies.

<table>
<thead>
<tr>
<th>Alcohol</th>
<th>Word</th>
<th>Freq.</th>
<th>%</th>
<th>Word</th>
<th>Freq.</th>
<th>%</th>
<th>Neutral</th>
<th>Word</th>
<th>Freq.</th>
<th>%</th>
<th>Words</th>
<th>Freq.</th>
<th>%</th>
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<tbody>
<tr>
<td>beer</td>
<td>8</td>
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<td>1</td>
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<td>boots</td>
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<td>2.16</td>
<td>canal</td>
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<td>0.7</td>
<td>robinsons</td>
<td>1</td>
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</tr>
<tr>
<td>whiskey</td>
<td>6</td>
<td>4.1</td>
<td>1</td>
<td>0.7</td>
<td>shoe</td>
<td>3</td>
<td>2.16</td>
<td>honey</td>
<td>1</td>
<td>0.7</td>
<td>pants</td>
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<td>0.719</td>
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<tr>
<td>alcohol</td>
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<td>4.1</td>
<td>1</td>
<td>0.7</td>
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<td>1.44</td>
<td>shift</td>
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<td>scarf</td>
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<tr>
<td>liquor</td>
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<td>1</td>
<td>0.7</td>
<td>wind shield</td>
<td>2</td>
<td>1.44</td>
<td>telephone</td>
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<td>fudge</td>
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<td>drunk</td>
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<td>1</td>
<td>0.7</td>
<td>invocation</td>
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<td>1.44</td>
<td>boat</td>
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<td>water</td>
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<td>que</td>
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<td>crags</td>
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<td>fan</td>
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<tr>
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<tr>
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<td>squash</td>
<td>1</td>
<td>0.719</td>
</tr>
<tr>
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<td>1</td>
<td>0.7</td>
<td>hardys</td>
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<td>0.72</td>
<td>stand</td>
<td>1</td>
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<td>blouse</td>
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<td>1</td>
<td>0.7</td>
<td>malt</td>
<td>1</td>
<td>0.72</td>
<td>tango</td>
<td>1</td>
<td>0.7</td>
<td>harbour</td>
<td>1</td>
<td>0.719</td>
</tr>
<tr>
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<td>0.7</td>
<td>1</td>
<td>0.7</td>
<td>brewery</td>
<td>1</td>
<td>0.72</td>
<td>hat</td>
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<tr>
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<td>malibu</td>
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<td>0.72</td>
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<td>cookie</td>
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<td>0.7</td>
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<td>shakes</td>
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<td>0.72</td>
<td>sweatshirt</td>
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<td>perrier</td>
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<tr>
<td>tavern</td>
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<td>0.7</td>
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<td>0.7</td>
<td>cooler</td>
<td>1</td>
<td>0.72</td>
<td>vest</td>
<td>1</td>
<td>0.7</td>
<td>in let</td>
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<tr>
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<td>0.7</td>
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<td>0.7</td>
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<td>0.7</td>
<td>meadow</td>
<td>1</td>
<td>0.719</td>
</tr>
</tbody>
</table>

Total 146 100 Total 139 100

Note: Some studies included neutral and control words. Control words are not included in the frequency table.

**Alcohol-Stroop Effect Size Analysis**

Effect size (ES) is an index of the magnitude of the difference between two means divided by their pooled standard deviation (Cohen, 1992). Unlike tests of statistical significance, an ES is independent of sample size. ESs are frequently used in meta-analytic studies that summarise the findings from a specific area of research. In alcohol-Stroop studies, the answer to two questions helps one to better understand the status of the research: What kinds of experimental conditions magnify differences in interference scores between the experimental and control groups? What kinds of variables optimise an alcohol-Stroop test so as to best reflect differences between two groups? This section
considers mainly how ESs are calculated, and discusses those studies that can be classified as showing small, medium, or large ESs. The ES for each study shown in Table 4 was calculated as the difference between the interference scores of the experimental and control groups divided by the pooled SD. Because in some studies (Johnsen et al., 1994; Jones & Schulze, 2000; Stetter et al., 1994; Ryan, 2002) the SD of interference scores was not attainable—even from personal communication with the researcher—ESs for these studies could not be calculated.

In effect size studies, Cohen's (1992) d has been frequently used. Cohen's d values of 0.20, 0.50, and 0.80 are defined as small, medium, and large, respectively. In the following discussion, ESs based on interference scores for non-alcohol stimuli (two conditions) and alcohol-interference scores based on strings of letters (e.g., Xs as the baseline) are not discussed because this baseline does not contain a comparable semantic dimension (two conditions).

The following ESs involve comparisons in which interference scores are based on the difference between RTs for alcohol-related and neutral words.

There are two conditions with small ESs (i.e., ESs = -0.30 and -0.36) but with results not in the hypothesised direction. The first condition (d = -0.30), was in Stewart et al. (1997), in which low and moderate food-restrained groups were compared, with the low-restrained group showing a large interference on the alcohol Stroop test. The second condition (d = -0.36), in Cox et al. (2002), included alcohol abusers admitted to an inpatient treatment unit but who later did complete the treatment and a group of control participants consisting of staff working at the centre. It seems very difficult to account for the first unexpected finding. However, the ESs related to both alcohol and food (see Table 2.4) suggest that moderate restraint increases the sensitivity to food-related (eating) stimuli but decreases the sensitivity to alcohol-related (drinking) ones, whereas high restraint increases the sensitivity to both alcohol- and food-related stimuli. However, an explanation for the second unexpected finding is easier: Those alcohol abusers who later completed the treatment, unlike those who failed to do so and the treatment staff, likely entered the treatment programme with strong negative attitudes about drinking alcohol so that they were better able to control their attention to alcohol stimuli.

There were four conditions that met the criterion for trivial ESs (i.e., ESs = -0.05 to 0.10). These were in (a) Cox et al. (1999) who compared heavy and light drinkers responding to alcohol-related and neutral stimuli after musical cue exposure (d = -0.05);
(b) Cox et al. (2002) who compared alcohol abusers who later did not complete their treatment with controls ($d = -0.02$); (c) Stewart et al. (2002) who compared a group of student participants with Enhancement Motives (EM) for drinking with a group with Coping Motives (CM) when both groups had been primed by positive emotional cues before the alcohol-Stroop test ($d = 0.09$); and (d) the same study, which compared a CM group with an EM group when both groups had been primed with negative emotional cues before the alcohol-Stroop test ($d = 0.10$). The null effect size in condition (a) could less plausibly be explained by assuming that musical cues primed alcohol concepts for light drinkers more than for heavy drinkers, thus obliterating a difference between the two groups when responding to the alcohol-related words. One explanation for condition (b) is that because the control group were the staff at the detoxification centre, they had strong current concerns about alcohol and drinking. As regard with the third and fourth condition, as Stewart et al. explained, both positive and negative emotional cues seem to have primed the alcohol concept for both the EM and CM groups. Although CM and EM people drink for different emotional reasons (e.g., Cooper, Agocha, & Sheldon, 2000; Cooper, Frone, Russell, & Mudar, 1995), Stewart et al.'s study suggests that emotional priming does not strongly influence the attentional bias of EM and CM drinkers.

Seven conditions met the criterion for a small ES (i.e., ESs = 0.10 to 0.36). These were in (a) in Stewart et al. (2002), who compared CM and EM student participants, after both groups had had a negative mood induction ($d = 0.10$)—the CM group had a larger interference than the EM group; (b) the same study, which compared CM and EM groups after both groups had been exposed to neutral cues ($d = .30$); (c) Cox et al. (2002), who compared a group of in-treatment alcohol abusers who later did not complete their four-week treatment with those who completed their treatment ($d = .24$)—the group not completing treatment showed larger alcohol interference than the group who completed treatment; (d) Cox et al. (1999), who compared a group of student heavy drinkers ($M = 57.4$ units/week) with a group of light ($M = 4.76$ units/week) student drinkers after both groups had been exposed to control (non-alcohol-related) cues prior to the Stroop test, and the stimuli on the Stroop test were alcohol-related words or names of musical instruments ($d = .30$)\(^1\); (e) Cox et al. (2000), who compared alcohol abusers and

---

1. In this study, there was an additional category of neutral stimuli, which consisted of words that were semantically unrelated to each other (see Table 2.2). The reason for including two categories of neutral words was to test the effect of semantic relatedness of neutral words on reaction times. When the neutral category consisted of semantically related words, reaction times were slower than when they were unrelated, even when the semantically related music-related words were not cued by musical stimuli prior to the Stroop task.
university students, both of whom responded to alcohol and neutral words on the Stroop task \( (d = .32) \); (f) Bauer and Cox (1998), who compared in-treatment alcohol abusers and control participants \( (d = .36) \); and (g) Sharma et al. (2001), who compared heavy and light drinkers \( (d = .26) \) divided according to their scores on the AUDIT.

Apart from Cox et al. (1998) and Cox et al. (2000), in which alcohol abusers were compared to social drinkers and students, respectively, one common element among studies with small effect sizes is that each of the comparisons is made within a homogenous group of participants. That is, student drinkers were compared with other student drinkers, or chronic alcohol abusers recently admitted to treatment were compared with other such chronic abusers. Another common feature is that in none of the conditions was an experimental technique used to accentuate participants' attentional bias for alcohol stimuli (e.g., alcohol cue exposure, experimental mood induction).

Six conditions met the criterion for a medium effect size (i.e., ESs = 0.50-to-0.65, and \( f^2 = .10 \)). These were (a) Stetter et al. (1995), who compared in-patient alcohol abusers and social drinkers \( (d = .52) \); (b) Cox et al. (1999) who compared heavy and light drinkers on alcohol vs. music Stroop words under alcohol cue exposure \( (d = .53) \); (c) Cox et al. (1999), which was similar to the last condition except that it included alcohol vs. neutral Stroop words \( (d = .55) \); (d) Stormark et al. (2000), who compared in-patient alcohol abusers and social drinkers \( (d = .65) \); (e) and Cox et al. (2003), who used a card version of the Stroop test and primed participants with alcohol cues prior to the Stroop task \( (f^2 = .10 \) for a regression model; Cohen, 1992). Among heavy drinkers (unlike light drinkers) exposed to alcohol cues but not to control cues, the amount of alcohol that participants habitually consumed predicted the degree of alcohol attentional bias on the Stroop task.

1. The test of significance reported in the article did not find a difference between alcohol abusers' and nonabusers' interference scores, although the ES analysis found a medium effect size for the difference between the two groups. This difference underscores the importance of effect-size analyses rather than relying solely on significance tests.
# Table 2.4. Effect Sizes for various conditions in the alcohol-Stroop studies.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Study</th>
<th>Experimental group</th>
<th>Control group</th>
<th>Effect size parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>N</td>
<td>SD</td>
</tr>
<tr>
<td>1 Alcohol - Neutral</td>
<td>Stierer et al. (1995)</td>
<td>60.20</td>
<td>40</td>
<td>80.70</td>
</tr>
<tr>
<td>2 H.R. vs. M.L</td>
<td>Stewart et al. (1997)</td>
<td>1.91</td>
<td>7.09</td>
<td>11</td>
</tr>
<tr>
<td>3 H.R. vs. M.J</td>
<td>0.12</td>
<td>4.18</td>
<td>11</td>
<td>6.48</td>
</tr>
<tr>
<td>4 H.R. vs. L.F</td>
<td>1.53</td>
<td>7.09</td>
<td>11</td>
<td>5.87</td>
</tr>
<tr>
<td>5 H.R. vs. L.F</td>
<td>0.62</td>
<td>4.18</td>
<td>11</td>
<td>6.48</td>
</tr>
<tr>
<td>6 M.R. vs. L.I</td>
<td>-0.30</td>
<td>-2.40</td>
<td>10</td>
<td>3.69</td>
</tr>
<tr>
<td>7 M.R. vs. L.I</td>
<td>0.35</td>
<td>3.20</td>
<td>10</td>
<td>9.86</td>
</tr>
<tr>
<td>8 Alcohol - Neutral</td>
<td>Bauer and Cox (1994)</td>
<td>22.33</td>
<td>20</td>
<td>23.13</td>
</tr>
<tr>
<td>9 Positive Emotion words - Neutral</td>
<td>13.88</td>
<td>20</td>
<td>16.90</td>
<td>2.29</td>
</tr>
<tr>
<td>10 Negative Emotion words - Neutral</td>
<td>7.00</td>
<td>20</td>
<td>20.54</td>
<td>3.64</td>
</tr>
<tr>
<td>11 Alcohol - Music</td>
<td>Terran et al. (1999)</td>
<td>-5.77</td>
<td>15</td>
<td>47.13</td>
</tr>
<tr>
<td>12 Alcohol - Neutral</td>
<td>4.10</td>
<td>15</td>
<td>46.50</td>
<td>6.64</td>
</tr>
<tr>
<td>13 Alcohol - Music</td>
<td>7.85</td>
<td>15</td>
<td>59.66</td>
<td>-25.30</td>
</tr>
<tr>
<td>14 Alcohol - Neutral</td>
<td>25.90</td>
<td>15</td>
<td>44.88</td>
<td>-2.55</td>
</tr>
<tr>
<td>15 Alcohol - Neutral</td>
<td>1.49</td>
<td>17</td>
<td>11.23</td>
<td>0.03</td>
</tr>
<tr>
<td>16 Concern words - Neutral</td>
<td>0.58</td>
<td>17</td>
<td>9.44</td>
<td>0.06</td>
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<tr>
<td>17 Alcohol - Neutral</td>
<td>Terran et al. (1999)</td>
<td>72.00</td>
<td>24</td>
<td>162.00</td>
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<tr>
<td>18 Negative emotion words - Neutral</td>
<td>Sharma et al. (2001)</td>
<td>73.00</td>
<td>24</td>
<td>181.00</td>
</tr>
<tr>
<td>19 In-patients vs. Light drinkers</td>
<td>160.58</td>
<td>20</td>
<td>125.54</td>
<td>7.91</td>
</tr>
<tr>
<td>20 In-patients vs. Heavy drinkers</td>
<td>160.58</td>
<td>20</td>
<td>125.45</td>
<td>21.33</td>
</tr>
<tr>
<td>21 Heavy drinkers vs. Light drinkers</td>
<td>21.33</td>
<td>20</td>
<td>43.88</td>
<td>7.91</td>
</tr>
<tr>
<td>22 Alcohol - Neutral</td>
<td>Terran et al. (2002)</td>
<td>19.90</td>
<td>14</td>
<td>56.30</td>
</tr>
<tr>
<td>23 Noncomp. Treat vs. Comp. Treat</td>
<td>35.90</td>
<td>9</td>
<td>82.50</td>
<td>19.90</td>
</tr>
<tr>
<td>24 Noncomp. Treat vs. Control</td>
<td>35.90</td>
<td>9</td>
<td>82.50</td>
<td>36.90</td>
</tr>
<tr>
<td>25 Comp. Treat vs. Control</td>
<td>13.90</td>
<td>14</td>
<td>51.90</td>
<td>33.16</td>
</tr>
<tr>
<td>26 Noncomp. Treat vs. Comp. Treat</td>
<td>97.31</td>
<td>9</td>
<td>105.00</td>
<td>13.90</td>
</tr>
<tr>
<td>27 Noncomp. Treat vs. Control</td>
<td>97.31</td>
<td>9</td>
<td>105.00</td>
<td>33.16</td>
</tr>
<tr>
<td>28 Alcohol Cues</td>
<td>Terran et al. (2002)</td>
<td>41.94</td>
<td>24</td>
<td>64.43</td>
</tr>
<tr>
<td>29 EM group vs. CM group (Alc-Neut)</td>
<td>Johnson et al. (1994)</td>
<td>46.39</td>
<td>24</td>
<td>70.75</td>
</tr>
<tr>
<td>30 EM group vs. CM group (Alc-Neut)</td>
<td>33.53</td>
<td>24</td>
<td>72.13</td>
<td>26.46</td>
</tr>
</tbody>
</table>

Note: Because there were no SDs available for the last six studies in the table, Effect Sizes were not calculated. P-SD = pooled SD, M Diff. = mean difference, EZ = effect size, Alc – Neut = Alcohol-related minus Neutral words interference score, Comp. Treat = completed treatment.

Four conditions met the criterion for large effect size (i.e., ESs = 1.48-to-1.91). These were (a) Stewart et al. (1997), who compared high versus low restrained eaters ($d = 1.91$); (b) the same study, which compared high versus medium restrained eaters ($d = 1.53$); (c) Sharma et al. (2001), who compared in-patient alcohol abusers versus light...
drinkers ($d = 1.56$); and (d) the same study, which tested in-patients and heavy drinkers ($d = 1.48$).

In conclusion, the studies with medium to strong effect sizes were in general those in which the experimental group were alcohol abusers, or were exposed to alcohol-related cues prior to the Stoop test. Therefore, the strong effects could plausibly be attributed to participants' experiencing urges to drink. Otherwise, strong effects seem to have occurred when the experimental group had strong concerns about consuming alcohol, and the control group did not. Another point is related to the Stroop test itself. Two (of four) conditions with large effect sizes (i.e., Stewart et al., 1997) and two studies (of five) with medium effect sizes (i.e., Stetter et al., 1995; Cox et al., 2003) used the card version of the Stroop test. Therefore, it would appear that, apart from computational advantages of the computerised version, it does not necessarily yield larger effect sizes. Studies with small, null, or negative ESs have used both the computerised or card format of the alcohol-Stroop test.

**Notes for Future Studies**

A few methodological issues related to prior studies need to be addressed in future studies using the alcohol-Stroop test.

- In no study has alcohol craving been measured before administering the alcohol-Stroop test to assess the relationship between craving and attentional bias for alcohol related stimuli. This is despite the fact that Franken et al. (2000) found that there is a significant correlation between craving for heroin during the prior week (as measured by the heroin version of the Obsessive Compulsive Drug Use Scale) and attentional bias for heroin-related stimuli on a supraliminal heroin-Stroop test. Cox et al. (2002) did find an increase in attentional bias for alcohol-related stimuli among in-treatment alcohol abusers during a four-week interval. The researchers suggested that the longer the length of abstinence, the more difficult it becomes for alcohol abusers to resist their urges to drink. In addition, Stewart et al. (1997) found that high-restraint participants had more distraction for alcohol than did low and medium restraint participants. These suggest that urges to drink can be an important factor in alcohol-Stroop studies.

- A few issues should be considered in two studies reporting that in-treatment alcohol abusers and control participants had similar distractions for alcohol-related stimuli. Ryan (2002) did not control for the emotional valence of alcohol-
related words. The control participants in this study were staff members in a
detoxification centre, for whom alcohol-related stimuli would appear to have
strong emotional valence, just as they presumably did for the experimental
participants. Nevertheless, for the entire sample, Ryan (2002) found that the
amount of alcohol consumed significantly predicted attentional bias for alcohol
stimuli.

- In reference to Bauer and Cox's (1998) study, one issue needs further
clarification. Although the authors controlled for the emotional valence of the
stimuli, there was no confirmatory evidence regarding the concern relatedness of
the alcohol-stimuli for either the in-treatment or control participants. There was
indirect evidence for the alcohol concern-relatedness (or lack of it) if one makes
the assumption that concern-relatedness is directly related to the amount of
alcohol consumed. The alcohol abusers habitually consumed more alcohol than
the control participants, so that the alcohol stimuli should have had greater
concern-relatedness for the former than the latter. This is similar to Mathews and
Klug's (1993) assumption while testing the effect of emotionality vs. concern-
relatedness. Their participants were a clinical sample of anxious patients, who
were assumed to have current concerns about avoiding feared objects. However,
having a current concern about consuming alcohol could be different from having
current concern about anxiety. One may have strong concerns about avoiding
alcohol rather than about drinking it. In fact, two people may have equally strong
concerns, even though one has a concern about approaching and the other, a
concern about avoiding. It seems reasonable that in-treatment participants would
have changed their concern from one about consuming alcohol to one about
avoiding it. Without an objective measure of concern-relatedness, the issue of the
exact equivalence of stimuli for the two groups will remain ambiguous.
CHAPTER THREE

Executive Cognitive Functioning and Alcohol Use

Information processing models of cognition assume that the brain is a limited processor. It must decide within a limited period of time which cluster of information should be processed and how this task should be done. This function of the brain, which is crucial to having a successful relationship with different aspects of the environment, generally happens in the *working memory system* (Jordan, 1998).

Accordingly, working memory is responsible for temporary storage and manipulation of information in the service of behavioural goals. This network is involved in many higher cognitive functions, such as multiple task co-ordination, set shifting, interference resolution, and memory updating. These functions are thought to be essential for high-level thought processes. The processes are directed by the prefrontal cortex (Fuster, 2000).

Working memory includes two components. First, there are short-term stores (in terms of seconds). These stores consist of verbal and spatial components. Second, there is a network of executive processes. This network operates on the contents of the stores (Shallice, 1982; cited in Bunge, Klingberg, Jacobson, & Gabrieli, 2000). Two of the fundamental executive processes are *selective attention* and *task management*. Research shows that both processes activate the dorsolateral prefrontal cortex (Smith & Jonides, 1999) and the anterior cingulate (e.g., areas 24 and 32; Cabeza & Nyberg, 2000). According to Cabeza and Nyberg, anterior cingulate activation occurs mainly in area 32. The area is usually associated with S-R compatibility (e.g., in Stroop tests), working memory, semantic generation, and episodic memory tasks. Cabeza and Nyberg suggested that there are three main anterior cingulate functions: *initiation, inhibition, and motor*. These are explained later in this chapter.

The anterior cingulate is important when less conscious cognitive processes are not adequate for goal seeking behaviours, especially in dual conflicting tasks. As Albright, Jessell, Kandel, and Posner (2000) stated, an executive attention system is needed in situations in which usual or automatic cognitive processes are not sufficient. These unordinary and non-automatic executive functions include selection among conflicting inputs, resolution of conflict among responses, and monitoring and correcting errors. This system is important when humans confront situations in which they need to control their goal directed behaviours, as in target detection, error detection, conflict resolution, and inhibition of automatic responses.
Considering the findings of other researchers, Jordan (1998) summarised the general roles of the executive functions into three categories of decision-making. (a) decision for selection requires the activation of necessary information on particular occasions and the inhibition of unnecessary stores at the same time during task performance; (b) decision for regulation involves time management, which is a function of the complexity of selected problem-solving strategies (two important points for time management are knowing what to focus on, and how to apply relevant information); and (c) monitoring of cognition and action evaluates the internal and external effects of current mental and physical activities, and which is necessary for the effective regulation of the task and achieving a final goal. Successful monitoring depends on the amount of vigilance and sensitivity to all cues, conditions, and states; this monitoring requires some immediate changes in information processing.

In a broader sense, the ECF can be divided into cognitive-based ECF and emotion-based ECF (Rolls et al., 1994), or affective ECF (Dias et al. 1996). Action selection at the emotional or affective level is based on rewards and punishments (i.e., positive and negative reinforcement) obtained in the past in similar situations. This emotion-related ECF can be assessed using tests (e.g., Visual Discrimination Reversal Test) that measure the ability to modify behavior in response to changing reinforcement conditions (Kodituwakku, Kalberg, & May 2001).

**Cingulated Cortices (CC) and Executive Cognitive Functioning**

Broca located the cingulate gyri in the brain’s limbic system (Smith & Jonides, 1999). Neurological evidence suggests that the cingulate cortex consists of numerous subdivisions responsible for integrating and mediating various cognitive, emotional, motor, motivational, nociceptive, visuospatial functions, and error correction (Bush, Luu, & Posner, 2000), conflict monitoring, and conflict correction (van Veen, Cohen, Botvinick, Stenger, & Carter, 2001).

Some authors (e.g., Bush et al., 2000) have provided evidence for more specific functions of anterior and posterior cingulate cortices. The anterior parts of cingulate cortex (ACC) are suggested to be responsible for executive functions, whereas the posterior regions (PCC) are suggested to be mainly related to evaluative functions.

Dehaene and colleagues (1998, 2000) described the dorsolateral prefrontal cortex and anterior cingulate systems as brain mechanisms responsible for attentional processes: execution of cognitive tasks, error correction, and monitoring the learning of novel tasks.
Allman, Hakeem, Erwin, Nimchinsky, and Hof (2001) argued that the anterior cingulate cortex acts as the interface between emotions and cognitions. They provided evidence, from EEG, PET, fMRI, and brain-lesion studies, illustrating that the anterior cingulate cortex comprises spindle-shaped neurons that are specific to humans and great apes. This region has an important role in emotional self-control, focused problem solving and error recognition, and in the coordination of those parts of the brain that are responsible for the capacity to shift attentional focus and to concentrate on difficult problems. All of these activities are closely related to the emotional functions of this region. Allman et al. (2001) argued that these neurological structures emerge postnatally. The ACC regions, as specialisations of the neocortex, react to environmental influences. Environmental conditions can influence the ACC regions and their functions (by enhancing or reducing them), and therefore may influence an adult's emotional self-control and problem-solving capacity.

Within the ACC, further specialised partitions have been tracked (e.g., Bush et al., 2000; Carter, Robertson, Nordahl, O'Shora-Celaya, & Chaderjian, 2000; Vogt, Finch, & Olson, 1992). Within the ACC the cognitive and emotional information is processed distinctively: a dorsal division (a part of a distributed attentional network) for cognitive processes, and a rostral-ventral region for affective appraisals. These two regions are abbreviated ACcd (anterior cingulate cognitive division) and ACad (anterior cingulate affective division), respectively. Whalen et al. (1998) conducted an fMRI study with cognitive and emotional versions of a counting-Stroop test. These tests activated the two subdivisions of the ACC differentially, providing further evidence for the spatial dissociation between the cognitive and emotive part of the AC. This evidence was based on the content of the task or its behavioural requirements.

Carter et al. (2000) employed fMRI and a version of the Stroop colour-naming task to test the functions of ACC in response to conflict situations. Carter et al. manipulated participants' expectancies in order to create two experimental situations, leading to two levels of conflict (high and low) and two levels of strategy making (high and low). The participants performed the Stroop task during fMRI under conditions of (a) high expectancy for incongruent stimuli (80% incongruent and 20% congruent) and (b) high expectancy for congruent stimuli (80% congruent and 20% incongruent). It was believed that, with increasing expectancy, participants would employ a strategy that would lead to small Stroop effects in the incongruent condition (Condition A) and to large Stroop effects in the congruent condition (Condition B). Carter et al. found response-related increases in the ACC activity when strategic processes were less engaged and
conflict was high (Condition A), but not when strategic processes were engaged and conflict was reduced (Condition B). Their finding was inconsistent with the general belief that the ACC instigates strategic processes to reduce cognitive conflicts (see, e.g., Posner, Peterson, Fox, & Reichle, 1988), such as response competition. These findings support Carter and colleagues' (Carter, Botvinick, & Cohen, 1999) view, and suggest that the ACC serves an *evaluative function* to detect conflicting cognitive states—including response competition—during task performance that might be associated with errors. Thus, as an on-line detector of conflict, the ACC has an evaluative function. This evaluative function provides the person with information about appropriate processes, which are needed to complete a task successfully.

van Veen et al. (2001) investigated the ACC contributions to cognition-based ECF and its role in detecting conflicts that might occur during information processing. They examined two kinds of conflict: conflict at the level of stimulus detection and conflict at the response level. They used fMRI to track the response of the ACC regions during an interference task in which distracting information could be congruent, conflicting at the level of stimulus identification, or conflicting at the response level. Results suggested that the ACC is responsive only to response conflict. Based on these findings, van Veen et al. suggested that the ACC is responsible for the detection of conflicts occurring at later, response-related levels of processing.

As discussed, decision-making involves affective and cognitive factors. The presence of uncertainty, in the form of outcome unpredictability, imposes further requirements on the decision-making process. During decision-making, the error rate and outcome predictability contribute to the process of response selection. Paulus, Hozack, Frank, and Brown (2002) demonstrated that error rate and outcome predictability influence the level of activation in the dorsolateral prefrontal lobes and the anterior cingulate. Their results support the hypothesis that error rate and outcome predictability affect the neural activity of those structures that are responsible for the representation of the reinforcement history. This history provides a pool of available response alternatives to the selection of an optimal strategy.

Paulus et al.'s (2002) findings closely resemble the global workspace theory of decision-making (Dehaene et al., 1988) and further support the contribution of executive cognitive functions (ECF) to the development of the motivational structure. As Hoaken, Giancola, and Pihl, (1998) pointed out, the ECF employs higher-order mental abilities, such as attention, planning, organization, abstract reasoning, and self-monitoring to utilize these functions in self-regulation and goal-directed behaviour. Blume, Marlatt, and
Schmaling (2000) studied the ECF of a group of heavy drinking college students and noticed that poorer ECF is associated with more drinking problems but little tendency to control their drinking habits among heavy drinkers. In spite of experiencing a variety of negative consequences related to their drinking behaviour, the college students were not trying to change their drinking patterns. Based on this finding, Hoaken et al. suggested that the ECF is important in motivating change and the self-regulation of problem drinking; therefore, poorer ECF may interfere with recognizing consequences and responding skilfully to avoid future harm.

Morgenstern and Bates (1999) used variations of ECF tests with 118 patients in a 12-step treatment programme, to examine the relationship between ECF impairments, participants' difficulties in achieving the goals of the 12-step treatment programme, and the amount of drug use during a six month follow-up. Half of their sample showed some form of ECF impairment. ECF impairments did not predict participants' progress in the 12-step programme or the amount of drug use during the follow-up period. However, ECF impairment was a significant moderator between judged progress in treatment and outcome. The treatment progress strongly predicted the amount of drug use for unimpaired patients, but not for impaired patients.

In addition, there is evidence from alcohol studies that deficits in self-control are responsible for sustaining excessive alcohol consumption (Lyvers, 2000a; Skutle & Berg, 1987). Cognitive studies have demonstrated that self-control is related to executive cognitive functioning (Espy, Kaufman, McDiarmid, & Glisky, 1999). It has been suggested that, among cognitive functions such as memory, spatial skills, and language ability, the ECF has the greatest contribution to sustaining self-control, planning, awareness of problems, organization, and the ability to manage instrumental activities of daily living (Cahn-Weiner, Malloy, Boyle, Marran, & Salloway, 2000).

To summarise:

Executive cognitive functions are mainly located in the ACC and are intertwined with cognitive, emotional, attentional, and motivational regulation. Recent findings point to evaluative functions of the ACC in conflict detection at the response level, and this is related to error monitoring and outcome predictability during decision-making. This is the neurological version of goal lurking, manifested as conflict monitoring. The ACC activity seems to influence an individual's motivational structure because of its role in strategy finding and behavioural decision-making.
**Alcohol and Executive Cognitive Functions**

There is increasing interest in the neurocognitive risks associated with alcohol use. The evidence suggests that alcohol abusers and those who are at the risk of developing problem drinking suffer from deficiencies in their ECF. Deckel and Hesselbrock (1996) conducted a longitudinal study to investigate the ability of neuropsychological and behavioural tests of the ECF (e.g., Trails, Categories Test, and Similarities) to predict changes in alcohol-related problems (using the Michigan Alcoholism Screening Test) three years after the initial evaluation. They found that, for participants with a positive family history of alcohol abuse, only tests of executive functioning significantly predicted alcohol consumption. Evidence supports the possibility that brain damage, whether resulting from or predating alcohol abuse, may contribute to the development and progression of the disorder (Bowden, Crews, Bates, Fals-Stewart, & Ambrose, 2001).

Many studies investigating recently detoxified alcohol abusers' ECF performance have used tasks that are sensitive to frontal lobe damage (Dao-Castellana, 1998; for a review see Moselhy, Georgiou, & Kahn, 2001). The results of these studies support the hypothesis that the frontal lobes are highly vulnerable to chronic alcohol consumption.

However, Noel et al. (2001) suspected that most of the executive tasks used in these studies also involved non-executive components, and these tasks had been shown to be impaired because of non-frontal lobe lesions. Therefore, Noel et al. used a series of executive tasks demonstrated to be associated with frontal lobe functioning, so that they could distinguish the relative importance of executive and non-executive processes. They tested 30 recently detoxified male alcoholic inpatients and 30 control participants for planning, inhibition, rule detection, coordination on dual tasks, speed of processing, and non-executive functions (such as short-term memory storage). Results demonstrated that detoxified alcohol abusers performed worse on almost all of the ECF tasks than did controls. However, abusers' performance on non-executive tasks was not poorer than that of controls. Therefore, Noel et al.'s study corroborated prior findings on the relationship between chronic alcohol consumption and ECF deficits. Their findings also demonstrated that such a relationship can persist even after a period of alcohol abstinence.

Accordingly, Beatty, Tivis, Stott, Nixon, and Parsons (2000) examined the relationships between severity of neuropsychological deficits and quantity and duration of alcohol consumption. Chronicity varied from 4 to 9 years for one group of alcohol abusers and from 10 to 33 years for another group. The neurological performance of the alcohol abusers was compared to a control group of normal drinkers ($N = 165$). Compared
to the controls, the alcohol abusers were impaired on the Shipley Vocabulary and Abstraction tests and on two versions of the Digit Symbol test, but there was no difference between the two alcohol groups on any measure. Regression analyses that controlled for age and education showed that recent alcohol consumption was a better predictor of neuropsychological deficits than was chronicity of alcohol consumption. The data provided weak support for a dose-effect relationship between degree of neuropsychological impairment and level of drinking during the past six months but no evidence for an influence of chronicity.

Alcohol depresses prefrontal cortex activity. There is evidence that acute alcohol consumption disrupts executive cognitive performance in humans (Hoaken et al., 1998; Lyvers, 2000a). Alcohol affects the brain, including the cingulate area, in different ways. Mantere et al. (2002) investigated serotonin density in the cerebral cortex of alcohol abusers and non-abusers. They found that serotonin density in the perigenual anterior cingulate cortex of alcohol abusers is significantly lower than that of non-abusers. They suggested that the perigenual anterior cingulate cortex is one of the main areas of the brain that controls affect.

To summarise:

Findings suggest that alcohol consumption is associated with ECF problems. However, the causal relationship between ECF deficits and alcohol abuse awaits further investigation.

**Short-Term Effects of Alcohol on Reaction Time**

Previous findings assumed that cognitive impairment emerges with prolonged (or relatively long), heavy consumption of alcohol. However, recent research has found neurocognitive difficulties among young people with a short history of heavy drinking (Brown, Tapert, Granholm, & Delis, 2000). Tapert and Brown (1999) reported that chronic abuse of alcohol by adolescents is associated with increasing attention deficits. Other evidence (e.g., Blume, Marlatt, & Schmaling, 2000) illustrated similar problems in the ECF among heavy drinking college students. Giancola and Moss (1998) argued that the ECF is an important determinant in the aetiology of alcohol abuse.

Maylor and Rabbitt (1993) conducted a meta-analysis of studies investigating the effects of alcohol on reaction time and information processing. They found that alcohol impairs information processing and increases the length of task performance. Information processing includes stimulus detection, stimulus recognition, response selection, and response execution. Stimulus detection and response execution represent peripheral
processes. Stimulus recognition and response selection represent central processes. Alcohol influences both peripheral and central processes. Maylor and Rabbitt's (1993) meta-analysis documented that task duration and task content have different influences on increased RT after consuming alcohol. RT slows down because of two factors: stimulus-response (R-S) uncertainty and consuming alcohol. Although consuming alcohol can influence task performance independently of task content, there can also be an interaction between the two factors being influenced.

The progressive impairment in performance is directly related to level of alcohol consumption and task complexity. Two dimensions of complexity of a task are response alternatives (i.e., the number of response options) and response compatibility. Huntley (1972; cited in Maylor & Rabbitt, 1993) demonstrated that the impairing effects of alcohol specifically influenced the response selection stage. However, Maylor and Rabbitt (1993) believed that the most appropriate explanation of the cognitive effects of alcohol addresses general rather than specific processes. This explanation is based on the reduced-processing hypothesis. According to this hypothesis, impairing effects of alcohol on cognitive tasks exacerbate limitations on a few general processing resources. Therefore, the interaction between the impairing effects of alcohol and general processing limitations is a function of task complexity; this leads to the alcohol-complexity effect. This formulation applies to any cognitive task that imposes processing demands (such as speed and accuracy) on limited cognitive resources.

Vogel-Sprott, Easdon, Fillmore, Finn, and Justus (2001) reported that even small doses of alcohol can impair the ECF and the inhibitory processes that are responsible for self-control. This is one reason why initial doses of alcohol can progressively lead to uncontrolled repeated drinking and binge drinking. Such effects might be intensified among those drinkers who already suffer from ECF impairments. However, this conclusion has yet to be corroborated.

*Tests of Executive Cognitive Functioning*

There are many tests of ECF. A few examples are WISC-R Similarities, the California Verbal Learning Test-Children's Version (CVLT), tests of phonemic and category fluency (e.g., White, Nortz, Mandernach, Huntington, & Steiner, 2001) the Semantic Cluster Ratio, the Booklet Category Test (DeFillippis & McCampbell, 1979; cited in Morooney, 1995), and the Controlled Oral Word Association Test (COWAT) (Tapert, Brown, & Sandra, 2000). Other examples include the Conditional Associative Learning Test (CAT), the Sequential Matching Memory Test (SMMT) (Giancola,

Each particular ECF test is designed to evaluate one or more specific aspects of ECF. Weingartner (2000) argued that the concept of ECF encompasses a broad range of mental operations. Although these operations are distinct from one another, they may also be intertwined in various ways. Therefore, researchers should take into consideration current neurocognitive findings about various ECF functions. When selecting a particular test, one should pay attention to the assumptions that determine the relevance of the test to the hypothetical construct of interest. Kodituwakku et al. (2001) provided a brief review of the most popular ECF tests. The present thesis, however, focuses on the assessment of ECF which is based on inhibitory processes.

The Classic Stroop Test and the Assessment of ECF

Two points are relevant when selecting an executive test in a study related to alcohol.

First, there is the role of cognitive flexibility and inhibition in the management of cognitive resources in double-component tasks. As discussed, an important aspect of the ECF is the person's inhibitory capabilities to respond selectively to the requirements of S-R compatibility tasks, such as the Stroop test. Among other tests of ECF (for assessing cognitive controllability and flexibility), the Wisconsin Card Sorting Test (WCST) is one that is most commonly used (see Giancola, Zeichner, Yarnell, & Dickson, 1996; Mahurin, Velligan, Miller, 1998; Tapert, Brown, & Sandra, 2000).

Second, alcohol problems are defined in terms of the inability to control (see Chapter 1). Earlier studies using the emotional Stroop paradigm examined preconscious or unconscious processes related to control (see Chapter 2). In this regard, tests of ECF for demonstrating the possible influences of controllability on addictive behaviours should address underlying neuropsychological structures similar to emotional Stroop tests. In this sense, the similarity between classic-Stroop test and alcohol-Stroop test is that performance on both tests requires inhibitory processes and cognitive flexibility.

Many studies have used the classic Stroop Colour-Word Test as a test of ECF. There are at least 58 studies of this sort. In these studies (e.g., Ardouin, Pillon, Peifferet et al., 1999; Carter et al., 2000; de Jong, Berendsen, & Cools, 1999; Mahurin et al., 1998; Pardo, Pardo, Janer, & Raichel, 1990), generally the interference score is considered to be
an index of participants' ECF. It is reasoned that with increasing task difficulty, more executive capabilities are needed to respond to the printed colours and ignore the meaning of the words.

Rossi et al. (1997) administered the WCST and the classic Stroop test to evaluate the specific processing mechanisms involved in the ECF of schizophrenic patients. Their data suggested that inasmuch as the two tests employed measured executive functions related to mental control and cognitive flexibility, the findings seemed to indicate shared or interconnected mechanisms. The authors concluded that use of the Stroop task can provide a ready cognitive analysis of specific processing mechanisms.

There is sufficient psycho-neurological evidence to use the classic Stroop test as a measure of executive functioning. As described, the frontal lobe and cingulate regions play an important role in executive functions (see Banich, Milham, Micheal et al., 2000). These regions are the anterior, central, and posterior ones. The anterior cingulate region is especially relevant to the present discussion. In fMRI studies, the activation of this area has been consistently seen in S-R compatibility tasks (such as the Stroop test), working memory, semantic generation, and episodic memory tests (Cabeza & Nyberg, 2000).

Gustafson and Kallmen (1990a) conducted a study on the prolonged effects of alcohol consumption on participants' cognitive performance. However, they did not find any significant difference between the experimental group that had sipped alcohol and control group on the first block of the Stroop test. However, when the length of the test was increased, and had longer trial blocks, the experimental group needed more time to complete the test, and they made more errors than the control group on the first block of trials. They concluded that the length of the test is an important variable. They suggested that the length of a complex cognitive task should be from 2 to 10 minutes.

As mentioned, after a comprehensive review of 275 studies, Cabeza and Nyberg (2000) summarised previous findings into three main views of the functions of the anterior cingulate: initiation, inhibition, and motor.

According to the initiation view, the anterior cingulate is responsible for attention to action. This is an attentional process required to initiate behaviour. Damage to this area is responsible for partial or complete lack of spontaneous motor or verbal behaviour. This view is consistent with the role that this area has in the performance of demanding tasks, such as the Stroop test and those tests in which working memory and episodic retrieval are involved.

According to the inhibitory view, the anterior cingulate region is involved in restraining inappropriate or unwanted responses. The inhibition and initiation views are
complements of each other. In this regard, the anterior cingulate region can involve both the inhibition of inappropriate responses and the initiation of appropriate ones (Paus, Petrides, Evans & Meyer, 1993; cited in Cabeza & Nyberg, 2000). Performance on incongruent trials on the Stroop test is dependent on both processes.

According to the motor view, the anterior cingulate is a passive receiver of cognitive or motor commands from various regions of the brain. Therefore, its duty is to funnel these commands to the related motor system (Paus et al. 1993, cited in Cabeza & Nyberg, 2000). The appropriate motor region of the anterior cingulate area depends on the nature of the task: ocular, manual, or verbal (Cabeza & Nyberg, 2000). In a Stroop task, especially when manual and verbal materials are involved, the motor regions of the anterior cingulate modulate task performance.

To summarise:

There is good evidence that the classic Stroop test is a valid and suitable measure of executive cognitive functions. This is especially true when the researcher is concerned about measuring task management, cognitive flexibility, stimulus inhibition, and response selection.

Neurocognitive Variations of the Stroop Task: Different Administrations and Scoring Methods

Stroop (1935) employed neutral and incongruent stimuli to study interference, or the inability to inhibit incorrect responses. The Stroop paradigm is frequently employed in neuropsychological studies (Henik, 1996), but within this broad field, researchers have used the Stroop paradigm for a variety of purposes. First, it has been used as a measure of cognitive functioning and cognitive impairment (e.g., Carter, Robertson, Nordahl, O'Shora-Celaya, & Chaderjian, 1993; Osimani, Alon, Berger, & Abarbanel, 1997). Second, it has been employed as a measure of memory impairment (e.g., Hooker & Jones, 1987). Third, it has been employed to assess negative priming and inhibitory processes (e.g., Laplante, Everett et al., 1992; Salo, Robertson, & Nordahl, 1996; Salo, Robertson, Nordahl, & Kraft, 1997; Sudevan & Taylor, 1987; West & Alain, 2000). Fourth, it has been widely used for the assessment of executive cognitive functioning (e.g., Buchanan, Holstein, & Breier, 1994; Connor, Sampson, Bookstein, Barr, & Streissguth, 2000; Cuesta, Peralta,& Zarzuela, 2001; Franke et al., 1999; Goodwin et al., 1997; Johnson-Selfridge & Zalewski, 2000; Lund-Johansen, Hugdahl, & Wester, 1996; McGrath, Scheldt, Welham, & Clair, 1997; Pineda, Merchán, Rosselli, & Ardila, 2000; Wecker, Kramer, Wisniewski, Delis, & Kaplan, 2000).
As a measure of executive functioning, the Stroop test mainly assesses respondents' ability to control inhibitory processes. Anderson (1998) provided a review of the ECF tests. He divided these tests into four domains: planning and organisation, problem solving, abstraction or concept formation, and mental flexibility. In Anderson's classification, tests of inhibition assess mental flexibility, or the ability to modulate performance with changes in rules. He introduced tests of mental flexibility, including the Wisconsin Card Sorting Test, the Trial-Making Test, and the Stroop test.

As mentioned, Stroop (1935) used colour words in black or coloured patches as neutral stimuli. Using a set of neutral stimuli enables researchers to calculate an interference score. It is arrived at by subtracting the mean reaction time on the neutral category from the mean reaction time on the incongruent category. The size of the interference is thought to be a function of the individual's ability to inhibit the irrelevant aspect of the task (i.e., the meaning of words) and selectively attend to the relevant aspect (i.e., the colour). However, there are not many consistencies among the various formats and scoring systems derived from the original Stroop task. In fact, researchers sometimes use a format of the Stroop test that does not comply with the original Stroop methodology or theory (Henik, 1996). The following section describes a few major variations of the neurocognitive versions of the Stroop paradigm.

**RTs on the incongruent card.** Golden (1978) adapted the Stroop test to measure cognitive flexibility and response inhibition. The test comprises three cards, each containing five columns of 20 items. On the first card, the words blue, green, and red are presented in black ink. The second card comprises Xs printed in blue, green, or red. The third card comprises the same colour words as the first card, but in incongruent colours (e.g., the word blue printed in red ink). The participants' task is to read as fast and accurately as possible the words on the first card, the Xs on the second card, and the ink colour of the colour words on the third card. For each card, the total number of correct responses within 60 seconds is recorded. However, in Golden's format, the scores from the third card are usually considered to reflect the participant's ability to sort information and respond selectively to it. In a similar scoring system, Gustafson and Kallmen (1990a, 1990b), in studies on the effects of alcohol on cognitive performance, used the scores on the incongruent colour-word card as a measure of participants' cognitive functioning. This format does not provide interference scores, which means that any differences among participants may reflect their general response speed rather than interference or inhibitory differences.
The Stroop effect and Stroop interference scores. Kieley and Hartley (1997) drew a distinction between the Stroop effect and Stroop interference. They defined the Stroop effect as the difference between incongruent and congruent scores, and Stroop interference as the difference between incongruent and X scores. In their view, the most common way to score the Stroop task is to take the difference between RTs on the incongruent condition and RTs on the baseline condition (e.g., monochrome colour words, congruent colour words, or coloured Xs). Nevertheless, in many studies these differences are referred to interchangeably. Others have used the term Stroop interference effect to refer to the Stroop effect (e.g., Chen, 1997; Pardo, Pardo, Janer, & Raichle, 1990; Verhaeghen & De Meersman, 1998; West & Bell, 1997). It seems that these labels are not exact descriptors of the methodological procedures in practice; one needs to explore the details of the Stroop task in each study.

Negative priming or identity suppression. In the single-presentation method, researchers can assess the reaction time to each stimulus. This provides an opportunity to measure the effect of a preceding stimulus on the next one. When a previous stimulus increases reaction time to the next one, negative priming has occurred. Inhibition is a hypothetical construct underlying negative priming. To calculate negative priming scores on a Stroop test, trials for the incongruent colour words are separated into two parts. These are (a) trials on which the ink colour on the current trial is the same as the name of the colour word on the immediately preceding trial, versus (b) those trials in which the two are different. Negative priming, or the identity-suppression effect (e.g., Kieley & Hartley, 1997), is the difference between RTs for matched and unmatched trails. The difference score is used as a measure of impaired inhibition (see, e.g., Kieley & Hartley, 1997; Laplante, Everett et al., 1992).

Multiplicative scores and the impulsivity index. Chen’s (1997) study modelled the relationship between response times to incongruent and neutral stimuli in order to investigate the mechanisms underlying the Stroop interference effect. He made a distinction between the stage view (as explained by the traditional perspective of Stroop interference scores) and his own view, which is based on the interactive view of Cohen, Dunbar, and McClelland (1990).

Chen believed that, according to the interactive view, the Stroop effect should accumulate throughout the process of colour naming. Therefore, he suggested that the ratio of the time to name colour stimuli to the time to name neutral stimuli would better reflect the consequence of the processing than would a simple interference score. He
designed six versions of the Stroop test. They were based on different stimulus attributes: colour, location, direction, numerosity, shape, and picture. In order to arrive at a more general measure of incongruent and control response times, he did the following:

First, he averaged response times of the incongruent tasks and those from the control conditions for each of the six versions. Second, he ran a regression analysis on these general measures; mean RTs from each of the incongruent conditions were regressed on the mean neutral RTs. He found a linear function with a small and non-significant intercept and a slope significantly greater than one. Based on these findings, he suggested that the mechanism underlying Stroop interference is interactive or multiplicative rather than stage-like or additive, and that a ratio of incongruent to control response times is a more appropriate measure than is a simple interference score. This is the ratio of the difference between incongruent and control RTs to the sum of these RTs (Chen, 1997).

The composite measure of inhibitory function is referred to as the Impulsivity Index. It is calculated as follows:

A potential problem with this index is that it is susceptible to inflation by those cases in which a participant achieves low RTs on the control but average RTs on the incongruent stimuli. Of course, designating scores as inflated requires an independent definition of what constitutes a low or average RT. Norms of typical RTs are not available for particular clinical or non-clinical groups (Wright, 2000).

Kindt, Biermann, and Brosschot (1997) modified Chen's formula to examine individual differences in children's performances on a modified Stroop task. They added the mean RTs on spider version of the emotional Stroop (mean RT spider + mean RT control) to the denominator of the impulsivity index ratio to normalise their data. This was done in order to minimise the influence of extreme reaction times one one word set—among four sets of colour words, non-words, spider, and control words.

**Dodrill's format.** Lezack (1995) discussed different formats of the Stroop test as a measure of concentration effectiveness. Making a comparison between different formats, she recommended Dodrill's format for two reasons: it has only two kinds of trials (hence, it is simple) and is the longest format in current use. A long format is believed to be a more sensitive measure of neurological damages than is a short version.
It contains 176 colour words (red, orange, green, and blue) on a single sheet. Each colour word was randomly printed in one of the colours. This test includes two parts. Part 1 involves reading the colour words that are printed in different ink colours, and Part 2 involves naming the ink colour of the colour words. The examiner's record sheet shows the correct word names for Part 1 and the correct order of the ink colours for Part 2. Performance is evaluated according to the total time on Part 2 minus the total time on Part 1. The examiner records the time when the participant is halfway through each part and makes a slash mark at the end of each minute during the reading and naming tasks. These scores give a more precise index of the possible effects of task familiarity and practice, which reflect difficulty in maintaining a response set, or attention during performance (Lezack, 1995).

Dodrill (C. B. Dodrill, personal communication, July 10, 2001) believes that his Stroop format is suitable for the assessment of any deficits in sustained attention and inhibitory processes. In addition, he suggested that there are a number of advantages of a paper format of his test over computerised formats. For example, the left-to-right reading requirement is more convenient for respondents, and the physical dimensions of the colours are more stable and reliable in paper than computer format. He believes that many variables are uncontrollable with computer presentation that would contaminate the data. Therefore, he urged use of his original paper format.

There are a few problems with Dodrill's format. First, its baseline task requires reading the incompatible colour names and, as mentioned, this slows the reading speed. There is no evidence on how the baseline task might differentially affect the reading speed of clinical and non-clinical participants. On the other hand, although impaired reading on Part 1 would provide a valuable neurological index (if there were a proper baseline, such as speed of reading congruent colour words), considering this index as a baseline for calculating inhibitory functioning leads to artificially low interference scores. Sacks, Clark, Pols, and Geffen (1991) administered six parallel formats of the Dodrill-Stroop test and noticed that the interference score was reduced significantly between Sessions One and Two of the test, but became stable in subsequent sessions. This primary instability, which disappears with practice, may render this format unreliable for single-session and pre-/post-test experiments. Second, because of the test's card format, it is not possible to have single response times for each stimulus. Therefore, one is not able to calculate negative priming, or identity suppression, effects from this format.

To summarise:
The classic Stroop task and its variations have been used in many studies. These studies vary in their research orientations. Nevertheless, there is a common component among experiments that employ the Stroop paradigm: the study of interference or inhibition.

**ECF and Performance on the Alcohol-Stroop**

Tzambazis and Stough (2000) found that alcohol consumption impairs information processing at both early and later stages of information processing. Their findings were based on the assessment of inspection time, simple reaction time, choice reaction time and cognitive ability (WAIS) in 16 adult participants in both alcohol and placebo conditions.

As discussed, the classic-Stroop test has been widely used as a measure of ECF. However, the effects of heavy drinking on alcohol-abusers’ performance on the alcohol Stroop test is not clear. This is an important issue because a “Stroop task requires an extensive and distributed network of processing centres” (Pardo et al., 1990, p. 259). As also discussed earlier, both the classic and the emotional Stroop tests assess participants’ performance on a similar phenomenon: performing a novel task while trying to minimise interference. The interference can arise from different sources. As discussed, on the classic Stroop test interference arises mainly from the conflict between semantic aspects of the stimuli and colour-naming, but on the emotional Stroop it emanates mainly from the inability to block out from attention the emotional or concern-related intrusion of the stimuli while concentrating on the colour-naming task. There is no evidence that interference in emotional Stroop tests is independent of participants’ general ECF ability.

As far as the alcohol Stroop is concerned, one study (Bauer & Cox, 1998) suggested that alcohol abusers' inhibitory deficiencies were responsible for their lack of differential responding to alcohol and neutral stimuli in this study. Cox et al. (2003) also did not find a significant difference between heavy and light drinkers on alcohol interference, when both the experimental and control groups were exposed to non-alcoholic cues prior to the Stroop trials. In addition, Stetter et al. (1994) failed to find any significant difference between the attentional bias of in-treatment alcohol abusers and non-clinical controls, but the clinical group was found to be neuro-psychologically impaired on the classic Stroop test. However, these researchers did not report whether their participants’ scores on the standard Stroop could predict their performance on the alcohol Stroop. Stetter et al. (1995) did consider this issue. This time, they found a significant difference between the attentional bias of alcohol abusers in a detoxification
centre and healthy controls, but compared to the control group the clinical group was not psycho-neurologically impaired on the classic Stroop test. This finding is inconsistent with the frequent findings in the field, suggesting alcohol abusers' poorer neuropsychological performance than controls (e.g. Beatty et al., 2000; Bowden et al., 2001; Dao-Castellana, 1998; Hoaken et al., 1998; Lyvers, 2000a; Mantere et al., 2002; Noel et al., 2001). Stetter et al.'s (1995) concluded that information processing on the alcohol-Stroop test is "independent from putative neuropsychological deficits of alcoholic patients" (p., 593). This generalisation seems unwarranted mainly because in an earlier study (Stetter et al., 1994), the authors reported a significant difference between the study samples' neuropsychological performance, with alcohol abusers performing poorer on the classic Stroop test than did controls. Scores from the classic Stroop alone constitute an independent index of participants' neuropsychological status (e.g., Golden, 1978; Stormark et al., 2000). Thus, it seems that Stetter et al.'s (1994) findings support the effects of participants' neurological status on their performance on the alcohol-Stroop test.

To summarise:

The classic and the emotional Stroop tests require the participant to employ his or her attentional resources. The tests require strong concentration to avoid interference. The ECF is generally believed to reflect the ability to employ attentional resources to manage novel tasks, which require volitional control, concentration, and monitoring. However, the relationship between general ECF and performance in the emotional Stroop awaits investigation.

The Research Hypotheses

Chapter 1 discussed several studies that demonstrated the role of motivational patterns in problem drinkers. Chapter 2 discussed the emotional Stroop paradigm and alcohol abusers' attentional distraction for alcohol stimuli. This chapter demonstrated the importance of ECF in attention management and alcohol abuse. However, no single study has encompassed all of these variables, and no study has focused on practical applications of its findings.

As documented, the concept of current concerns is pivotal in the motivational model of alcohol use. It is also central to the concept of attentional bias, and the role of executive cognitive functions (located at the cingulated cortices) is central to motivational structure and attentional bias. On the other hand, the evidence reviewed in this chapter
Chapter 3

illustrates that impairments in executive cognitive functioning are associated with risky patterns of alcohol consumption.

It is reasonable to hypothesise that ECF impairments can lead to differences among high-risk and problem drinkers with social drinkers. The differences could be attributed to drinkers' motivational structure and their attentional bias for alcohol-related stimuli. Thus far, there has been no investigation of the plausible associations between (a) ECF impairments and participants' performance on the emotional Stroop task, and (b) ECF impairments and motivational-structure patterns as described in Cox and Klinger's (1988) theory. In addition to addressing these issues, the present work examines the relationship between motivational structure and alcohol consumption in order to achieve a parsimonious model for predicting alcohol consumption. It also seeks the development of an alcohol-specific attention diversion programme to correct alcohol abusers' attentional bias for alcohol-related stimuli. In an attempt to answer these questions, the remainder of this thesis is organised as follows:

- Chapter 4 describes methodological issues concerning the student sample tested, such as effect sizes, power analyses, participant characteristics, instruments, and procedure. It also deals with considerations for scoring the Stroop tasks.
- Chapter 5 explores a parsimonious model for predicting alcohol consumption based on the data from the student sample. It mainly seeks to corroborate the power of motivational structure and attentional bias in predicting alcohol consumption among a non-dependent sample.
- Chapter 6 examines the relationships between students' ECF, their motivational structure, and their performance on the alcohol-Stroop test.
- Chapter 7 explores the motivational structure of a sample of alcohol abusers and compares it with the motivational structure of a sample of non-dependent drinkers. It also addresses the ECF questions of the thesis through a clinical sample. The chapter examines three issues. First, it examines the relationship between the drinking indices (amount of drinking and drinking chronicity) and the ECF impairment. Second, it investigates the relationship between patients' ECF impairment and their motivational patterns. Third, it explores the effects of ECF in this clinical sample on their performance on an alcohol-Stroop test.
- Chapter 8 discusses the reasons for constructing and employing an attention diversion programme aimed at alcohol-specific ECF rehabilitation, in order to enhance drinkers' ability to shift their attention away from alcohol-related stimuli.
This programme aims to improve recent abstainers' ECF skills in order to help them control their distraction for alcohol-related stimuli. This chapter deals with methodological considerations related to the training programme and covers issues related to the participants, instruments, and procedure. It also describes the results of the training programme with recent alcohol abstainers in a detoxification centre. Last, it discusses how the training programme addresses the original question of the role of ECF in addictive behaviours and its therapeutic outcomes.

- Chapter 9 integrates the findings of the previous chapters and explains them in the light of other theoretical and research findings. This chapter also suggests preventive and therapeutic applications of the research findings.
CHAPTER FOUR

Methodology

This chapter covers common methodological considerations and procedures that were employed in Experiments 1-3 (Chapters 5-7). Experiments 1-2 encompass a group of student participants, and Experiment 3 encompasses a group of in-treatment alcohol abusers. First, the chapter explains instruments used in the study. These include the Personal Concern Inventory (PCI), Perceived Stress Scale (PSS), Shipley Institute of Living Scale (SILS), Alcohol Use Questionnaire, Short version of the Michigan Alcohol Screening Test (SMAST), classic and alcohol-Stroop tests, and post-Stroop memory and emotional valence tasks. Second, it covers the apparatus used in this study, including the computerised versions of the classic and alcohol-Stroop tests and their scoring system. Third, it covers the procedure for administering the tests and conducting the research.

Instruments

Personal Concern Inventory (PCI)

The Personal Concern Inventory (PCI; Cox & Klinger, 2002, 2003) is an amended research version of the Motivational Structure Questionnaire (MSQ; Klinger & Cox, 1986, 1996; Klinger, Cox, & Blount, 1995; see Chapter 1). An abridged research version of the PCI was developed for the purposes of this research (Appendix 6). In the research version of the PCI, participants are not asked to describe the content of their concerns; rather they decide whether they have a current concern in each of the eight areas of life listed in the questionnaire: Home and Household Matters, Relationships, Love, Intimacy and Sexual Matters, Self-changes, Finance and Employment, Leisure and Recreation, Health, and Education. These were selected because they seem to represent the most common areas of life. After they had decided whether they had a current concern in a particular life area, participants were asked to rate their goals striving related to that concern on 10 dimensions. These include (a) Appetitive Action (to “get”, “obtain”, or “accomplish” a goal); (b) Aversive Action (to “get rid of” or “avoid” a goal); (c) Chances of Success (in achieving the goal); (d) Amount of Perceived Control (over achieving the goal); (e) Knowledge (about ways of achieving the goal); (f) Hope (about achieving the goal if the participant were to do his or her best); (g) Joy (from achieving the goal); (h) Commitment (to the goal pursuit); (i) Goal Distance (from goal achievement); and (j) Sorrow (if the goal could not be achieved). Answers from each
participant on the PCI are individually scored, and the resulting indices can be used to
draw each participant's motivational profile.

The evidence indicates that the MSQ is a valid and reliable test (for a review see
Cox & Klinger, 2002; Klinger & Cox, 2003). There are a few studies supporting the
validity of the test. First, laboratory research has identified relationships between
participants' current concerns on the MSQ and their skin-conductance responses (Nikula,
Klinger, & Larson-Gutman, 1993), the content of their dreams (Nikles, Brecht, Klinger,
& Bursell, 1998), and the pattern of their daily activities (Klinger, 1987b). Research has
also found that motivational structure has measured by the MSQ can predict treatment
outcome for substance abusers (Cox & Klinger, 2002; Klinger & Cox, 1986).

To calculate the inter- and intra-scales consistencies as measures of the reliability
of the abridged research version of the PCI developed for this study, Cronbach's Alpha
(α) was used (Cox & Klinger, 2004). Cronbach's Alpha is an index of internal
consistency and is one of the most commonly used indices of a test's reliability. In the
social sciences and psychology, the widely accepted cut-off point for acceptable
reliability is .70. To calculate the inter-scales reliability (Cox & Klinger, 2004) intra-
individual means for each of the rating scales were first calculated. Cronbach's Alpha
was then computed for each of the 10 PCI scales for both the student sample and the
alcohol abuser sample. Cronbach's Alpha measured the extent to which the PCI scales
were correlated with each other and with the mean of the PCI score. Two alphas were
calculated, one for the whole inventory and the other for each of the individual scales.
The item-specific alpha indicates what the overall alpha for the whole scale would be if
that particular scale was removed (Bryman & Cramer 1995). Because the polarity of the
Goal Distance and Aversive Motivation indices is opposite to that of the other PCI
indices, their reversed values were included in the reliability analysis. An unstandardised
α = .77 resulted for the student sample, and an unstandardised α = .75 resulted for the
alcohol abuser sample. (Standardised alpha is always larger than the unstandardised one.)
There was no item in the scale the removal of which increased the reliability of the scale.
To calculate the intra scales reliability Cronbach's Alphas were calculated for each scale
at a time (e.g., amount of control, goal distance) with the rating of each concern taken as
an item score. Table 4.1 shows Intra-scales Cronbach's Alphas for the student sample
and for the alcohol abuser sample.
Table 4.1. Intra-scale Cronbach’s Alphas for the PCI.

<table>
<thead>
<tr>
<th>The PCI scales</th>
<th>Cronbach’s Alpha (α)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Students</td>
<td>Alcohol abusers</td>
<td></td>
</tr>
<tr>
<td>Likelihood of achieving goals</td>
<td>.63</td>
<td>.60</td>
<td></td>
</tr>
<tr>
<td>Control over achieving goals</td>
<td>.46</td>
<td>.40</td>
<td></td>
</tr>
<tr>
<td>Knowledge about how to achieve goals</td>
<td>.56</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>Hope about achieving goals</td>
<td>.45</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>Happiness from achieving goals</td>
<td>.55</td>
<td>.35</td>
<td></td>
</tr>
<tr>
<td>Commitment to achieving goals</td>
<td>.53</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>Distance from goal achievements</td>
<td>.61</td>
<td>.73</td>
<td></td>
</tr>
<tr>
<td>Sadness from failure at goal achievements</td>
<td>.75</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>Appetitive verbs</td>
<td>.46 *</td>
<td>.37 **</td>
<td></td>
</tr>
<tr>
<td>Aversive verbs</td>
<td>.64 **</td>
<td>-- **</td>
<td></td>
</tr>
</tbody>
</table>

Note. Analyses including 78 students and 28 alcohol abusers who rated their expectancies about achieving their goals on more than five areas of life on the PCI, * N = 67, fields = 4, ** N = 19, fields = 3, "N = 36, fields = 4, " did not contain sufficient cases for the analysis.

As Table 4.1 shows, many PCI items do not meet the .70 criterion for good reliability and also there is a considerable variation among the size of the Alphas from one scale to another. It should be noted that the PCI is not a test of traits, talent, or ability. It is expected that people’s ratings of their views about achieving their goals will vary from one life area to another. The ratings could, for example, depend on their experience in each area, relevant skills, available resources for achieving goals, etc. However, the intra-scales reliability of the PCI suggests that the whole inventory provides consistent scores for respondents’ views about their goal achievements.

In addition to the evidence presented above, Fadardi and Cox (2001) recently found that a maladaptive motivational pattern extracted from the PCI indices was significantly positively related to university students’ irrational beliefs (see Chapter 1).

*Factor analysis of the Personal Concern Inventory.* For ease of data analysis, respondents’ indices from the MSQ and the PCI can be subjected to Principal Component Analysis (PCA). In earlier research with the MSQ and the PCI, PCA was usually used to extract factor loadings that indicated adaptive and maladaptive motivational structures.
(e.g., Cox, Blount, Bair, & Hosier, 2000; Cox & Klinger, 2002; Cox et al., 2002; Hosier, 2002). The results of these analyses have not led to a fixed array of factor loadings for adaptive or maladaptive dimensions, although there are similarities among the results of the different studies (Klinger & Cox, 2004). Rather, for each sample of participants, interpretation of motivational structures is based on the particular combination of MSQ or PCI factor loadings that are derived. The pattern of high or low loadings determines how adaptive or maladaptive each factor is. For example, a pattern of strong positive loadings on Commitment, Joy, and Chances of Success would suggest an adaptive motivational structure. A pattern of positive loadings on Joy and Chances of Success but no loading on Commitment would suggest a maladaptive motivational pattern; this is because motivationally people should be committed to pursuing goals of which they expect to experience joy and of which they expect to succeed.

As noted, in the earlier studies PCA was used to summarise the PCI indices. PCA differs from commonly used EFA methods (e.g., Principal-Axis Factoring, Maximum Likelihood) and Confirmatory Factor Analysis (CFA). CFA is considered more of a theory-testing procedure because it is usually based on a strong theoretical or empirical foundation. Such a theoretical or empirical foundation allows the researcher to specify an exact factor model in advance. CFA is developed to specify which variables will load on which factors, and it estimates the degree of correlation between each factor and other variables. The latter is routinely used with eigenvalues greater than 1.00, also with Varimax rotation (rotation methods are explained in this section). An eigenvalue is the amount of variance accounted for by a specific factor in a factorial model in proportion to the total amount of variance in the model (Kline, 1994).

As some authors (e.g., Preacher & MacCallum, 2003) argue, PCA and EFA (e.g., PAF) are based on different concepts and mathematical procedures. EFA is a modification of PCA which identifies a factor structure for a set of variables (Stevens, 1996). To clarify the differences between PCA and PAF, the various sources of variance in a factorial model need to be explained. The variance in a factorial model can be divided into three types: (a) common variance (this is the variance that different factors in the model share in common); (b) specific variance (this is the variance within one or more of the individual variables); and (c) error variance (this represents random error in the measurement) (Kline, 1994). The latter two sources of variance together indicate the amount of the unique variance in a model that is distinguished from the common variance. The shared or common variance in a model is referred to as the model's communalities.
If a researcher seeks to retain components that explain as much of the variance as possible among measured variables, he or she should use EFA methods, not PCA. A model based on EFA methods assumes that common factors are latent variables—these variables are explained by common variance and by covariance among the measured variables, where the unique variance is excluded from the model. The appropriate factorial method that can identify the common factors is believed to be Principal-Axis Factoring (PAF) (Preacher & MacCallum, 2003). On the other hand, PCA aims to reduce data by identifying factors that explain the total variance in the model. PCA combines all sources of variance in order to determine the linear composites of measured variables and in order to retain components that explain as much of variance as possible.

These differences between PCA and PAF models do not necessarily mean that PAF is always preferred to PCA. As Kline (1994) noted, with large data sets the difference between the two methods becomes trivial, and where the communality among measured variables is high (i.e., the unique variance is low), PFA and PCA yield similar results (Preacher & MacCallum, 2003). Therefore, considering the similarities between the two methods, if a researcher is specifically interested in data reduction (Preacher & MacCallum, 2003) and seeks a simple structure, it is standard to use PCA with Scree test for the number of factors and to use Direct Oblimin oblique rotation (Kline, 1994).

To summarise:

PCA is used to find optimal ways of combining variables into a small number of subsets, whereas factor analysis is used to identify the structure underlying such variables and to estimate scores with which to measure the latent factors. If the latent variable is considered to cause the observed items, factor analysis is appropriate. If the observed items are considered to cause the latent variables, then PCA is better-suited (Bollen, & Lennox, 1991).

Rotation methods are commonly used in factor analyses to find a clearer structure. Rotation increases the interpretability of factors by making a more distinctive picture of the loadings by maximizing the variance within factors. There are two commonly used rotation methods: orthogonal and oblique.

Orthogonal rotation produces factors that are not related to each other. It may yield non-redundant factors, but the results do not necessarily correspond to reality. For example, many psychological factors (e.g., anxiety, depression) are related to each other. Oblique rotation produces factors that are related to each other. In much psychological research, oblique rotation has advantages over orthogonal rotation because in real world most variables are not entirely independent from each another.
Kline (1994) suggests that if the results of an oblique rotation are similar to an orthogonal rotation, the latter is preferred because the pattern and the structure matrices contain similar loadings. Statisticians argue that the reliability of a factor analysis depends on the sample size on which it is based; however, there is no agreement on what the sample size should be (Bryman, & Cramer, 2001). Cattell (1978) suggested a minimum of three participants \(N\) per variable \(P\), whereas Gorsuch (1983; cited in Kline, 1994) suggested a minimum of five \(N\) for each \(P\), but with no \(N\) fewer than 100 per analysis. These estimations of the sample size are known as \(N:P\).

MacCallum, Widaman, Zhang, and Hong (1999) discovered the lack of necessity for a certain criterion for \(N\) or \(N:P\) for recovery of population factors. They pointed out studies with samples as low as 78 and an \(N:P\) of 1:3 that had resulted in good recovery of population parameters. The authors highlighted the importance of five factors for a power analysis in factor analysis studies: the sample size, the number of factors retained, the number of variables examined, the level of communalities, and the level of model error. They suggested that in behavioural studies aimed at factor recovery, the lack of model fit is less crucial than is its communalities. Accordingly, Preacher and MacCallum (2002) recommended rules for selecting appropriate sample sizes in behavioural studies. For example, when recovery of two factors among 10 variables is sought, a sample size in the 20-to-50 range is expected to be associated with a good to excellent model fit.

Based on the above guidelines, the indices calculated from the PCI were subjected to factor analyses. The results of these analyses are reported in Chapters 5-to-7.

**Perceived Stress Scale**

There are three traditions for assessing the role of stress in disease risk: the environmental, the psychological, and the biological. The environmental tradition emphasizes the normative assessment of stressful events or experiences. These require substantial adaptive demands and cause excessive pressure for a person. However, the evaluation of an event as stressful differs from one person to the other. In addition, there is no unique checklist that can encompass all stressful events and applies to all populations. The psychological tradition focuses on individuals' subjective ratings (appraisals) of their abilities to cope with life challenges, and of their affective reactions to them. The biological tradition focuses on specific physiological responses; these modulate dealing with demanding physical, environmental, and psychological pressures. The assessment of physiological indices of stress needs special equipment and this constrains the applicability of these measures outside laboratories.
The Perceived Stress Scale (PSS) (Cohen, Kamark, & Merelstein, 1983; Cohen & Williamson, 1988) falls within the psychological tradition. It measures the degree to which situations in a person's life are appraised as stressful. The scale is designed to assess how unpredictable, uncontrollable, and overloaded respondents find their lives to be.

The PSS is designed for use with those with at least a junior high-school education. The questions are general and, hence, are relatively free of specific content. Therefore, they can be applied to any sub-population (Cohen, & Williamson, 1988). Cohen et al. (1983) reported the concurrent and predictive validities and internal and test-retest reliabilities of the PSS by using scores from 446 undergraduates and from 64 smokers (mean age 38.4 years) participating in a smoking-cessation programme. Results showed that the PSS's immediate retest reliability (concurrent reliability) was adequate. PSS was a better predictor of depressive and physical symptomatology, utilization of health services, social anxiety, and smoking-reduction maintenance than were life-event scores. In comparison to a depressive symptomatology scale, the PSS was found to measure a different and independently predictive construct.

Cohen and Williams (1988) ascertained that, in comparison to life-event scores, the PSS is a more reliable and is a better predictor of depressive and physical symptoms, seeking health services, social anxiety, and smoking-reduction maintenance. As far as the reliability and validity of the scale are concerned, the four-item version is acceptable (Appendix 4).

There is considerable evidence on the relationship between stress and alcohol consumption (e.g., Cole, Tucker, & Friedman, 1990; also see Chapter 1). Cooper, Russell, Skinner, Frone, and Mudar (1992) suggested that the stress-vulnerability model of alcohol use cannot be broadly applied to all individuals regardless of their gender, coping styles, and alcohol expectancies. However, there is a vast body of evidence suggesting that stress plays a pivotal role in understanding alcohol use among adults (e.g., Armeli, Carney, Tennen, Affleck, & O'Neil, 2000), adolescents (Evans & Dunn, 1995; Laurent, Catanzaro, & Callan, 1997; Perkins, 1999), and college students (Camatta & Nagoshi, 1995). The PSS is correlated with variables that may promote alcohol consumption. For example, Eskin and Parr (1996) found that perceived stress was correlated significantly and positively with symptoms of depression, and negatively with social support from friends and family. When the life events were grouped into "high"
versus "low," according to their degree of negative impact in a person's life, the PSS correlated significantly and positively with the number of highly negative life events.

On the other hand, chronic stress can impair memory and may impair cognitive functioning (e.g., Beatty et al., 2000; McEwan, Sapolsky, 1995).

**Shipley Institute of Living Scale**

Shipley (1940) developed The Shipley Institute of Living Scale (SILS) to assess general intellectual functioning in adults and adolescents. Many authors have written about this test. However, the revised manual of the scale by Zachary (2000) has often been referred to. Accordingly, for this section, the revised manual was mainly consulted. The SILS is one of the oldest tests that is still being administered in its original form. It is a paper-and-pencil, self-administered test and consists of two subtests: the *vocabulary* and the *abstraction*. Note the following:

- The Vocabulary subtest consists of 40 multiple-choice questions, for which participants decide which of four words is closest in meaning to a target word. Administration time for this subtest is 10 minutes. The Vocabulary subtest relies on verbal skills. This subtest measures reading ability, verbal comprehension, acquired knowledge, long-term memory, and concept formation.

- The Abstraction subtest consists of 20 questions, in which the final element in sequences of numbers, letters, or words have been omitted. Participants are required to find the relationships between the first parts of each sequence and to complete the missed sequence. Administration time for the subtest is 10 minutes. The Abstraction subtest measures attentional abilities; letter, word, and number concept formation; abstract thinking; cognitive flexibility; analysis and synthesis; processing speed; long-term memory; and specific vocabulary and arithmetic skills. The SILS scales are reliable and valid, and are psychometrically acceptable (Zachary, 2000).

- The rationale for the scale is that pathology does not equally influence cognitive abilities. Verbal abilities (e.g., tests of word knowledge) are less vulnerable to the influences of many pathologies. In contrast, abstract reasoning is believed to be more vulnerable to a wide variety of pathologies. Six scores can be generated from this test and form the basis for the analysis.

- The *Vocabulary* score is computed from the total number of correct responses out of 40. As this test involves multiple-choice responses, the respondent may give
some correct responses by chance. In order to interpret this score, it is converted to a T-score by using normative tables. The T-score adjusts for the respondent’s age.

The *Abstraction* score is computed from the total number of correct responses on the 20 items of this subtest. This total score is then multiplied by 2 to equate the total raw score range for the Vocabulary and Abstraction subtests (0 to 40). As with the Vocabulary subtest, raw scores are converted to T-scores.

The *Total score* is computed by summing the Vocabulary and Abstraction raw scores. Again, the Total score is converted into a T-score that is adjusted for age.

The *Conceptual Quotient (CQ)* score is a ratio that is calculated by dividing the Abstraction score by the Vocabulary score. The assumption underlying this ratio is that a person with intact intellectual functioning should have roughly equal abilities in Vocabulary skills and Abstract thinking. A conversion table is used to generate the ratio. The result is multiplied by 100 to eliminate decimals. A CQ of 100 is equal to a ratio of 1:1 and indicates that an individual’s abstract reasoning is consistent with his or her mental age as estimated by the individual’s Vocabulary score. A CQ higher than 100 indicates that the individual’s abstraction ability is higher than would be expected for his or her age. A CQ less than 100 indicates poorer than average abstract reasoning abilities relative to the person’s age. CQ scores smaller than 70 are interpreted as a sign of cognitive pathology. The CQ is rarely used. This is because it not adjusted for the respondent’s age and education.

The *Abstraction Quotient* is a score similar to the CQ, but it has been adjusted to reflect both age and education.

*WAIS or WAIS-R Full Scale IQ* scores can be estimated from SILS raw scores. The IQ scores are derived from Total raw scores in conversion tables, which take the age of the respondent into account.

As discussed, a common use of the test is to detect intellectual deterioration, defined as a markedly low abstraction score relative to the vocabulary score. However, as the Abstraction subtest is more difficult than the Vocabulary subtest, a number of potential confounding variables need to be considered. These variables include language difficulties, little formal education, severe intellectual impairment, and age-related changes in verbal and abstract thinking.
Chapter 4

Zachary (2000) reviewed studies that administered the SILS to in-treatment alcohol abusers (i.e., Dalton & Dubnicki, 1981; Dietvorst, Swenson, & Morse, 1978; Jansen & Hoffman, 1973; Kish, 1970; Malerstein & Belden, 1968; all cited in Zachary, 2002). He concluded that the SILS does not appear to be a useful instrument for providing brief IQ estimates of people with alcohol problems; because of confounding effects from mediating variables (e.g., age, race, education, and socioeconomic conditions), the ability of the CQ index to differentiate levels of cognitive impairments is limited.

However, subsequent studies suggested that the SILS can distinguish alcohol abusers from non-abusers. Nixon, Parsons, Schaeffer, and Hale (1995) administered the Shipley Institute of Living Vocabulary (SILS-V) and Abstraction (SILS-A) sub-tests to in-treatment male alcohol abusers ($N = 1430$) and non-abusers ($N = 98$). The clinical group performed significantly more poorly than the non-abusers on the SILS-A. Strong test-retest reliability, with a two-week interval between testing sessions, was obtained. Item analysis of the 20-item SILS-A revealed that only 11 items (4-to14) discriminated clinical participants from controls. Among these items, 6 required reversal of a cognitive set (reversal items) and 5 did not (non-reversal items). An exploratory factor analysis confirmed essentially the same items and their division. In another study, Beatty et al., (2000) examined the relationships between the severity of neuropsychological deficits and the quantity and duration of alcohol consumption among alcohol abusers ($N = 195$) and a control group ($N = 165$). Compared to the controls, the alcohol abusers were impaired on the Shipley Vocabulary and Abstraction sub-tests and on two versions of the Digit Symbol test.

Parker, Birnbaum, Boyd, and Noble (1980) found that amount of alcohol per drinking session was significantly negatively correlated with students' ($N = 40$) performance on the SILS. However, neither frequency of drinking nor lifetime alcohol consumption was significantly related to cognitive performance. Wehr and Bauer (1999) measured cognitive ability; depression; anxiety; antisocial personality; and length, type, and severity of addiction among 122 in-treatment substance abusers. A six-month follow-up revealed that 46 participants had relapsed to substance abuse, 17 participants had withdrawn from treatment, and 56 had remained in contact with their counsellors after detoxification. Wehr and Bauer reported that the only variables that could significantly differentiate the successful and unsuccessful groups were IQ and the Verbal subtest of the Shipley Institute of Living Scale.
It seems that the SILS scales, especially the Abstraction scale, are sensitive to neurological impairments. The test also provides a brief and reliable measure of general IQ.

**Alcohol Use Questionnaire**

The Alcohol Use Questionnaire (AUQ, Cox, 2002, see Appendices 7 and 8) assesses respondents’ quantity and frequency of alcohol consumption during the past year, both the usual quantity per occasion and the maximum amount per occasion. The questionnaire covers four types of alcohol beverages (i.e., beer, wine, spirits, and alcopops). It also asks about the number of days since the last drink, the amount of alcohol consumed on the last day of drinking, the age at which the person started drinking regularly, and the approximate date that the person noticed that he or she was drinking too much. The average total consumption can be calculated on a weekly, monthly, or yearly basis.

There is agreement that self-reports of alcohol consumption (Cohen & Vinson, 1995; Sobell & Sobell, 1986) and substance abuse (Johnson et al., 2000) are reliable and valid.

**Michigan Alcohol Screening Test (MAST)**

The original format of the Michigan Alcoholism Screening Test (MAST) (Selzer, 1968, 1971) is a 25-item questionnaire. Several briefer versions of the MAST have been used. The 13-item Short MAST (SMAST; Selzer, Vinokur & van Rooijen, 1975) was used in the present study (Appendix 9). The SMAST focuses on the consequences of problem drinking and respondents' perceptions of their alcohol-related problems. The SMAST includes items from the original test that have been identified as able to discriminate dependent from non-dependent alcohol consumption. A cut-off score of three is considered for the SMAST. There is supportive evidence for the reliability and validity of the test (e.g., Conley, 2001; Hirata, Almeida, Funari, & Klein, 2001; Storgaard, Nielsen, & Gluud, 1994; Zung, 1984) as a screening instrument for abnormal alcohol consumption.

**The Stroop Test**

*Stimuli.* As described in Chapter 2, the classic Stroop test consists of colour words presented in different colours. The words could be either compatible with the colour (e.g., red in red) or incompatible with the colour (e.g., red in blue) in which they
appear. It usually takes longer for participants to name the colours of the incongruent colour-words than it does to name the colour of the congruent one. Interference scores are calculated as the participants' reaction times on the incongruent category minus their reaction times on the congruent one. The interference score is a measure of cognitive flexibility and executive cognitive functioning. In a modified version of the classic Stroop test, the emotional Stroop test, researchers use words related to a psychopathology to make the salient category of the test. The second category of words (in an emotional Stroop test) consists of neutral words. The salient and neutral words are usually matched in accordance to different linguistic dimensions. This is to achieve at an unbiased baseline for the participants' reaction time (RT) on both categories, such that the interference score can be attributed only to the participants' attentional bias for the salient words. On an emotional Stroop test, the interference score is the difference between RTs on the salient category and RTs on the neutral. This is a measure of the participants' attentional bias for concern- or psychopathology-related stimuli.

Both classic and emotional (alcohol-) Stroop tests were used in the present study. The two tests were combined with each another to make a computerised test based on a mixed randomised single presentation procedure. The tests are described below.

The Stroop test used for the thesis research comprised four word sets: congruent colour, incongruent colour, alcohol-related, and control (building-related items). Each set comprised 28 words (see Table 4.2). The first two sets constituted the stimuli used in the classic Stroop test and the other sets constituted the stimuli used in the alcohol-Stroop test. The congruent colour words were red, yellow, blue, and green appeared in a consistent colour with their meaning (e.g., red in red). The incongruent colour words were the same colour words as congruent ones but they appeared in a font colour that was incompatible with the colour name (e.g., red in blue). The second two sets used in the alcohol-Stroop test were either alcohol-related (e.g., beer, wine, bar) or control (e.g., bath, carpet, and ceiling) words. The alcohol-related words and control words were compiled particularly for the thesis research, rather than being selected from an existing list. Building-related words were selected as controls because it was assumed that these words, unlike the alcohol words, are not related to alcohol. This assumption was confirmed by a pilot study. Ten students and 10 in-treatment alcohol abusers in a detoxification centre rated forty alcohol-words on a Likert scale about the relevance of each of the alcohol words to alcohol category (0-to-10; 0 for not relevant at all, 10 for very relevant). The same participants, rated the relevance of forty building-related items (e.g., doorknob, ceiling, stairs, shed). A t-test revealed that alcohol words were rated
significantly more relevant to alcohol concept than did building-related words (see Chapter 5 and 7 for more evidence on the neutrality of control words used in this study). Based on the participants' ratings of the words, 28 alcohol and 28 control words were selected. Each list of the alcohol and control words comprised a single semantic category (alcohol-related vs. building-related words), according to Green and Rogers' (1993) recommendation. The 28 alcohol words and 28 control words were each allocated to four blocks, consisting of seven words each, in such a way that each block was equivalent in terms of word frequency, average number of letters, and number of syllables per word. Each alcohol and neutral word was written in each of the four colours (blue, green, yellow, and red), resulting in a total of 28 alcohol words and 28 control words in each block. Twenty-eight congruent colour words and 28 incongruent colour words were included to arrive at 112 words in each list. The order of presentation of the words in the test was randomised.
Table 4.2: Frequency of the alcohol-related and neutral words according to the Baayen et al (1996) CELEX lexical database.

**Group (A)**

<table>
<thead>
<tr>
<th>Alcohol-related category</th>
<th>Neutral (building-related) category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol Words</td>
<td>No. of letters</td>
</tr>
<tr>
<td>Beer</td>
<td>4</td>
</tr>
<tr>
<td>Whisky</td>
<td>6</td>
</tr>
<tr>
<td>Scotch</td>
<td>6</td>
</tr>
<tr>
<td>Liquor</td>
<td>6</td>
</tr>
<tr>
<td>Tequila</td>
<td>7</td>
</tr>
<tr>
<td>Bar</td>
<td>3</td>
</tr>
<tr>
<td>Rum</td>
<td>3</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

**GROUP (B)**

<table>
<thead>
<tr>
<th>Alcohol-related category</th>
<th>Neutral (building-related) category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol Words</td>
<td>No. of letters</td>
</tr>
<tr>
<td>Shot</td>
<td>4</td>
</tr>
<tr>
<td>Shorts</td>
<td>6</td>
</tr>
<tr>
<td>Vodka</td>
<td>5</td>
</tr>
<tr>
<td>Pint</td>
<td>4</td>
</tr>
<tr>
<td>Liqueur</td>
<td>7</td>
</tr>
<tr>
<td>Alcohol</td>
<td>7</td>
</tr>
<tr>
<td>Bourbon</td>
<td>7</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>5.7</strong></td>
</tr>
</tbody>
</table>

Continued
### Table 4.2: Continued

#### Group (C)

<table>
<thead>
<tr>
<th>Alcohol-related category</th>
<th>Neutral (building-related) category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alcohol</strong></td>
<td><strong>No. of letters</strong></td>
</tr>
<tr>
<td>Wine</td>
<td>4</td>
</tr>
<tr>
<td>Bitter</td>
<td>6</td>
</tr>
<tr>
<td>Stout</td>
<td>5</td>
</tr>
<tr>
<td>Pub</td>
<td>3</td>
</tr>
<tr>
<td>Brandy</td>
<td>6</td>
</tr>
<tr>
<td>Champagne</td>
<td>9</td>
</tr>
<tr>
<td>Mead</td>
<td>4</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>5</td>
</tr>
</tbody>
</table>

#### GROUP (D)

<table>
<thead>
<tr>
<th>Alcohol-related category</th>
<th>Neutral (building-related) category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alcohol</strong></td>
<td><strong>No. of letters</strong></td>
</tr>
<tr>
<td>Drink</td>
<td>5</td>
</tr>
<tr>
<td>Sherry</td>
<td>6</td>
</tr>
<tr>
<td>Cider</td>
<td>5</td>
</tr>
<tr>
<td>Booze</td>
<td>5</td>
</tr>
<tr>
<td>Spirit</td>
<td>6</td>
</tr>
<tr>
<td>Gin</td>
<td>3</td>
</tr>
<tr>
<td>Cocktail</td>
<td>7</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>5.3</td>
</tr>
</tbody>
</table>
The equivalence of the blocks was confirmed by analysis of variance. Word frequency was determined by use of the most recent lexical database, CELEX (Baayen, Piepenbrock, & Van Rijn, 1993). According to Jones and Schulze (2000), this lexical database has advantages over other databases frequently used in emotional Stroop studies (i.e., Kucera-Francis, 1967; Thordike-Lorge, 1944). This is a database of British rather than American English words. It was selected for use because the participants in the present studies were British. The database consists of about 20 million words compiled from a wide range of the written and spoken language.

**Post-Stroop Memory and Emotional Valence Tasks**

As far as memory is concerned, there are studies suggesting the importance of addiction-related memory in sustaining and relapsing to addictive behaviours (Boening, 2001, McCusker, 2001). The accessibility from memory of substance-related concepts has important implications for behavioural decisions about substance use (Stacy, 1997; Weingardt, Stacy, & Leigh, 1996). On the other hand, Peretti (1998) asserted that the Stroop emotional task biases short-term memory through the presentation of emotionally salient stimuli. This bias can be interpreted as the addiction memory’s sensitivity to external addiction-related cues (Boening, 2001, Stacy, 1996). The evidence suggests that each Stroop word can act as a prime for the next word, leading to a primed chain of stimuli (Waters, Sayatte, & Wertz, 2003) through which longer latencies can be attributed to the elicited semantic network.

Therefore, there is a logic underlying the assessment of addiction-related memory after completion of an alcohol-Stroop test. The recall task comprised a question, asking the participants to recall as many alcohol and non-alcohol words as they could among the words they had just reacted to on the computer (Appendix 5). Addiction memory, measured through a post-Stroop recall task would be predicted to distinguish heavy drinkers from light drinkers, with heavy drinkers remembering more alcohol words than light drinkers. In addition, to determine whether there was a difference between the emotional salience of alcohol- and building-related words a Likert scale was used on which 0 is for “not pleasant at all” and 10 is for “very pleasant” (Appendix 5). Whether or not the category of neutral words on an emotional Stroop task is in fact neutral for each participant needs further consideration. As explained earlier, the alcohol-related and neutral (building-related) words used in this study were selected based on ratings provided in a pilot study of 10 in-treatment alcohol abusers and 10 university students. However, confirmation of the pilot ratings was evaluated through post-experimental
analysis reported in Chapter 5 and Chapter 7 for students and alcohol abusers, respectively.

**Apparatus**

SuperLab Pro (SKD) software (Cedrus-corporation, 1999) was used to present the Stroop task. The words were presented individually in the centre of a PC laptop (Toshiba Satellite 1700-200) colour display screen (12.1-inch DSTN). The viewing distance was 36-40 cm. The Laptop’s keyboard was used as the input device. The time resolution of the PC keyboards is between 15-35 ms for every key-press (Cedrus-corporation, 1999, April 2003) and is constant for a given keyboard/motherboard combination (Irtel, 1996). In addition, when measuring reaction times with one millisecond accuracy with a large standard deviation, keyboard variance is not a problem (Segalowitz & Graves, 1990). Ulrich and Giary (1984) and Wartenberg (1994) suggested that mean reaction times collected via a standard keyboard (with a resolution of 15-35 ms) should be unbiased. Ulrich and Giary (1984) suggested that a built-in timing mechanism with a 10-30 ms time resolution is reliable and any “additional effort [to develop a more accurate timing mechanism] is often unnecessary” (p. 12).

**The Stroop Procedure**

The task involved presentation of the stimuli individually. The monitor’s background colour was always black. The font used for the Stroop words was Century School Book, 48-point bold. The first letter of each word appeared in uppercase and the remainder of the word in lowercase, because this composition is the most frequently used one for writing single words in the real world. Prior to each trial, a fixation cross “+” appeared at the centre of the display screen for 800 ms. This intertrial interval to be used was carefully considered, because very long intertrial intervals can decrease the interference (Sharma & McKenna, 2001). The order of presentation of the four blocks of stimuli was counterbalanced across participants. To counteract fatigue, participants were invited to rest for two minutes between each stimulus block.

The order of presentation of the words within each block was randomised. The randomisation was based on the software’s timing-seed option. This option allows unrepeated randomised representation of the stimuli. Therefore, it was possible for a given word or colour to appear on consecutive trials, but no word could appear on more than two consecutive trials and no colour on more than three consecutive trials. On
average, colours and words appeared consecutively on 25.6% and 25% of the trials, respectively.

**Scoring the Stroop Tests**

Consecutive repetitions of stimuli (e.g., red in *red* followed by red in *red*) occurred on 1.6% of the trials and were excluded prior to analysis, as were trials on which errors were made (the percentages of which are presented in the experimental Chapters for each sample).

Interference scores were calculated for the classic Stroop stimuli and alcohol-Stroop stimuli separate. For the classic Stroop, mean reaction times to colour congruent words were subtracted from mean reaction times to colour incongruent words. For the alcohol Stroop, mean reaction times to the neutral words were subtracted from mean reaction times to the alcohol-related words.

**Procedure**

Except for the SMAST, which was not administered to the alcohol abusers, the order of administration of the tests was the same all participants. In addition, the AUQ administered to alcohol abusers was slightly modified (Appendix 8). The data were collected in different locations for the student and patient samples, but in both locations the experiment was run individually in a quiet, dimly illuminated room. At the beginning of the test session each participant was first given the information sheet (Appendices 1 and 2) and consent form (Appendix 3). After giving informed consent, and then completing a short version of the Perceived Stress Scale, each participant received the Stroop practice task. The participants were told that their task was to press as quickly and accurately as possible the coloured key (labelled with coloured stickers) that corresponded to the coloured patch appearing on the screen. The same instructions were presented on the monitor immediately prior to the practice trials. Participants were told that there would be a 6,000 ms time limit for making a response; however, during the practice phase no participant exceeded the limit. Participants were then presented with 100 practice trials, which were following by the experimental trials. For the latter, they were given both verbal and written (on-screen) instructions to ignore the meaning of the words and respond to the colour of the font in which the word was written. As explained earlier, the experimental trials occurred in four blocks of 112 trials each. The participants were given a short rest of two minutes between each block and the next. While the
participant performed the Stroop test, the experimenter sat behind or next to the participant, in order to monitor the procedure. Immediately after completing the Stroop test, participants were asked to complete two researcher-compiled tasks: a memory task and an emotional valence task. In the memory task, participants were asked to recall as many alcohol and control words as they could (except for the colour words) within five minutes or as soon as their mind went blank. They wrote alcohol and non-alcohol related words in separate columns, below which they were instructed to rate the emotional valence of each category of the words as a whole. They were also provided with an example to explain what an emotional evaluation of a word means, and could see the complete list of words prior to their emotional ratings of the words on a Likert scale—ranging from “1” (*Not at all pleasant*) to “10” (*Very pleasant*).

Next, participants were asked to complete the SILS. It was administered in two parts with a maximum completion time of 10 minutes for each part. The Vocabulary subtest was completed first, followed by the Abstraction subtest. Participants were given another two minutes in which to rest. Next, they were instructed to complete the PCI. In addition to the written instructions provided, the experimenter explained the purpose of the inventory how it should be completed. Following completion of the PCI, the student sample was given the SMAST and AUQ, respectively. The whole procedure lasted about one hour and fifteen minutes for students and about two hours for patients. At the end of the session, the participant was debriefed and thanked for his or her participation.
CHAPTER FIVE

A Parsimonious Model for Predicting Alcohol Consumption

As discussed in Chapter 1, many factors contribute to people's motivation to drink alcohol. These factors include heredity, personality, current situational factors, experienced stress, socioeconomic condition, and biological influences. Recall that the motivational model of alcohol use (Cox & Klinger, 1988, 1990) depicts how these factors interact with one another through a motivational pathway to alcohol use. The model depicts the motivation to drink as competing with other kinds of incentives. If a person forms goals (becomes committed) to pursuing non-drinking goals, he/she will have current concerns for those goal pursuits. Whether or not the person succeeds in reaching the other goals will depend on his or her motivational structure (pattern of goal striving). Evidence presented in Chapter 1 indicates that a maladaptive motivational structure is associated with a higher risk for abusive drinking than is an adaptive motivational structure. An important issue, however, is the extent to which motivational structure can predict alcohol consumption after other variables have been controlled.

Another focus of the previous literature (see Chapter 2) has been the role of cognitive factors, especially attentional bias for alcohol-related stimuli, in alcohol consumption. The power of attentional bias to predict alcohol consumption over motivational structure had not been previously assessed. Therefore, the present study evaluated the relative importance of motivational structure and attentional bias for alcohol-related stimuli in predicting alcohol consumption among non-dependent social drinkers. The chapter tests the hypothesis that maladaptive motivational structure and attentional bias for alcohol-related stimuli are more potent predictors of student's alcohol consumption, than are other factors, such as age, gender, IQ, memory for alcohol-related stimuli, and executive cognitive functioning.

Method

The analyses reported here were based on data collected in the study for which the methodology was described in Chapter 4. The methodology will be summarised here, to describe those issues not covered in Chapter 4.

Power Analysis

A power analysis was conducted to determine the sample size needed for the target population in this study. Power analysis requires the researcher first to estimate the
size of the effect that the study being planned will be able to detect. The results of previous research can be used to decide on a small, medium, or large expected effect size. Prior alcohol-Stroop and motivational structure studies have produced a wide variety of effect sizes from a variety of research designs. Six studies have administered the alcohol-Stroop test to university students, among which just one study does not contain sufficient information for effect-size calculations. There are, however, differences between these five studies and the present one.

First, Stewart et al.'s (1997) alcohol-Stroop study differed from the present study in that their participants completed the Stroop test under food-deprivation conditions (a condition that could increase the sensitivity to alcohol-related stimuli). However, using the mean interference scores and pooled SD of this study, an effect size of $d = .65$ was obtained (see Table 2.4). This corresponds to a large effect size (Cohen, 1992).

Second, Cox et al.'s (1999) study is different from the present study in that in their research participants were primed by either alcohol-related or non-alcohol-related stimuli while being exposed to the experimental stimuli. As far as reaction time to alcohol vs. neutral stimuli is concerned, the largest effect size in this study was calculated for the condition in which heavy drinkers were exposed to alcohol cues while completing the task. A Cohen's $d$ of .24 was calculated for this condition, which corresponds to a small effect size (Cohen, 1992).

Third, Sharma et al.'s (2001) study is different from the present study in the nature of the sample test. That is, a sample of university students was divided into two groups based on their scores on the Alcohol Use Disorders Identification Test (AUDIT). They were a group with high scores on the test and a group with low scores on the test. The two groups showed significantly different interference scores for alcohol-related stimuli, with an effect size (Cohen's $d$) equal to .97, which is a large effect size (Cohen, 1992).

Fourth, Cox, Brown, and Rowland's (2003) alcohol-Stroop paradigm is methodologically different from the present study in the sense that these researchers used a card version of the Stroop test, and they primed their participants prior to exposing them to the Stroop stimuli. The interaction between alcohol cues and amount of habitual drinking significantly predicted students' attentional bias for alcohol-related stimuli ($R^2 = .096, p < .001$). Based on Cohen's (1992) guidelines, an effect size of $f^2 = .10$ was calculated for Cox et al.'s (2002) study. According to Cohen, an $f^2 = .10$ is defined as a medium effect size.
Fifth, Stewart et al. (2002) divided their student sample into two groups according to their scores on Enhancement Motives (EM) or Coping Motives (CM), and each group completed the alcohol-Stroop after being cued with either positive, negative or neutral stimuli. The effect sizes relating to the interference scores for the EM group under positive and negative mood inductions were .21 and .20, respectively. These correspond to Cohen's $d$ criteria for a small effect size. The effect sizes related to the interference scores for the CM group under positive and neutral mood inductions were $d = .28$ and $d = .38$, respectively. These correspond to Cohen's criterion for a medium effect size.

Calculating an effect size for Jones and Schulze (2000) was not possible, because they did not report SDs. The mean effect size from the above studies is .39, which corresponds to a medium value for $d$. However, this estimated average effect size could be misleading. The mean size (.40) was largely influenced by studies that increased the interference scores either by affective priming, or restricting the target population to participants meeting a certain criterion, such as being abstinent (see Stewart et al., 2002). The study most similar to the present study was that of Cox, Brown, et al. (2002), with an effect size of $f^2 = .10$ when all participants were treated as a whole.

As far as the motivational dimension of the present study is concerned, Cox, Schippers et al.'s (2002) study is the only one assessing the relationship between university students' motivational structure and their drinking. Restricting their sample to participants reporting alcohol-related problems on the SMAST, MSQ Factor 1 (adaptive motivational structure) was significantly negatively correlated with the annual amount of alcohol consumed ($R^2 = .11, p < .01$). Based on Cohen's (1992) guidelines, an effect size of $f^2 = .12$ was calculated for these results. According to Cohen, an $f^2 = .12$ is in the medium effect-size category. Based on results of the previous studies, it was decided that an $f^2 = .20$ (with a bias toward a large effect size) best fits the requirements of the present study. Therefore, based on Cohen's (1992) guidelines, entering $k = 9$ as the number of variables for the present study, $f^2 = .20$, alpha level .05, and power = .80 into G*power software (Erdfelder, Faul, & Buchner, 1996) revealed that a sample size of 88 participants in the present study could be judged adequate for detecting a significant effect in a multiple regression analysis.

**Participants**

Undergraduate psychology students were recruited through the University of Wales, Bangor, Student Participant Panel ($N = 99$). They received credit for their participation. In addition to psychology students, 29 students were recruited from other
university departments. They were paid £7.50 for participating. Screening criteria for taking part in this study were as follows. First, participants must not have recently taken part in any Stroop-related studies. Second, they must have remained abstinent from alcohol since the evening before the experiment.

**Procedure**

The procedure was as described in Chapter 4. Briefly, after reading the information sheet and signing the informed consent, participants completed the tasks in the following order: (a) Perceived Stress Scale—PSS, (b) classic Stroop and alcohol-Stroop tests, (c) recall of Stroop stimuli and emotional-valence ratings of them, (d) Shipley Institute of Living Scale—SILS, (e) Personal Concerns Inventory—PCI, (f) Short Michigan Alcohol Screening Test—SMAST, and (g) Alcohol Use Questionnaire—AUQ. At the end of the session, participants were debriefed, thanked and dismissed.

**Results**

Six participants were not included in the final sample for analysis because of faulty data. One was excluded because of a bout of coughing during the Stroop tests, and five were excluded because they were not conversant enough in English to be treated as true bilinguals. Only those participants who were drinkers and did not meet the SMAST cut-off point (i.e., < 3) for problem drinkers were included in this study. Non-drinkers were excluded from data analyses because personality differences between drinkers and non-drinkers have been frequently reported (e.g., King, Bernardy, & Hauner, 2003), although personality was not assessed in this study. There was no criterion regarding participants' pattern of drinking. The total, final sample included 87 participants (females = 55, males = 32), which meets the requirement of the priori power analysis. The gender difference reflects that of the pool of participants from whom the sample was drawn. Female students far outnumber male students in the School of Psychology.

**Stroop Paradigm**

**Neutrality of the Control Words**

As discussed in Chapter 4, the neutrality of the control words for participants is an issue that merits evaluation in emotional Stroop tests. In the present study, if participants named a current concern in the Home and Household area on the PCI, it could be considered unlikely that the neutral category of household-related words would actually
be neutral for them. Therefore, the participants were divided into two groups: those with (Group A, \(N = 59\)) and without (Group B, \(N = 28\)) a current concern related to Home and Household. Based on the number of words from the neutral and alcohol-related categories that were recalled just after the Stroop test, a series of \(t\)-tests were carried out, the results of which were as follows. First, Group A (\(M = 2.50, SD = 1.81\)) did not remember more neutral words than did Group B (\(M = 2.08, SD = 1.79\)), \(t(76) = -.93, p > .05\), two-tailed. Second, Group A (\(M = 3.18, SD = 2.28\)) did not rate the neutral words stronger in emotional valence than did Group B (\(M = 3.58, SD = 1.74\)), \(t(76) = .76, p > .05\), two-tailed. Third, Group A’s (\(M = -3.19, SD = 25.44\)) interference score on the alcohol-Stroop test did not differ from that of Group B (\(M = 7.07, SD = 30.17\)), \(t(85) = 1.65, p > .05\), two-tailed. Analyses of only those students with a current concern in the Home and Household area (i.e., Group A) gave the following results. First, the participants remembered significantly more alcohol-related words (\(M = 5.32, SD = 2.30\)) than neutral words (\(M = 2.41, SD = 1.85\)), \(t(53) = 8.25, p < .001\), two-tailed. Second, the participants rated the alcohol-related words significantly higher in emotional valence (\(M = 5.129, SD = 2.41\)) than the neutral words (\(M = 3.24, SD = 2.30\)), \(t(53) = 3.54, p < .001\), two-tailed. Therefore, these results confirmed that the building-related words (i.e., predetermined neutral category) were equally neutral for all participants, regardless of whether or not participants had current concerns in the Home and Household area. (Also see Page 124 for comparisons among the age groups and types of drinkers in respect with the number of remembered words and their emotional valence.)

**Analysis of Errors**

The mean percentages of errors were 3.7% for the classic Stroop test and 3.1% for the alcohol-Stroop test. A series of nonparametric and parametric analyses of the errors indicated no significant difference across the four categories of words (i.e., congruent, incongruent, alcohol, and neutral). For example, Kruskal-Wallis test comparing the categories on number of errors revealed no significant difference, \(X^2(3) = .001, p > .05\)

Next, based on weekly mean drinking, participants were divided into three groups (using the N-tile command in SPSS—N-tile command divides continuous data into categories based on percentile groups, with each group containing approximately the same number of cases.) designated as light (\(M = 1.68, SD = 1.46\)), medium (\(M = 10.84, SD = 3.82\)), or heavy drinkers (\(M = 40.82, SD = 24.96\)). Analysis of variance revealed that there were no significant differences among the three groups of drinkers in terms of the number of errors made in the congruent category, \(F(2,84) = .246, p > .05\), incongruent
category $F(2, 84) = .925, p > .05$, alcohol category $F(2, 84) = .683, p > .05$, and neutral
category $F(2, 84) = .186, p > .05$. In addition, the same analysis did not show any
significant differences among the three groups of drinkers in the total numbers of errors
on the classic Stroop test, $F(2, 84) = .548, p > .05$, or the alcohol-Stroop test, $F(2, 84) = .995, p$
$> .05$. Therefore, further analysis of errors seemed unnecessary.

**Demographic Characteristics and Between-Group Comparisons**

The means and standard deviations of age, education, Shipley Institute of Living
Scale (SILS) scores, and Perceived Stress Scale (PSS) scores are shown in Table 5.1,
separately for males and females.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Females ($N = 55$)</th>
<th>M</th>
<th>SD</th>
<th>Males ($N = 32$)</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>24.13</td>
<td>9.35</td>
<td></td>
<td>22.19</td>
<td>6.99</td>
<td></td>
</tr>
<tr>
<td>Education (in years)</td>
<td>14.13</td>
<td>0.75</td>
<td></td>
<td>14.13</td>
<td>1.04</td>
<td></td>
</tr>
<tr>
<td>Shipley Vocabulary T-score</td>
<td>55.29</td>
<td>6.32</td>
<td></td>
<td>55.47</td>
<td>7.21</td>
<td></td>
</tr>
<tr>
<td>Shipley Abstract T-score</td>
<td>59.13</td>
<td>4.71</td>
<td></td>
<td>59.72</td>
<td>4.25</td>
<td></td>
</tr>
<tr>
<td>Shipley Abstraction Quotient</td>
<td>107.78</td>
<td>9.41</td>
<td></td>
<td>107.38</td>
<td>8.58</td>
<td></td>
</tr>
<tr>
<td>IQ (Shipley WAIS-R)</td>
<td>108.53</td>
<td>6.71</td>
<td></td>
<td>113.56</td>
<td>7.91</td>
<td></td>
</tr>
<tr>
<td>Perceived Stress Score</td>
<td>5.51</td>
<td>2.36</td>
<td></td>
<td>5.22</td>
<td>2.67</td>
<td></td>
</tr>
</tbody>
</table>

There was (a) no significant difference between females’ and males’ age, $t_{(85)} =$
1.09, $p > .05$, two-tailed; (b) no significant difference between female’s and male’s
education, $t_{(85)} = .028, p > .05$, two-tailed; and (c) no significant difference between
female’s and male’s PS score, $t_{(85)} = .59, p > .05$, two-tailed. The SILS indices were
subjected to a series of $t$-tests, which yielded a significant difference between females and
males only on the Shipley estimated WAIS-R IQ, $t_{(85)} = 3.06, p < .01$, two-tailed, with
males scoring higher than females.

The means and standard deviations of usual drinking per week (the usual amount
of consuming alcohol per week), unusual drinking per week (the amount of alcohol
consumed more than the usual amount), and weekly mean drinking, age of first drink,
participant-SMAST, mother-SMAST, and father-SMAST are shown in Table 5.2, separately for males and females.

Table 5.2 Mean and standard deviation of drinking indices, and the SMAST scores.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Females (N = 55)</th>
<th>Males (N = 32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Usual drinking per week</td>
<td>9.63</td>
<td>13.36</td>
</tr>
<tr>
<td>Unusual drinking per week</td>
<td>5.04</td>
<td>9.48</td>
</tr>
<tr>
<td>Weekly mean drinking</td>
<td>14.67</td>
<td>20.45</td>
</tr>
<tr>
<td>Age of starting to drink</td>
<td>17.02</td>
<td>1.79</td>
</tr>
<tr>
<td>Participant-SMAST</td>
<td>0.45</td>
<td>0.66</td>
</tr>
<tr>
<td>Mother-SMAST</td>
<td>0.33</td>
<td>0.58</td>
</tr>
<tr>
<td>Father-SMAST</td>
<td>0.62</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Note: The amount of drinking is in standard units.

To determine if males' and females' drinking differed, the drinking indices (after being logarithmically transformed to correct for non-normal distributions) were subjected to a series of t-tests. The difference between unusual amount of drinking of the two genders was not significant, $t_{(85)} = -0.46$, $p > .05$, two-tailed. However, the difference between usual amount of drinking between the two genders was significant, $t_{(85)} = -2.56$, $p < .05$, two-tailed, with males drinking greater quantities than females. This difference, in turn, elevated males' weekly mean drinking index. The amount of weekly mean drinking was subjected to the t-test, which yielded a significant difference between males and females, $t_{(85)} = -2.06$, $p < .05$, two-tailed, with males drinking more alcohol than females.

To determine if different age groups differed in their pattern of drinking, a series of one-way analyses of variance were run in which age was the between-participants factor. Using the N-tile command in the SPSS, participants were divided into three age groups: Group A ($N = 36, M = 18.60$ years, $SD = .50$), Group B ($N = 28, M = 20.40$ years, $SD = .50$), and Group C ($N = 23$, Mean age = 34 years, $SD = 10.25$). Three indices of drinking were compared: usual amount of drinking per week, unusual amount of drinking per week, and weekly mean drinking (see Table 5.2). Results revealed a main effect for
age, $F(2,84) = 3.94, p < .05$. Differences were isolated using the Bonferroni post hoc procedure, which showed that groups A and B consumed significantly greater usual amount of alcohol per week than did Group C (see Figure 5.1).

Figure 5.1. Weekly alcohol consumption as a function of age.

Note: Group A ($N = 36, M = 18.60$ years, $SD = .50$), Group B ($N = 28, M = 20.40$ years, $SD = .50$), and Group C ($N = 23$, Mean age = 34 years, $SD = 10.25$).

To determine the relationships between participants' SMAST scores and those of their parents, simple bivariate Pearson correlations were computed. Results revealed that scores on the participant-SMAST were moderately correlated with those on the mother-SMAST, $r(85) = .33, p < .01$, and father-SMAST, $r(85) = .39, p < .001$. In addition, scores on the mother-SMAST were positively correlated with those of the father-SMAST, $r(85) = .64, p < .001$.

To identify differences between females' and males' quantity of consumption, each gender was divided into three groups according to their amount of alcohol consumption ($N$-tiles = 3). The reason why that males and females were considered separately was that the healthy limits of drinking are different for the two genders: 21 units vs. 14 units per week, respectively (Department of Health, 1995).
Table 5.3 shows the means and standard deviations for light, moderate, and heavy drinkers, separately for each gender.

Table 5.3. Mean and standard deviation for weekly levels of drinking for each gender.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Female</th>
<th></th>
<th>Male</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$N$</td>
<td>$M$</td>
</tr>
<tr>
<td>Light</td>
<td>1.24</td>
<td>1.18</td>
<td>18</td>
<td>3.42</td>
</tr>
<tr>
<td>Moderate</td>
<td>8.10</td>
<td>3.48</td>
<td>19</td>
<td>16.35</td>
</tr>
<tr>
<td>Heavy</td>
<td>35.04</td>
<td>25.20</td>
<td>18</td>
<td>47.82</td>
</tr>
</tbody>
</table>

Note: the classification was achieved by using the $N$-tile command in SPSS

Table 5.4 shows the means and standard deviations of reaction times on the classic Stroop test and alcohol-Stroop test, the means and standard deviations of the number of words recalled on the post-Stroop test recall task the and means and standard deviations of emotional valence ratings of the words used in the alcohol-Stroop test. The information is presented separately for males and females at the three levels of drinking.
Table 5.4. Means and standard deviations of the classic Stroop test RTs, the alcohol-Stroop test RTs, the recall tasks, and the emotional valence tasks for female and male drinkers.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Variables</th>
<th>Light</th>
<th>Moderate</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(M) (SD)</td>
<td>(M) (SD)</td>
<td>(M) (SD)</td>
</tr>
<tr>
<td></td>
<td>Clas. Stroop Int.</td>
<td>67.51 66.75</td>
<td>92.46 48.54</td>
<td>104.30 67.51</td>
</tr>
<tr>
<td></td>
<td>Alc. Stroop Int.</td>
<td>-8.82 23.25</td>
<td>7.50 31.34</td>
<td>2.46 27.79</td>
</tr>
<tr>
<td>Females</td>
<td>Recalled alcohol words</td>
<td>4.68 2.33</td>
<td>4.71 2.20</td>
<td>5.38 2.87</td>
</tr>
<tr>
<td></td>
<td>Recalled neutral words</td>
<td>2.63 1.83</td>
<td>2.36 1.69</td>
<td>2.54 1.13</td>
</tr>
<tr>
<td></td>
<td>Emot. rating of Alc.</td>
<td>4.16 2.03</td>
<td>5.14 1.83</td>
<td>5.69 2.10</td>
</tr>
<tr>
<td></td>
<td>Emot. rating of Neut.</td>
<td>3.16 2.36</td>
<td>3.00 2.25</td>
<td>3.23 1.01</td>
</tr>
<tr>
<td></td>
<td>Clas. Stroop Int.</td>
<td>101.00 61.98</td>
<td>90.30 58.03</td>
<td>91.31 56.38</td>
</tr>
<tr>
<td></td>
<td>Alc. Stroop Int.</td>
<td>-9.30 32.15</td>
<td>1.35 22.24</td>
<td>5.87 28.00</td>
</tr>
<tr>
<td>Males</td>
<td>Recalled alcohol words</td>
<td>6.71 1.60</td>
<td>6.00 1.48</td>
<td>5.50 2.14</td>
</tr>
<tr>
<td></td>
<td>Recalled neutral words</td>
<td>3.86 2.48</td>
<td>1.00 1.34</td>
<td>2.21 1.89</td>
</tr>
<tr>
<td></td>
<td>Emot. rating of Alc.</td>
<td>4.71 2.43</td>
<td>3.91 2.63</td>
<td>6.14 1.46</td>
</tr>
<tr>
<td></td>
<td>Emot. rating of Neut.</td>
<td>4.86 3.13</td>
<td>2.73 2.15</td>
<td>3.57 1.79</td>
</tr>
</tbody>
</table>

Note: Clas. Stroop Int. = classic Stroop interference score, Alc. Str. Int. = alcohol-Stroop interference score, Emot. rating of Alc. = emotional ratings of the alcohol stimuli, Emot. rating of Neut. = emotional ratings of the neutral stimuli.

To identify whether there were differences among the age groups and types of drinkers on (a) interference scores on the classic Stroop and alcohol-Stroop tests, and (b) the number of remembered words and their emotional valence, a series of 2 x 3 x 3 between-participants ANOVAs were performed by using the GLM option in SPSS. The three factors were gender with two levels (males and females); levels of drinking, with three levels (light, moderate, and heavy); and age with three levels (A, B, and C). All possible two- and three-way interactions were included in the model. The interactions were then removed from the model if the product term was not significant. Dependent variables were the classic Stroop interference score, the alcohol-Stroop interference score, number of alcohol words recalled, emotional-valence ratings of the alcohol words, and emotional valence ratings of the neutral words.
First, the classic Stroop interference score was entered into the model as the dependent variable. There was a main effect for age, $F(2, 82) = 3.33, p < .05$, with Group C having larger interference scores than Groups A or B.

Second, the alcohol-Stroop interference score was entered into the model as the dependent variable. With an alpha level of .05, there was no significant main effect for gender, $F(2, 81) = .031, p > .05$, age, $F(2, 81) = .21, p > .05$, level of drinking, $F(2, 81) = 2.56, p > .05$, or any of the product terms.

Third, the number of alcohol words recalled from the alcohol-Stroop test was entered into the model as the dependent variable. There was a main effect for gender, $F(1, 60) = 4.04, p < .05$, with males recalling more alcohol words than females.

Fourth, the number of neutral words recalled from the alcohol-Stroop test was entered into the model as the dependent variable. The only statistically significant effect was for level of drinking, $F(2, 73) = 3.57, p < .05$, with light drinkers remembering more neutral words than moderate or heavy drinkers.

Fifth, participants’ ratings of the emotional valence of the alcohol-words were entered into the model as the dependent variable. The only statistically significant effect was for level of drinking, $F(2, 73) = 4.06, p < .05$, with heavy drinkers giving stronger emotional-valence ratings to the alcohol words than light or heavy drinkers.

Sixth, participants’ ratings of the emotional valence of the neutral-words were entered into the model as the dependent variable. With an alpha level of .05, there was no significant main effect for gender, $F(1, 72) = .92, p > .05$, age, $F(2, 72) = .99, p > .05$, level of drinking, $F(2, 72) = .37, p > .05$, or any of the product terms.

**Factor Analysis of the PCI**

Based on the guidelines discussed in Chapter 4, participants’ indices derived from the PCI were subjected to Principal Component Analysis (PCA). Ten PCI indices were included. Eight of the indices were mean ratings of the goal strivings (corresponding to eight of the rating scales). The appetitive-motivation index was calculated as $(n_{app} / n_t) \times m_{app}$, where $n_{app}$ is number of appetitive goals (i.e., those designed with the Action Word “to get” instead of “to avoid”), $n_t$ is the total number of goals, and $m_{app}$ is the mean appetitive rating of the appetitive goals. A parallel formula was used to calculate the aversive-motivation index: $(n_{aver} / n_t) \times m_{aver}$.

Based on guidelines provided by Preacher and MacCallum (2002), the sample size of 87 was deemed statistically appropriate for this factor analysis. Frequency tables and normality plots of all the variables in the analysis were explored to detect any severe
violations from normality. Three indices (mean happiness, mean sadness, and aversive motivation) were severely skewed and had an unacceptably large kurtosis. The positive skewness and high kurtosis of the happiness and sadness arose because most students had high happiness and sadness ratings. Low scores on the aversive motivation index were responsible for its negative skewness and its high kurtosis. The distributions of the remaining indices were acceptable in terms of skewness and kurtosis. Despite the problem (that homogeneity of the sample on three variables may have affected the factor solution), the issue was scrutinised further in the factor analysis diagnostic tests, which did not suggest the necessity of data transformations for the homogenous indices.

To determine whether the PCI indices shared common variance, the matrix of correlations among the indices was examined. The matrix revealed that 66% of variables were significantly correlated with each other. This suggested that many of the indices measured a common factor. Additionally, Bartlett's test of sphericity ($\chi^2 = 377.85, p < .0001$), a measure of the degree to which a variable is related to itself but not to the other variables, and Kasier-Meyer-Olkin's (KMO) measure of sampling adequacy, which yielded a medium-to-high value of .71, supported the suitability of conducting a factor analysis on the data set.

As the first step in the exploratory factor analysis of the PCI indices, Maximum Likelihood (ML) was examined. The ML method yielded an initial three-factor solution but with a non-significant Goodness-of-Fit (GOF)\(^1\). GOF yields a chi-square value and tests the null hypothesis that there is no relationship between the observed and latent variables in a predetermined model. In spite of a non-significant GOF, the three factor solution in the ML model did not yield a theoretically interpretable pattern. Limiting the number of factors to two (which fits prior factor solutions on similar data sets yielding adaptive maladaptive motivational factors) led to a significant result of the GOF test. In addition, the extracted pattern was difficult to interpret. Rotation (using orthogonal and oblique methods) improved neither the significance of the solution nor the interpretation of it.

Next, Principal-Axis Factoring (PAF) was used, again leading to an initial three-factor solution. However, limiting the number of factors to two factors did not lead to a solution, because the eigenvalues exceeded 1.00 on 25 Iterations, which is the SPSS default. Choosing various rotation methods still did not lead to any two-factor solution.

---

1. In this context, the Chi-square should have a probability value greater than 0.05 to indicate a good solution.
Next, the PCI indices were subjected to Principal Component Analysis (PCA). As discussed in Chapter 4, this method has been used in earlier studies with the MSQ and the PCI. It is the preferred method over other exploratory methods in that it is aimed at data reduction where latent variables are sought from observable variables (Bollen & Lennox, 1991). The PCA also led to an initial three-factor solution. The three models examined (LM, PAF, and PCA) all had eigenvalues greater than 1.00 on the first three factors. The Scree plots on the PAF and PCA methods led to similar conclusions about the appropriate number of factors to be included in the model. The slope of the two largest factors tapered between the second and the third factors, indicating that a two-factor solution was achievable.

In conclusion, a two-factor solution using Principal Component Analysis was selected to summarise the PCI data, based on the results of the Scree plot and interpretability of the factor loadings. Factor 1 was defined as *adaptive motivation* and Factor 2 as *maladaptive motivation*. Factor 1 accounted for 37.06% of the variance, and Factor 2, for 17.13%, for a total of 54.19% of the variance explained by the two factors. Because orthogonal and oblique rotations did not improve the factor patterns, the non-rotated solution was selected.

The loadings on the two factors are shown in Table 5.5

<table>
<thead>
<tr>
<th>The PCI variables</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood of achieving goals</td>
<td>.796</td>
<td></td>
</tr>
<tr>
<td>Control over achieving goals</td>
<td>.649</td>
<td></td>
</tr>
<tr>
<td>Knowledge about how to achieve goals</td>
<td>.719</td>
<td></td>
</tr>
<tr>
<td>Hope about achieving goals</td>
<td>.711</td>
<td>.393</td>
</tr>
<tr>
<td>Happiness from achieving goals</td>
<td>.636</td>
<td></td>
</tr>
<tr>
<td>Commitment to achieving goals</td>
<td>.769</td>
<td></td>
</tr>
<tr>
<td>Distance from goal achievements</td>
<td></td>
<td>.307</td>
</tr>
<tr>
<td>Sadness from failure at goal achievements</td>
<td>.487</td>
<td></td>
</tr>
<tr>
<td>Appetitive motivation index</td>
<td>.557</td>
<td>-.745</td>
</tr>
<tr>
<td>Aversive motivation index</td>
<td></td>
<td>.872</td>
</tr>
</tbody>
</table>

Note. Loadings less than .30 are suppressed. Highest loadings are in bold.
Respondents who scored high on Factor 1 (called *adaptive motivational structure*) felt optimistic about achieving their goals. They reported knowing what to do to achieve their goals, and felt strong personal commitment to them and control over achieving them, and expected achievement in the relatively near future. They were emotionally involved in their goal pursuits, expecting strong happiness if they succeeded and moderate sadness if they did not. Moreover, they reported a strong appetitive style in their goal pursuits; this pattern suggests that the participants tended to make an effort to get, accomplish, or obtain things that they wanted, rather than avoid things that they did not want.

Participants who scored high on Factor 2 (called *maladaptive motivational structure*) viewed themselves as avoiding things that they did not want, rather than approaching things that they did want. Factor 2 was unrelated to expectations of likelihood of achieving goals, control over achieving them, knowledge about how to achieve them, and happiness from achieving or sadness from failure to achieving them.

To define further the two factors, participants were divided into two groups through median splits of the factor scores. Participants were allocated to Group 1 if they scored above the median on Factor 1 and below the median on Factor 2. Those with scores above the median on Factor 2 and below median on Factor 1 were allocated to Group 2. Participants who scored high on both factors or low on both were not included in the following t-tests. Group 1 contained 33 participants and Group 2 had 34. The results of a series of one-tailed t-test analyses revealed that Group 1 scored significantly higher than did Group 2 on “knowledge about how to achieve goals,” \( t_{(65)} = 2.47, p < .05 \), “happiness from achieving goals,” \( t_{(65)} = 2.20, p < .05 \), and “sadness from failure at goal achievements,” \( t_{(65)} = 3.27, p < .05 \). Group 2 scored significantly higher than did Group 1 on “number of avoidant goals,” \( t_{(65)} = 5.14, p < .05 \), “distance from goal achievements,” \( t_{(65)} = 2.05, p < .05 \), and the “aversive motivation” index, \( t_{(65)} = 11.79, p < .05 \). The above results further underscore the interpretation that members of Group 1 (participants with high scores on Factor 1 and low scores on Factor 2) had an adaptive motivational pattern, whereas members of Group 2 (participants with low scores on Factor 1 and high scores on Factors 2) had a maladaptive motivational pattern.

**Multiple Regression Analyses**

To seek a parsimonious model for predicting quantity of alcohol use among university students, hierarchical regression analysis was used. Before entering the variables into the regression analysis, a scatter plot of all independent variables against
the dependent variable was drawn. Scrutinising the fit line indicated that there was a problem with the linearity assumption, suggesting a problem with the distribution of the data. To investigate the normality assumption further, the variables were subjected to skewness and kurtosis tests to determine whether either skewness or kurtosis assumptions were significantly violated. The issue was tested according to the criterion of Miles and Shevlin (2001), who suggested that a score greater than twice the standard error indicates a significant departure from acceptable skewness or kurtosis. However, these authors pointed out that violations in kurtosis are not as serious as violations of skewness, and suggested a skewness score less than 2.00 as probably unproblematic. All tests for normality assumption were followed by the Shapiro-Wilks significance test. It was found that the weekly mean drinking (the dependent variable) and age severely violated the normality assumption. In addition, perceived stress scores (PSS), classic Stroop interference scores, and scores from the recall task moderately violated the normality assumptions (either for skewness or kurtosis, or both). To normalise the distributions, area transformation was used. There are several different transformations for normalising distributions (e.g., cubic, logarithm and logarithm 10, square and square root, Arcsine, reciprocal, reciprocal root). However, one of the most efficient transformations is the area transformation that was introduced by McCall (1922; cited in Krus, 1977; 2003). Accordingly, the standardised data were subjected to area transformation using the Rankit formula in SPSS. After the transformations, the variables were re-examined using normal-distribution tests. In all cases, the assumptions of normality and linearity were now met. Moreover, after fitting the model, all the linear-regression assumptions, including the assumption of joint distribution, were tested by multiple regression diagnostic methods. All assumptions were met.

1. Transformation→ Rank cases→ Rank type→ More→ Normal Scores→ Options are Blom, Tukey, Rankit, or Van der Waerden.

2. The formulae for area transformation is shown below. The mean of standard scores, always equals zero; the variance of standard scores, always equals one. ($\mu = \text{each moment's mean, } Z = \text{standard scores, } n = \text{number of variables.}$)

<table>
<thead>
<tr>
<th>Mean</th>
<th>Variance</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_1 = \frac{\sum Z}{n}$</td>
<td>$\mu_2 = \frac{\sum Z^2}{n}$</td>
<td>$\mu_3 = \frac{\sum Z^3}{n}$</td>
<td>$\mu_4 = \frac{\sum Z^4}{n} - 3$</td>
</tr>
</tbody>
</table>
Table 5.6 shows the intercorrelations among variables entered into the regression model.

Table 5.6. Intercorrelations among the study variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>WD</th>
<th>Gender</th>
<th>Age</th>
<th>IQ</th>
<th>PSS</th>
<th>RAW</th>
<th>F. 1</th>
<th>F. 2</th>
<th>ECF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>0.23*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.25*</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>NS</td>
<td>0.32**</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAW</td>
<td>NS</td>
<td>0.23*</td>
<td>NS</td>
<td>0.2*</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. 1</td>
<td>NS</td>
<td>NS</td>
<td>0.32**</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. 2</td>
<td>0.33**</td>
<td>NS</td>
<td>-0.24*</td>
<td>-0.08</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECF</td>
<td>NS</td>
<td>NS</td>
<td>0.22*</td>
<td>0.22*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>-0.26*</td>
<td></td>
</tr>
<tr>
<td>Alc. Int.</td>
<td>0.26**</td>
<td>NS</td>
<td>NS</td>
<td>-0.2*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>-0.2*</td>
</tr>
</tbody>
</table>

Note. WD = weekly mean drinking; PSS = perceived stress score; RAW = recalled alcohol words; F. 1 = Factor 1 (adaptive motivational structure); F. 2 (Factor 2 (maladaptive motivational structure)); ECF = executive cognitive functions (assessed by classic Stroop test); Alc. Int. = alcohol interference score (attentional bias for alcohol-related stimuli). *p < .05, **p < .01, two-tailed.

Table 5.6 shows that there were significant correlations between weekly mean drinking and gender, age, maladaptive motivational structure, and attentional bias for alcohol-related stimuli. From the intercorrelations matrix, there is no evidence of collinearity among the variables. The collinearity issue was also addressed in the regression model. This and other regression diagnostics is described later in this chapter.

The hierarchical regression analysis comprised nine steps, each of which estimated the unique contribution of the variable at that step over the variables previously entered. The variables entered in each step and the rationale for the order of entering them is as follows.

Gender was the first variable entered because there was prior evidence that it is a strong predictor of alcohol consumption among university students. Age was entered next to control for its effect on drinking above the effect of gender. IQ was entered in the third step because participants' responses to the recall task, their evaluation of their level...
of perceived stress, and their responses to the PCI all could logically have been affected by their IQ. The perceived stress scores (PSS) were entered in the fourth step, because the literature provides evidence for the role of stress in drinking behaviour (see Chapter 4). The number of alcohol words recalled was entered in Step Five, because of the evidence (see Chapter 4) suggesting that memory can be addiction-sensitive—hence, it can play a role in drinking behaviour—and that the alcohol-Stroop test primes alcohol-related stimuli in short-term memory. The PCI Factors 1 and 2, indicating adaptive and maladaptive motivational structures, were entered in Steps Six and Seven to estimate the unique effect of each factor in predicting amount of drinking.

Chapter 2 described how time latencies on the alcohol Stroop can be attributed to a general ability to respond in conflict situations and that performance on both the classic and alcohol-Stroop tests reflect interference from this source. To exclude plausible effects of general executive cognitive functioning on reactions to the alcohol words, interference scores in the classic Stroop test were entered in Step Eight followed by interference scores in the alcohol-Stroop in Step Nine.

The hypothesis by the regression analysis was that maladaptive motivational structure and attentional bias are significant predictors of the amount of alcohol consumption when the effects of other variables had been controlled. The results of the analysis are shown in Table 5.7.

Before interpreting the results of the regression analysis, the model was scrutinised to ensure that the regression model’s assumptions had been satisfied (see Miles & Shevlin, 2001). First, two indices were used to examine the assumption of a normal joint distribution. These indices were (a) the shape of standardised residual histogram and its normal curve and (b) the normal P-P plot of regression-standardised residuals. Both indices confirmed the normality assumption. Second, to test the homoscedasticity assumption, studentised residuals were plotted against standardised predicted values. It was clear from the scatter plot of residuals that the distributions of the variances were equal; therefore, the assumption of homoscedasticity was not violated. Third, to test the assumption of linearity, partial regression plots (i.e., plots of residuals) were examined. These revealed that all nine partial regression plots met the criteria for the linearity assumption. Fourth, to check for possible problems with collinearity,

---

1. The homoscedasticity assumption requires that the variance of the residuals at every set of values for the independent variables is equal. The condition violating this assumption is heteroscedasticity.
Table 5.7. The results of hierarchical regression analysis of variables predicting weekly mean drinking.

<table>
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<tr>
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Note. Gender was coded as males = 0, females = 1; ECF = executive cognitive function (assessed by use of classic Stroop test); and PSS = perceived stress score. *$p < .05$. 
Tolerance and VIF scores were examined. With no Tolerance score less than .78, it was concluded that collinearity was not a problem. Fifth, to investigate the existence of any influential outliers that may have had an effect on the outcome of the calculations, Cook’s *distance statistics*, and *DfFit* influential statistics were examined. The advantage of Cook’s distance is that it is based on studentised residuals and leverage values. A Cook’s distance value greater than 1.00 deserves scrutiny (see Howell, 1997). Miles and Shevlin (2001) suggested a formula¹ to calculate a cut-off point for DfFit. In this model, a cut-off point of DfFit = 6.25 was calculated (see Miles & Shevlin). As far as Cook’s distance and the DfFit were concerned, the model did not include any value greater than .086 for the Cook’s distance and .34 for the DfFit. The above tests established the validity of the hierarchical regression model that was used.

In the regression model, Step One showed that gender significantly predicted amount of drinking, accounting for 5% of the variance, $F(\eta, 86) = 4.86, t = -2.20, p < .05$. The second step showed that age was a significant predictor of the amount of drinking, producing a 5% increment in $R^2$ above the proportion already explained by gender, $F(\eta, 86) = 4.39, t = -2.20, p < .05$. However, inclusion of IQ in the third step ($\Delta R^2 = .01, p > .05$), PSS in the fourth step ($\Delta R^2 = .01, p > .05$), number of alcohol words recalled in the fifth step ($\Delta R^2 = .01, p > .05$), and adaptive motivational structure (Factor 1) in the sixth step ($\Delta R^2 = .01, p > .05$) did not produce any significant increment in $R^2$. In the seventh step, inclusion of maladaptive motivational structure (Factor 2) accounted for a significant increment in $R^2$ ($\Delta R^2 = .06$) that was independent of the earlier variables in the model, $F(\eta, 86) = 2.97, t = 2.50, p < .05$. In the eighth step, inclusion of the ECF index (derived from the classic Stroop test) did not produce a significant increment in $R^2$ ($\Delta R^2 = .002, p > .05$). In the ninth step, inclusion of attentional bias for alcohol-related stimuli accounted for a significant change in $R^2$ over all of the preceding variables in the model ($\Delta R^2 = .05$). Therefore, the final step included nine predictors, with three significant predictors (i.e., gender, maladaptive motivational structure, and attentional bias for alcohol-related stimuli), which together explained 18% of the variance in the amount of drinking, $F(\eta, 86) = 3.09, t = 2.48, p < .05$. The entire model (including nine predictors) was subjected to a *post hoc* effect-size and power analyses. Using the G*power software (Erdfelder, Faul, & Buchner, 1996) an $f^2 = .36$ was obtained. This corresponds to a large effect size (Cohen, 1992). The rule of thumb that should be used is to scrutinise cases that have a cut-off: $DfFit = \sqrt{\frac{2}{K/N}}$

1. The rule of thumb that should be used is to scrutinise cases that have a cut-off: $DfFit = \sqrt{\frac{2}{K/N}}$ where $K$ is number of predictors and $N$ is the sample size.
A post hoc power analysis using the same software yielded a Power of .98 and a Lambda value of 32.17.

To determine if gender and age moderated the effects of the other variables in the model, a series of two-way interactions was tested. In all, 9 two-way interactions involving gender and 9 two-way interactions involving age were calculated and tested. Ten three-way interaction terms were also calculated and tested. The interactions were (a) Age x Gender x Factor 1, (b) Age x Gender x Factor 2, (c) Age x ECF x Factor 1, (d) Age x ECF x Factor 2, (e) Age x Alcohol attentional bias x Factor 1, (f) Age x Alcohol attentional bias x Factor 2, (g) Gender x ECF x Factor 1, (h) Gender x ECF x Factor 2, (i) Gender x Alcohol attentional bias x Factor 1, and (j) Gender x Alcohol attentional bias x Factor 2.

To test the two-way interactions that included a continuous variable (e.g., age), all continuous variables were first standardised and then, if necessary, they were normalised. In order to identify the unique effect of each product term, each pair of main-effect variables was entered in the first step and the interaction term in the second step. Only the interaction between gender and Factor 2 was significant, \( F(2, 86) = 7.59, t = -2.01, p < .05 \) (see Figure 5.2).

![Figure 5.2. Graph showing the interaction between gender and the PCI Factor 2 in predicting weekly mean drinking.](image)

Note. UPV = Unstandardised Predicted Values
As Figure 5.2 shows, males and females had different slopes for predicting the amount of drinking from their maladaptive motivational scores; males had a flat slope at different points of Factor 2 whereas women did not.

Based on the above results and in an attempt to identify a parsimonious model to predict alcohol consumption, gender, Factor 2, and attentional bias for alcohol-related stimuli were included in a separate hierarchical regression analysis. This was done to see if after removing other variables from the model gender, Factor 2, and attentional bias could still significantly predict amount of alcohol consumption (Table 5.7).

Table 5.8. Results of hierarchical regression analysis for predicting the amount of alcohol consumption from gender, PCI Factor 2, and alcohol attentional bias.

<table>
<thead>
<tr>
<th>Steps</th>
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Note. Gender was coded as males = 0, females = 1. *p < .05, ** p< .01.

First, the regression model was tested for the required assumptions to be met. There was no evidence to suspect that the model was not valid. As Table 5.7 shows, gender, F(1, 86) = 4.86, t = -2.20, p < .05, PCI Factor 2, F(2, 86) = 7.59, t = 3.13, p < .01, and attentional bias for alcohol-related stimuli, F(3, 86) = 7.51, t = 2.52, p < .05, remained significant predictors of amount of drinking, with attentional bias a significant predictor over and above the other two variables (R² = .27, λ = 23, Power = .99).

These results suggest that something had been ignored in the earlier studies using the MSQ or PCI to predict amount of drinking from motivational structure, as well as in alcohol research in general. The important consideration that has been overlooked is the use of a gender-specific scale of drinking that gives the researcher the ability to predict heavy drinking based not only on the absolute amount of drinking but one that takes gender-specific levels of heavy drinking into account. In the United Kingdom, 21 units of alcohol is considered the healthy limit for males, and 14 units, for females; therefore,
females are advised to drink a maximum of two-thirds of the amount that males can drink. These cut-off points can be used to develop a simple gender specific index of drinking (GSID) in which the number of units that females drink is multiplied by 1.5. The gender-adjusted scores from this index were used in the present study, instead of the absolute number of units consumed, and the regression analysis was run again. The results showed that the significant effect of gender originally seen was no longer significant in the new analysis. In the new model, age, PCI Factor 2, and attentional bias remained significant predictors; therefore, inclusion of the GSID as dependent variable in the analysis led to a powerful model, \( f^2 = 0.25 \), power = .89. The interaction between gender and PCI Factor 2 was still significant \( (R^2 = .12 \) for Gender x Factor 2, and \( R^2 = .045 \) for the product term), \( F(1,3) = 5.57, p < .05 \). In summary, the new index of drinking removed the main effect of gender that was apparent in the earlier model, in which the customary amount of drinking index was used as the predicted variable.

**Discussion**

First, some comments should be made about the statistical analysis of the current results. The results of the power analysis is in accordance with the idea that suggest the lack of necessity for restricted criteria for sample size in factor analysis (e.g., Gorsuch, 1983; MacCallum, et al., 1999; see Chapter 4). Recall that according to some views discussed in Chapter 4, a researcher should not select a sample size less than 100 when conducting a factor analysis. The factor analysis results in this study fell within Preacher and MacCallum's (2002) guidelines for selecting appropriate sample sizes. The authors suggest that when recovery of two factors among 10 variables is sought, a sample size in the 20-to-50 range is expected to be associated with **good to excellent** model fit. The results of the PCA showed that this method could be reliably used to reduce the PCI data in order to simplify the data analyses.

The results of the study showed that the mean level of alcohol consumption by male and female students is slightly above the recommended levels (i.e., 14 units for females and 21 units for males in a week). However, 43.8% of the males \( (M = 43.19 \) standard units) and 34.5% of the females \( (M = 33.94 \) standard units) consumed alcohol above the recommended levels. The finding is consistent with the Gill's (2002) recent report that the percentage of male and female university students who exceeded the recommend levels of alcohol consumption is substantial.
The hierarchical regression analysis supported the study hypothesis that maladaptive motivational structure and attentional bias for alcohol-related stimuli can predict amount of drinking over and beyond other variables in the model. In addition, there was a significant interaction between gender and PCI Factor 2 in predicting amount of drinking. The interaction indicates that males' drinking was not dependent on their level of maladaptive motivation; for females, however, amount of drinking consistently increased as maladaptive motivational scores increased. This result should be interpreted cautiously. Considering that there were 36 possible two-way interactions in the model and an alpha of .05, two significant interaction terms should have resulted by chance. The results (see Table 5.2) are consistent with other findings in the field indicating that male students drink more alcohol than female students (e.g., Gill, 2002). However, for the majority of students (56% males and 63.5% females) this amount usually did not exceed the recommended level. This may be related to female students suffering from greater negative consequences of heavy drinking than male students (Gill, 2002). For example the risk of injury increases with the quantity of alcohol consumed, and the risk of injury is significantly higher for women than for men. McLeod, Stockwell, Stevens, and Phillips (1999) reported an odds ratio of 3.4 for the risk of injury after consuming more than 60 g of alcohol in a 6-hour period, after controlling for demographic variables. The risk of injury at different levels of alcohol use was substantially higher for females with a significant odds ratio of 9.6 at greater than 60 g of alcohol compared to 2.1 for men.

Evidence (e.g., Baraona et al., 2001; Jelski, Chrostek, Szmitkowski, & Laszewicz, 2002) suggests that women's greater susceptibility to the negative or toxic effects of alcohol (such as on the liver, heart muscle, skeletal muscle, pancreas, and the brain), which has long been attributed to women's smaller body size and their relatively higher percentage of fatty tissue, could be a result of what is known as first-pass metabolism. Before alcohol reaches the blood stream, it goes through the stomach, where gastric Alcohol Dehydrogenase (ADH) enzymes break some of it down. Women have less of the ADH activity than do men. Therefore, for a given dose of alcohol, women's blood level is higher than it is for men. However, Parlesak, Billinger, Bode, and Bode (2002) reported that the question of ADH activity in males and females should be addressed with respect to age. These authors found that gastric ADH activity in young men is distinctly higher compared to young women, but the opposite is true in middle-aged participants. Therefore, there is evidence that, at least partly, explains why female students tend to drink less alcohol than do male students.
Although the results of the recall tasks are consistent with the view that the Stroop test can be considered a measure of memory retrieval (Macleod, 1991; Pretti, 1998; Wells & Mathews, 1994), the number of recalled alcohol words was not a significant predictor of alcohol consumption. This finding suggests that among non-dependent drinkers, addiction-sensitised memory is not sufficiently developed to predict the level of alcohol consumption. The finding, however, is inconsistent with those theories (e.g., Boening, 2001, McCusker, 2001; Stacy, 1997; Weingardt, Stacy, & Leigh, 1996) giving addiction-related memory retrieval a prominent role in addictive behaviours. Resolution of this issue, therefore, awaits further research.

The results of the study help to elucidate both cognitive and motivational reasons for drinking, and how the two kinds of factors can be brought together in a unifying cognitive-motivational theory of alcohol consumption (Cox & Klinger, 1988).

The ability of motivational structure to predict alcohol consumption is consistent with earlier findings. Cox et al. (2002) found that a maladaptive motivational pattern significantly predicted amount of drinking among university students, irrespective of the nationality of the participants. Therefore, the present study adds to the evidence in support of the idea that motivational structure is an important determinant of drinking behaviour.

The convergent evidence from different studies that motivational structure can predict drinking behaviour supports the notion described in Chapter 1 that motivational adaptivity or maladaptivity depends on the combination of different motivational dimensions (i.e., appetitive versus avoidant action, expected likelihood of success, knowing what to do to reach one’s goals, perceived control, commitment, expected joy, expected sorrow, and goal distance). In this study, the adaptive motivational structure was characterised by appetitive motivation, knowing what to do, feelings of optimism about achieving goals, perceived control over goal achievements, expected happiness from success and sorrow from lack of success, and a feeling that goals would be achieved in the near future. In contrast, the maladaptive structure was characterised by a strong negative loading on appetitive motivation and a strong positive one on aversive motivation, and without significant loadings on the other motivational indices. The importance of appetitive and avoidance motivation in characterising motivational structure as assessed by the PCI is consistent with Elliot and Thrach’s (2002) finding that approach and avoidant temperaments are systematically linked to goal achievements.
The finding that aversive motivation is related to alcohol consumption melds nicely with relationships between drinking and positive and negative mood states identified in earlier research. According to Cox and Klinger (1988), as described in Chapter 1, expectancies about affective changes from consuming alcohol can be summarised into four categories: alcohol can (a) enhance positive affect, (b) decrease positive affect, (c) decrease negative affect, or (d) increase negative affect. Three studies (Carey & Correia, 1997; Cooper, 1994; Cooper et al., 1995) have found support for the predictive values of positive and negative motives for drinking. In the present study, only negative motives were significant predictor of drinking; therefore, an avoidant style of motivation (i.e., one in which the person tries to avoid harm and undesirable consequences) seems strongly associated with heavy drinking. In the present study, the predictive value of maladaptive motivational structure (with the highest loading on aversive motivation) to explain alcohol consumption is consistent with these earlier findings. An aversive motivational pattern is likely to be associated with strong negative affect and a pattern of heavy drinking to overcome the negative feelings. This interpretation is consistent with the results of prior studies (e.g. Colder, 2001) and theory (Greely & Oei, 1999) that people drink to cope with negative moods.

The ability of attentional bias to predict alcohol consumption, which was demonstrated in the present study, supports cognitive theories of addiction which state that alcohol-related stimuli capture drinkers' attention and play an important part in their alcohol consumption (e.g., Robinson, & Berridge, 2000, 2003; Tiffany, 1999; Tiffany & Conklin, 2000). The significant relationship between students' attentional bias for alcohol-related stimuli and their alcohol consumption is consistent with the results of earlier attentional-bias studies of heavy drinking students (Stormark, Field, Hugdahl, & Horowitz, 1997)

The present study also supports the results of other alcohol-Stroop studies with student samples. For example, Stewart and Samoluk (1997) found that a group of high (but not low or moderate) food-restraint students had significantly longer latencies for food-related and alcohol-related stimuli on a Stroop task than they did for control words. As the authors noted, one reason for the high-restraint group's attentional bias may have been their extreme concern to avoid high-calorie foods and drinks. Finally, the present results also support Cox et al.'s (1999) finding that alcohol cue exposure increases heavy student drinkers' distraction for alcohol-related stimuli.
Conclusions

The following conclusions can be drawn from the study, although they are, of course, subject to certain limitations. (a) The alcohol-Stoop test is a valid and sensitive measure of attentional bias for concern-related stimuli. However, unlike prior research, future research should ensure that the stimuli intended to be neutral in emotional valence are in fact neutral for the participants being tested. (b) The PCI can appropriately be subjected to principal component analysis for purposes of data reduction and analysis. (c) Apart from demographic variables (i.e., age, gender), only maladaptive motivational structure and attentional bias for alcohol-related stimuli were significant predictors of alcohol consumption in the current sample of participants.

Although motivational structure is a significant predictor of drinking behaviour in situations promoting drinking behaviour, such as universities, its predictability may be affected by gender-specific norms (i.e., male students usually drink more than do female student). In the present study, gender was a significant predictor of drinking when the usual index of drinking was used but not when the new one adjusted for gender-specific healthy levels of drinking was used. Recall that in both cases there was a significant interaction between gender and PCI Factor 2. However, the power of attentional bias to predict amount of drinking remained unaffected by which index of drinking was used. Although both maladaptive motivation and alcohol attentional bias on the alcohol-Stroop test were positively related to the amount of alcohol that participants consumed, attentional bias remained a significant predictor after maladaptive motivation and the other variables had been controlled. This finding underscores the importance of attentional bias for alcohol-related stimuli in predicting drinking behaviour.
CHAPTER SIX

Social Drinkers’ Executive Cognitive Functioning and Its Relationship to Motivation and Attentional Bias

As discussed earlier, many factors are associated with alcohol consumption. Results presented in Chapter 5 suggest that, beyond other factors, gender, maladaptive motivational structure, and attentional bias for alcohol-related stimuli were the most potent predictors of amount of alcohol consumption among a sample of student drinkers. Chapter 3 discussed the view that alcohol consumption can be associated with impairments in executive cognitive functioning (ECF). Recall that the ECF refers to cognitive functions involved in planning and guiding behaviour in order to achieve a goal in an effortful and deliberate manner. The system is involved in various abilities, such as holding and manipulating information in working memory. As mentioned, communicating with stores in working memory and the inhibition of task-irrelevant responses are two fundamental processes that underlie both types of ECF (i.e., cognition-based and emotion-based); therefore, the ECF plays an important role in self-monitoring, self-control, and behavioural planning and decision-making (e.g., Cahn-Weiner et al. 2000; Hoaken et al., 1998). Evidence supports the possibility that brain damage, whether resulting from or predating alcohol use, may contribute to the development and progression of alcohol abuse (e.g., Bowden et al., 2001; Giancola & Moss, 1998).

It is reasonable to ask whether students who drink heavily exhibit deficiencies in their ECF processes. Only limited research has directly evaluated the relationship between alcohol and the ECF processes in university students. Blume et al. (2000) studied the ECF of a group of heavy drinking college students and noticed that poorer ECF was associated with more drinking problems and little motivation to change. There has been no study of student drinkers’ ECF impairments, and their relationship to motivational pattern (Cox & Klinger, 2004) and attentional bias on an alcohol-Stroop test. For the reasons discussed (see Chapter 3), the classic Stroop test was considered a valid test to assess students’ ECF.

As discussed in Chapter 3, alcohol consumption can damage the central nervous system, especially the frontal lobe, where executive functions are located. In addition, performance on dual component tasks such as the classic Stroop test requires considerable ECF abilities (Ardouin et al., 1999; Carter et al., 2000; de Jong et al., 1999; Mahurin et al., 1998; Pardo et al., 1990). Stetter et al. (1995) found a positive significant relationship
between participants' scores on the classic Stroop test (as a measure of cognitive impairment) and their scores on the alcohol-Stroop test. One explanation by these researchers focused on the similarity between test materials on the two versions of the Stroop. Other explanations are plausible. For example, perhaps one important similarity between these two tests is their relationship to ECF. Moreover, in Stetter et al.'s study, it is not clear whether interference scores on the classic Stroop test were associated with interference scores on the alcohol-Stroop test, or whether only the reaction times were correlated with each other. Chapter 3 suggested that the relationship between ECF (assessed by classic Stroop test) and participants' performance on the emotional Stroop tests (e.g., alcohol-Stroop test) warrants investigation. One can suspect that some proportion of the attentional bias on the alcohol-Stroop test results from ECF impairments caused by alcohol consumption. The argument follows the assumption that ECF deficits may differentially influence participants' reactions to emotional and neutral words. Theoretically, responses to emotional words need more inhibitory resources to suppress the semantic dimension of the salient words in favour of responding to the relevant aspect (i.e., colours). In such case, it is reasonable to hypothesise a relationship between interference scores on the classic Stroop test and interference scores on the emotional Stroop test. This issue was addressed in the current research.

This chapter investigates the following hypotheses: (a) students' ECF performance can be predicted from their drinking behaviour, (b) interference scores on the alcohol-Stroop test reflect attentional bias for alcohol-related stimuli independently of participants' ECF, and (c) a poorer ECF is associated with a more maladaptive motivational structure.

In the present research, ECF is defined as classic Stroop interference scores for the reasons described in Chapter 4. However, to further investigate the relationship between alcohol consumption and cognitive processes, the SILS Vocabulary and Abstraction Reasoning Indices (i.e. Abstract T-score and Abstraction Quotient) were also used in analyses.

In summary, the present analyses were designed to see if alcohol consumption can predict the level of ECF, and how ECF can predict attentional bias for alcohol-related stimuli.
**Method**

The analyses are based on the data about which the methodological issues were described in Chapter 4 and Chapter 5. The methodology will be covered here only to describe those issues not covered in Chapter 4 and Chapter 5.

**Participants and Procedure**

The participants were those described in Chapter 5. However, for purposes of this study, only the participants who drank alcohol were included, regardless of whether they were problem drinkers. Six participants were not included in the sample because of problematic data. The total sample included 101 participants (females = 50, males = 51), which fits the requirements of the priori power analysis (see Chapter 5). The experimental procedure was as described in Chapter 4.

**Results**

**Analysis of Errors**

The mean percentage of errors was 1.97% on the classic Stroop test and 1.62% on the alcohol-Stroop test. Similar to Chapter 4, a series of nonparametric and parametric analyses of errors in this study indicated no significant difference across the four categories of words (i.e., colour-congruent, colour-incongruent, alcohol, and neutral). A Kruskal-Wallis Test of the errors across the categories revealed no significant difference in number of errors made by participants regardless of their level of alcohol consumption, $x^2 (3) = .001 p > .05$. Next, using the N-tile command in SPSS ($N = 3$) and based on weekly mean of alcohol consumed, participants were divided into three groups, designated as light ($N = 33, M = 4.87, SD = 2.68$), moderate ($N = 34, M = 17.74, SD = 6.26$), or heavy drinkers ($N = 34, M = 49.95, SD = 21.04$). A series of one-way analyses of variance revealed that there was not a significant difference among the three groups of drinkers in the number of errors made across each category of words. The same analysis showed no significant difference among the three groups of drinkers on total numbers of errors on the classic Stroop test or on the alcohol-Stroop test. The negative correlation between PCI Factor 2 and number of errors on the classic Stroop test approached significance, $r = -.16, p = .052$. Further analysis of errors was deemed unnecessary.
**Demographic Characteristics and Between-Group Comparisons**

The means and standard deviations of age, years of education, the Shipley Institute of Living Scale (SILS) scores, and Perceived Stress Scale (PSS) scores are shown in Table 6.1, separately for males and females.

Table 6.1. Means and standard deviations of age, years of education, SILS scores, and PSS score for each gender.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Females (N = 50)</th>
<th>Males (N = 51)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>22.98 7.06</td>
<td>21.49 5.88</td>
</tr>
<tr>
<td>Education (in years)</td>
<td>14.12 .71</td>
<td>14.13 .960</td>
</tr>
<tr>
<td>Shipley Vocabulary T-score</td>
<td>53.92 6.72</td>
<td>55.65 6.36</td>
</tr>
<tr>
<td>Shipley Abstraction T-score</td>
<td>57.94 5.47</td>
<td>59.80 3.91</td>
</tr>
<tr>
<td>Shipley AQ</td>
<td>107.54 9.27</td>
<td>107.98 8.32</td>
</tr>
<tr>
<td>IQ (Shipley WAIS-R)</td>
<td>106.60 8.20</td>
<td>112.14 6.84</td>
</tr>
<tr>
<td>PSS</td>
<td>6.00 2.00</td>
<td>6.00 3.00</td>
</tr>
</tbody>
</table>

Note: Shipley AQ = Shipley Abstraction Quotient, PSS score = perceived stress scale score.

To determine if males and females differed from each other on these variables, a series of t-tests was conducted (all tests two-tailed). There was no significant difference (a) between females’ and males’ age, \( t_{(99)} = 1.15, p > .05 \); (b) females’ and male’s education, \( t_{(99)} = .102, p > .05 \); and (c) females’ and males’ PSS score, \( t_{(99)} = .060, p > .05 \). The SILS scores were subjected to a series of t-tests (all tests two-tailed), which yielded a significant difference between females and males only on the Shipley Estimated WAIS-R IQ, \( t_{(99)} = 3.68, p < .01 \), with males scoring higher than females.

The means and standard deviations of usual drinking per week, unusual drinking per week, weekly mean drinking, age of first drink, participant-SMAST scores, mother-SMAST scores, and father-SMAST scores are shown in Table 6.2, separately for males and females.
Table 6.2. Means and standard deviations of the drinking indices and SMAST scores.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Femaless (N= 50)</th>
<th>Males (N= 51)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Usual drinking per week</td>
<td>12.79</td>
<td>14.36</td>
</tr>
<tr>
<td>Unusual drinking per week</td>
<td>6.39</td>
<td>9.90</td>
</tr>
<tr>
<td>Weekly mean drinking</td>
<td>19.17</td>
<td>21.50</td>
</tr>
<tr>
<td>Age of first drink</td>
<td>16.78</td>
<td>1.75</td>
</tr>
<tr>
<td>Participant-SMAST scores</td>
<td>.64</td>
<td>1.07</td>
</tr>
<tr>
<td>Mother-SMAST scores</td>
<td>.30</td>
<td>.65</td>
</tr>
<tr>
<td>Father-SMAST scores</td>
<td>.66</td>
<td>1.10</td>
</tr>
</tbody>
</table>

Note: The amount of drinking is in standard units.

To determine the relationship between participants' SMAST score with those of their parents, simple bivariate Pearson correlations were computed. Results revealed that scores on the participant-SMAST (M = .93, SD = 1.50) were significantly correlated with those on mother-SMAST (M = .38, SD = .83), \( r_{(101)} = .33, p < .001 \), and father-SMAST (M = .62, SD = 1.16), \( r_{(101)} = .21, p < .01 \). In addition, scores on the mother-SMAST were moderately correlated with those on the father-SMAST, \( r_{(101)} = .45, p < .001 \).

Table 6.3. Mean and standard deviations of the classic Stroop and alcohol-Stroop interference scores, recall scores, and emotional valence ratings for each gender.

<table>
<thead>
<tr>
<th></th>
<th>Females (N = 50)</th>
<th>Males (N = 51)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Classic Stroop test interference score</td>
<td>100.03</td>
<td>59.25</td>
</tr>
<tr>
<td>Alcohol-Stroop test interference score</td>
<td>1.48</td>
<td>28.09</td>
</tr>
<tr>
<td>Recalled alcohol words</td>
<td>4.83</td>
<td>2.35</td>
</tr>
<tr>
<td>Recalled neutral words</td>
<td>2.37</td>
<td>1.51</td>
</tr>
<tr>
<td>Emotional rating of the alcohol words</td>
<td>5.41</td>
<td>1.95</td>
</tr>
<tr>
<td>Emotional rating of the neutral words</td>
<td>3.15</td>
<td>1.80</td>
</tr>
</tbody>
</table>
The means and standard deviations of reaction times on the classic Stroop test and the alcohol-Stroop test, the memory scores (for the alcohol and neutral words), and the emotional valence ratings (for alcohol and neutral words) are shown in Table 6.3, separately for males and females.

To determine whether males and females differed from each other on the variables shown in Table 6.3, a series of $t$-tests was conducted (all tests two-tailed). Results revealed a significant difference between females and males in number of alcohol words recalled, $t(90) = 2.33, p < .05$, with males remembering more alcohol words than females. In addition, there was a significant difference between females and males in their ratings of the emotional valence of the neutral words, $t(90) = 2.21, p < .05$, with males giving stronger ratings to the neutral words than females.

**Factor Analysis of the PCI**

Based on guidelines discussed in Chapter 4 and Chapter 5, the PCI results were factor analysed. Again, Principal Component Analysis (PCA) was used. All data considerations were similar to those of Chapter 5, explained under Factor Analysis of the PCI.

To determine whether the indices shared common variance, a correlation matrix for the 10 PCI variables was examined. The matrix revealed that 53% of the variables were significantly correlated with each other, suggesting that the variables shared a common factor.

Bartlett's test of sphericity ($\chi^2 = 42.00, p < .0001$), a measure of each variable's relatedness to itself and the lack of relatedness to the other variables, and the Kasier-Meyer-Olkin (KMO) measure of sampling adequacy giving a medium-to-high value (.69) indicated that the data were appropriate for factor analysis (Kline, 1994). The PCA led to an initial three-factor solution. Based on the Scree plot (the slope of the two largest factors tapered between the second and the third factors) and the interpretability of the factor loadings, a two-factor solution was selected to summarise the PCI data.

Factor 1 accounted for 31.24% of the variance, and Factor 2 accounted for 17.35% of the variance, for total of 48.60% of the variance explained by the two factors. Because orthogonal and oblique rotations did not improve the factor patterns, the non-rotated solution is reported here. The two factors with their corresponding factor loadings are shown in Table 6.4.
Table 6.4. Factor loadings from the PCI factor analysis.

<table>
<thead>
<tr>
<th>The PCI variables</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood of achieving goals</td>
<td>.753</td>
<td></td>
</tr>
<tr>
<td>Control over achieving goals</td>
<td>.624</td>
<td></td>
</tr>
<tr>
<td>Knowledge about how to achieve goals</td>
<td>.749</td>
<td></td>
</tr>
<tr>
<td>Hope about achieving goals</td>
<td>.725</td>
<td></td>
</tr>
<tr>
<td>Happiness from achieving goals</td>
<td>.591</td>
<td></td>
</tr>
<tr>
<td>Commitment to achieving goals</td>
<td>.629</td>
<td></td>
</tr>
<tr>
<td>Distance from goal achievements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sadness from failure at goal achievements</td>
<td>.346</td>
<td></td>
</tr>
<tr>
<td>Appetitive motivation index</td>
<td>.402</td>
<td>-.842</td>
</tr>
<tr>
<td>Aversive motivation index</td>
<td></td>
<td>.899</td>
</tr>
</tbody>
</table>

Note. Loadings less than .30 are suppressed. Highest loadings are in bold.

The results of the factor analysis are similar to the pattern reported in Chapter 5. Respondents who scored high on Factor 1 (showing an adaptive motivational structure) believed that they were very likely to achieve their goals. They reported knowing what to do to achieve their goals, commitment to doing so, control over their goal attainments, and they believed that they would achieve their goals in the relatively near future. They were also emotionally involved in their goal pursuits, expecting strong happiness if they succeeded and moderate sadness if they did not succeed.

By contrast, participants who scored high on Factor 2 (reflecting a maladaptive motivational structure) did not show strong loadings on the motivational indices that the Factor 1 participants were high on. They did not know how to pursue their goals. They did not report expectations of either happiness from achieving or sadness from failing to achieve their goals. They did not feel commitment to or control over or optimism about their goal achievements. Motivationally, they were characterised by trying to avoid unpleasant things rather than trying to approach attractive ones.

**Multiple Regression Analyses**

To test the hypotheses of the present study, a series of hierarchical regression analyses was conducted. Based on procedures described in Chapter 5, the variables were tested to ensure that the regression analysis assumptions were met. To meet the
assumptions about linearity and normal distribution, normalised z-scores were calculated for Age, PSS score, participant-SMAST scores, and weekly mean drinking. After transformation (using area transformation; see Chapter 5), the variables were re-examined using normal-distribution tests. It was found that, after normalisation, the assumptions of normality and linearity were met. Moreover, after fitting each model, all the linear regression assumptions including the assumption of joint distribution of variables, homoscedasticity, collinearity, and distance statistics (i.e., Cook's distance and D/fit influential statistics) were tested using multiple regression diagnostic methods (see Chapter 5). Again, all the assumptions were met and the adequacy of the regression models was ensured.

To test the first hypothesis that students' ECF performance can be predicted from their drinking behaviour, first, classic Stroop interference scores were regressed on the weekly amount of drinking after controlling for the effects of gender, age, IQ, and perceived stress scores.

Table 6.5 shows the intercorrelations among the variables entered into the regression model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>ECF</th>
<th>Gender</th>
<th>Age</th>
<th>IQ</th>
<th>PSS score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td>.15*</td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>.15*</td>
<td>-.348***</td>
<td>.15*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS score</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>-.16*</td>
<td></td>
</tr>
<tr>
<td>Weekly mean drinking</td>
<td>NS</td>
<td>-.28**</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Note: P-SMAST = participant-SMAST scores, *p < .1, *p < .05, **p < .01, and ***p < .001, two-tailed.

As Table 6.5 shows, there was a negative correlation between IQ and gender and between IQ and age, and negative significant correlations between PSS score and IQ and weekly mean drinking and gender. Therefore, males had higher IQs than females and males drank more than females.

Table 6.6 shows the hierarchical regression model to predict ECF (classic Stroop interference scores) from amount of drinking.
Table 6.6. Results of hierarchical regression analysis for weekly mean drinking predicting the ECF (classic Stroop interference) scores.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>.129</td>
<td>.199</td>
<td>.004</td>
<td>.065</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>.118</td>
<td>.200</td>
<td>.005</td>
<td>.059</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.071</td>
<td>.107</td>
<td></td>
<td>.073</td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>.264</td>
<td>.210</td>
<td>.041*</td>
<td>.133</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.107</td>
<td>.106</td>
<td></td>
<td>.101</td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>.027</td>
<td>.013</td>
<td></td>
<td>.217*</td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
<td>.264</td>
<td>.211</td>
<td>.0001</td>
<td>.133</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.107</td>
<td>.107</td>
<td></td>
<td>.101</td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>.029</td>
<td>.014</td>
<td></td>
<td>.217*</td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>-.004</td>
<td>.103</td>
<td></td>
<td>.000</td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>.292</td>
<td>.220</td>
<td>.002</td>
<td>.147</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.111</td>
<td>.107</td>
<td></td>
<td>.105</td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>.027</td>
<td>.014</td>
<td></td>
<td>.217*</td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>-.004</td>
<td>.103</td>
<td></td>
<td>-.003</td>
</tr>
<tr>
<td></td>
<td>Weekly mean drinking</td>
<td>.045</td>
<td>.105</td>
<td></td>
<td>.049</td>
</tr>
</tbody>
</table>

Note. Gender was coded as males = 0, females = 1. *p < .05.

The only significant predictor of ECF in the model was IQ, $F(3,100) = 1.71, t = 2.03, p < .05$. Weekly mean drinking was not a significant predictor of ECF in the model, $F(5,100) = 1.04, t = .46, p > .05$.

To investigate further the relationship between drinking and ECF (the first hypothesis), classic Stroop interference scores (ECF) were regressed on participants’ SMAST scores after controlling for the effects of gender, age, IQ, and the PSS score. However, before predicting the ECF from the participants’ SMAST scores, it was necessary to determine if there was a relationship between the amount of alcohol consumption and participants’ SMAST scores. A bivariate correlation showed that there was such a relationship, $r_{(101)} = .51, p < .001$, one-tailed. In addition, the relationship was assessed using a hierarchical regression analysis.
Table 6.7 shows the intercorrelations among variables entered into the regression model to test this relationship.

Table 6.7. Intercorrelations among participant-SMAST scores, weekly mean drinking, gender, age, IQ, and PSS score.

<table>
<thead>
<tr>
<th>Variable</th>
<th>P-SMAST</th>
<th>Gender</th>
<th>Age</th>
<th>IQ</th>
<th>PSS score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-.16*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>NS</td>
<td>-.34***</td>
<td>-.15*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS score</td>
<td>.21*</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly mean drinking</td>
<td>.34***</td>
<td>-.28**</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

Note: P-SMAST = participant-SMAST scores, *p < .05, **p < .01, and ***p < .001, two-tailed.

As Table 6.7 shows, scores on the participant-SMAST scores were positively correlated with PSS scores and weekly mean drinking, indicating that higher levels of perceived stress were associated with more alcohol problems. There was also a negative correlation between gender and IQ and gender and weekly mean drinking, indicating that males were scored higher on the SILS estimated WAIS-R than females and males were drinking more than females.

In the regression model, the amount of drinking was entered into the model after controlling for the effects of gender, age, IQ, and PSS scores. Table 6.8 shows the results of the model.
Table 6.8. The results of hierarchical regression analysis for variables predicting participants' SMAST scores.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gender</td>
<td>-.26</td>
<td>.16</td>
<td>.027</td>
<td>-.16</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>-.28</td>
<td>.16</td>
<td>.021</td>
<td>-.17</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.12</td>
<td>.08</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>-.34</td>
<td>.17</td>
<td>.010</td>
<td>-.21</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.11</td>
<td>.09</td>
<td>.13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>-.01</td>
<td>.01</td>
<td>-.11</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
<td>-.32</td>
<td>.17</td>
<td>.038*</td>
<td>-.20</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.11</td>
<td>.08</td>
<td>.13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>-.01</td>
<td>.01</td>
<td>-.07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>.16</td>
<td>.08</td>
<td>.20*</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>-.16</td>
<td>.16</td>
<td>.098***</td>
<td>-.10</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.13</td>
<td>.08</td>
<td>.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>-.01</td>
<td>.01</td>
<td>-.06</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>.15</td>
<td>.08</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amount of drinking</td>
<td>.27</td>
<td>.08</td>
<td>.33***</td>
<td></td>
</tr>
</tbody>
</table>

Note. Gender was coded as males = 0, females = 1; PSS score = Perceived Stress Scale score. * p < .05, ** p < .01, and *** p < .001.

As Table 6.8 shows, two variables were significant predictors of the participants' SMAST scores (i.e., their drinking problem). The PSS scores significantly predicted drinking problems, independently of the effects of gender, age, and IQ, $F(4, 100) = 2.53, t = 2.16, p < .05$. In Step Five, the amount of weekly mean drinking was a significant predictor, accounting for 10% of the change in variance above and over the effect of the PSS scores, $F(5, 100) = 4.55, t = 3.39, p < .001$.

The significant relationship between amount of drinking and drinking problems provided the evidence necessary to proceed with testing the hypothesis that drinking problems (i.e., SMAST scores) predicts impairments in ECF. Table 6.9 shows the intercorrelations among variables entered into the regression model to test this hypothesis.
Table 6.9. Intercorrelations among participant-SMAST scores, gender, age, IQ, PSS, and ECF (classic Stroop interference scores).

<table>
<thead>
<tr>
<th>Variable</th>
<th>ECF</th>
<th>Gender</th>
<th>Age</th>
<th>IQ</th>
<th>PSS score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>.15*</td>
<td>-.34***</td>
<td>-.15***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS score</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>P-SMAST</td>
<td>.16*</td>
<td>-.16#</td>
<td>.13&quot;</td>
<td>-.052&quot;</td>
<td>.21*</td>
</tr>
</tbody>
</table>

Note: P-SMAST = participant-SMAST scores, *p < .05, **p < .01, and ***p < .001, two-tailed.

As Table 6.9 shows, there were significant correlations between the ECF and IQ and participants' SMAST scores, between gender and IQ, between Age and IQ, and between PSS scores and participants' SMAST scores. The correlations with gender indicated that males had more drinking problems than did females.

The hierarchical regression analysis consisted of five steps; each estimated the unique effect of the variable entered at that step over and above the variables entered in the earlier steps (Table 6.10). The question being asked was whether drinking problems are a significant predictor of participants' performance on the ECF task (i.e., interference scores on the classic Stroop test), after the effects of other variables had been controlled. The results of hierarchical regression analysis are shown in Table 6.10.

In the regression model, gender (Step One) did not produce any significant change in the prediction of ECF ($\Delta R^2 = .004, p > .05$). Similarly, age (Step Two) did not produce any significant change in the prediction of ECF ($\Delta R^2 = .005, p > .05$). Inclusion of IQ in Step Three led to a significant increment ($\Delta R^2 = .04$) in the amount of variance in ECF scores accounted for, $F(1,100) = 1.70, t = 2.03, p < .05$. Inclusion of PSS scores in Step Four did not produce a significant change independently of the other variables ($\Delta R^2 = .0001, p > .05$). However, inclusion of participants' SMAST scores (the index of drinking problem) in Step Five accounted for a 4% increase in the variance, which was independent of other variables in the model, $F(5,100) = 1.86, t = 2.01, p < .05$.1

---

1. The model was subjected to post hoc effect size and power analyses (Erdfelder, et al., 1996), which yielded an $f^2 = .11$ and a power of .71.
Table 6.10. The results of hierarchical regression analysis for participant-SMAST scores predicting the ECF (classic Stroop interference) scores.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>.13</td>
<td>.20</td>
<td>.004</td>
<td>.06</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>.12</td>
<td>.20</td>
<td>.005</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.08</td>
<td>.11</td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>.26</td>
<td>.21</td>
<td>.041*</td>
<td>.13</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.11</td>
<td>.11</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>.03</td>
<td>.01</td>
<td>.22*</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
<td>.26</td>
<td>.21</td>
<td>.000</td>
<td>.13</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.11</td>
<td>.11</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>.03</td>
<td>.01</td>
<td>.22*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>.00</td>
<td>.10</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>.34</td>
<td>.21</td>
<td>.039*</td>
<td>.17</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.08</td>
<td>.11</td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>.03</td>
<td>.01</td>
<td>.23*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>-.04</td>
<td>.10</td>
<td>-.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Participant-SMAST</td>
<td>.26</td>
<td>.13</td>
<td>.21*</td>
<td></td>
</tr>
</tbody>
</table>

Note. Gender was coded as males = 0, females = 1. *p < .05.

Figure 6.1 shows the partial regression plot and its fit line, where the classic Stroop scores (the measure of ECF) are regressed onto participants-SMAST scores, after controlling for gender, age, IQ, and PSS scores. As the fit line indicates, increasing drinking problems are associated with increasing interference scores on the classic Stroop test.
To determine whether gender and age moderated the effects of the other variables in the model, two-way interactions were tested. These interactions were between (a) gender and participant-SMAST scores and (b) age and participant-SMAST scores. Neither of the two interactions tested was significant.

Spearman correlations did not yield any significant bivariate relationships between ECF and SILS-Vocabulary T-scores, SILS-Abstract T-scores, and SILS-Abstraction Quotient ($p > .05$, one-tailed).

In addition, in three hierarchical regression analyses, after controlling for the effects of gender, age, and PSS scores, participant-SMAST scores was a significant predictor of neither SILS-Vocabulary T-scores, $F(4,100) = 1.003, t = -1.06, p > .05$, nor SILS-Abstract T-scores, $F(4,100) = 1.83, t = -1.65, p > .05$. Because the SILS-Abstraction Quotient is recommended as a better index of abstract reasoning than the SILS Abstraction T-score or the SILS Conceptual Quotient (Zachary, 2000, see Chapter 4), a regression model examining its relationship with participant-SMAST scores is presented below. Table 6.9 shows the intercorrelations among the variables entered into the regression model to test the hypothesis that drinking problems adversely influence students’ abstract reasoning.
Table 6.11. Intercorrelations among the SILS AQ, participant-SMAST score, gender, age, IQ, and PSS score.

<table>
<thead>
<tr>
<th>Variable</th>
<th>SILS AQ</th>
<th>Gender</th>
<th>Age</th>
<th>PSS score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Age</td>
<td>-.237**</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>PSS score</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>P-SMAST</td>
<td>NS</td>
<td>.164#</td>
<td>.132#</td>
<td>.213*</td>
</tr>
</tbody>
</table>

Note: SILS AQ = Abstraction Quotient, P-SMAST = participant-SMAST score. #p < .1, *p < .05, **p < .01

As Table 6.11 shows, there were significant correlations between age and the SILS Abstraction Quotient, and between participants' SMAST scores and gender, age, and PSS scores.

The hierarchical regression analysis comprised four steps; each estimated the unique effect of the entered variable over and above the variables entered in the earlier steps. The results of hierarchical regression analysis for variables predicting the SILS Abstraction Quotient are shown in Table 6.1.

Table 6.12. The results of hierarchical regression analysis for participant-SMAST scores predicting the AQ.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>-.042</td>
<td>.198</td>
<td>.000</td>
<td>-.018</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>-.002</td>
<td>.194</td>
<td>.056*</td>
<td>-.001</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.24</td>
<td>.103</td>
<td>.23*</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>-.003</td>
<td>.195</td>
<td>.002</td>
<td>-.001</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.24</td>
<td>.104</td>
<td>.23*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>-.043</td>
<td>.099</td>
<td>-.043</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
<td>-.02</td>
<td>.199</td>
<td>.001</td>
<td>-.006</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.24</td>
<td>.105</td>
<td>.23*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>-.041</td>
<td>.102</td>
<td>.037</td>
<td></td>
</tr>
<tr>
<td></td>
<td>participant-SMAST</td>
<td>-.041</td>
<td>.198</td>
<td>.018</td>
<td></td>
</tr>
</tbody>
</table>

Note. Gender was coded as males = 0, females = 1. *p < .05.
In the regression model, only age was a significant predictor of the SILS Abstraction Quotient (independent of gender), accounting for 6% of the variance, $F(1, 100) = 2.91, t = -2.40, p < .05$. The inclusion of participant-SMAST scores in the fourth step, however, did not produce a significant change ($\Delta R^2 = .001, p > .05$) beyond the other variables in the model, $F(4, 100) = 1.49, t = -.28, p > .05$.

Further exploring of The SILS vocabulary and abstraction scores using t-tests (all tests two-tailed) revealed that there was no significant difference between problem drinkers and non-problem drinkers (a) on the SILS-vocabulary T-score, $t(99) = 1.19, p > .05$; (b) on the SILS-abstract T-score, $t(99) = .60, p > .05$; and (c) on the SILS Abstraction Quotient, $t(99) = -.017, p > .05$.

To test the hypothesis that poorer ECF is associated with a stronger maladaptive motivational structure, a hierarchical regression analysis was conducted. Table 6.13 shows the intercorrelations among the variables entered into the regression model to test this hypothesis.

Table 6.13 Intercorrelations among the PCI Factor 2, gender, age, IQ, PSS scores, and ECF (classic Stroop interference) scores.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 2</th>
<th>Gender</th>
<th>Age</th>
<th>PSS score</th>
<th>SILS AQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>NP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NP</td>
<td>NP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS score</td>
<td>.16*</td>
<td>NP</td>
<td>-.14*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILS AQ</td>
<td>.13*</td>
<td>NP</td>
<td>-.17*</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>ECF</td>
<td>-.19*</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

Note: SILS AQ = Shipley Abstraction Quotient, *p < .1, *p < .05, **p < .01, and ***p < .001, two-tailed.

As Table 6.13 shows, there was a negative correlation between ECF (classic Stroop interference scores) and PCI Factor 2 and between Shipley AQ and age. Based on the intercorrelations matrix, there was no evidence that collinearity among the variables was a problem; however, the issue was also addressed in the regression model, and the results were confirmed.

The hierarchical regression analysis consisted of five steps, in which the power of Shipley Abstraction Quotient and ECF to predict maladaptive motivational structure (Factor 2) was tested over the effects of gender, age and PSS score scores.
The results of the hierarchical regression analysis for the variables predicting the ECF are shown in Table 6.14.

Table 6.14. The results of hierarchical regression analysis for the ECF (classic Stroop interference) scores predicting Factor 2.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>$B$</th>
<th>$SE\ B$</th>
<th>$\Delta R^2$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>-.021</td>
<td>.200</td>
<td>.000</td>
<td>-.010</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>-.012</td>
<td>.202</td>
<td>.001</td>
<td>-.006</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.006</td>
<td>.016</td>
<td>-.038</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>-.015</td>
<td>.201</td>
<td>.024</td>
<td>-.008</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.002</td>
<td>.016</td>
<td>-.015</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILS Abstraction Quotient</td>
<td>.065</td>
<td>.042</td>
<td>.158</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
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<td>.200</td>
<td>.020</td>
<td>-.007</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.002</td>
<td>.016</td>
<td>.012</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILS Abstraction Quotient</td>
<td>.070</td>
<td>.042</td>
<td>.171</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>.017</td>
<td>.012</td>
<td>.146</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>.009</td>
<td>.198</td>
<td>.033*</td>
<td>.004</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.001</td>
<td>.016</td>
<td>.010</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILS Abstraction Quotient</td>
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<td>.041</td>
<td>.166</td>
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</tr>
<tr>
<td></td>
<td>PSS score</td>
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<td>.011</td>
<td>.138</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ECF</td>
<td>-.180</td>
<td>.098</td>
<td>-.181*</td>
<td></td>
</tr>
</tbody>
</table>

Note. Gender was coded as males = 0, females = 1. # $p < .1$.

In the regression model, none of the steps was a significant predictor of PCI Factor 2. Shipley AQ (Step Four) did not produce significant increment ($\Delta R^2 = .024$) in the prediction of PCI Factor 2, $F_{(1, 100)} = 1.17, t = 1.43, p > .05$. However, inclusion of ECF in Step Five accounted for a nearly significant change ($\Delta R^2 = .033$), $F_{(1, 100)} = 1.62, t = 1.83, p = .07$.

To test whether interference scores on the alcohol-Stroop test reflected attentional bias for alcohol-related stimuli that was independent of the participants' ECF, the interference scores were regressed onto the ECF scores (assessed by the classic Stroop...
test). Table 6.13 shows the intercorrelations matrix for the variables entered into the hierarchical regression model testing the hypothesis (Table 6.15).

Table 6.15. Intercorrelations among alcohol-Stroop, gender, age, IQ, PSS score, and the ECF (classic Stroop interference) scores.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Alc-Stroop</th>
<th>Gender</th>
<th>Age</th>
<th>IQ</th>
<th>PSS score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>NS</td>
<td></td>
<td>-.38**</td>
<td>-.16*</td>
<td></td>
</tr>
<tr>
<td>PSS score</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td>-.16*</td>
</tr>
<tr>
<td>The ECF</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td>.15*</td>
</tr>
</tbody>
</table>

Note: Alc-Stroop = alcohol-Stroop interference score. *p < .1, *p < .05, **p < .01

As Table 6.15 shows, there were significant correlations between IQ and gender, between IQ and PSS score, and between IQ and the ECF (classic Stroop interference) scores.

The hierarchical regression analysis comprised five steps; each estimated the unique effect of the entered variable over and above the variables entered in the earlier steps. The results of the hierarchical regression analysis are shown in Table 6.16.
Table 6.16. The results of hierarchical regression analysis for the ECF (classic Stroop interference) scores predicting the alcohol-Stroop interference scores.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>-5.26</td>
<td>5.84</td>
<td>.008</td>
<td>-.090</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>-5.26</td>
<td>5.88</td>
<td>.0001</td>
<td>-.090</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.023</td>
<td>3.13</td>
<td></td>
<td>.001</td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>-6.22</td>
<td>6.29</td>
<td>.002</td>
<td>-.107</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.17</td>
<td>3.17</td>
<td></td>
<td>-.006</td>
</tr>
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<td></td>
<td>IQ</td>
<td>-.17</td>
<td>.39</td>
<td></td>
<td>-.048</td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
<td>-6.07</td>
<td>6.33</td>
<td>.001</td>
<td>-.104</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.16</td>
<td>3.19</td>
<td></td>
<td>-.005</td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>-.15</td>
<td>.40</td>
<td></td>
<td>-.041</td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>1.06</td>
<td>3.08</td>
<td></td>
<td>.036</td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>-6.34</td>
<td>6.41</td>
<td>.001</td>
<td>-.109</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.27</td>
<td>3.22</td>
<td></td>
<td>-.009</td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>-.18</td>
<td>.41</td>
<td></td>
<td>-.049</td>
</tr>
<tr>
<td></td>
<td>PSS score</td>
<td>1.06</td>
<td>3.09</td>
<td></td>
<td>.036</td>
</tr>
<tr>
<td></td>
<td>The ECF</td>
<td>1.03</td>
<td>3.07</td>
<td></td>
<td>.035</td>
</tr>
</tbody>
</table>

Note. Gender was coded as males = 0, females = 1. *p < .05.

In the regression model, no variable was a significant predictor of the alcohol-Stroop interference scores, including ECF. In accordance with the hypothesis, ECF failed to significantly predict the alcohol-Stroop interference scores, $F(5, 100) = .24, t = .33, p > .05$. 
Discussion

The first hypothesis of this study, that drinking and drinking-related problems can predict students' level of ECF (classic Stroop interference scores), was confirmed. Although weekly mean drinking was a significant predictor of participants' drinking problems (as defined by the SMAST scores) it did not predict students' level of ECF. The results of two hierarchical regression analyses revealed that only drinking problem was a significant predictor of poorer ECF (larger classic Stroop interference scores) among students. The results of a series of hierarchical regression analyses, in which SMAST scores were regressed onto SILS Abstraction Quotient, revealed that the SILS Abstraction Quotient was not as sensitive a predictor of cognitive impairment associated with drinking problems as was the classic Stroop interference scores. This finding suggests that performance on the classic Stroop, as a measure of ECF, can be more easily adversely affected by drinking problems than abstract reasoning can.

The SMAST scores were a stronger predictor of ECF (classic Stroop interference scores) than was weekly mean drinking. A reason for this finding could be that mean alcohol consumption does not precisely reflect the hazardous effects of consuming alcohol. Evidence (see Heather, Peters, Timothy, & Stockwell, 2001) indicates that drinkers' vulnerability to the hazardous effects of alcohol depends on many factors, including their gender, age, family history of drinking, pattern of drinking (chronic vs. binge), biological predisposition (through genes, level of enzymes, etc.), nutrition, tobacco smoking, participation in sport, and the presence of other diseases. As evidence confirming the above explanation, the results of this study indicated that participants' drinking problems were significantly correlated with their parents' drinking problems. In addition, the fathers' and mothers' drinking problems were significantly correlated with each other. Weitzman and Wechsler (2000), surveying a national sample of university students in the United States, reported that alcohol use, abuse, and related problems among children of problem drinkers were greater than among children without problem-drinking parents. This finding is consistent with the evidence (e.g., Windle, 1996) pointing to the role of heredity and other parental factors in children's risky patterns of drinking.

The above findings do not provide firm support for the suggestion that there is a causal relationship between drinking problems and ECF impairment. However, neuropsychological evidence suggests that there is an interaction (e.g., Ciesielski, Waldorf, & Jung, 1995) between drinking problems and ECF impairment. Problem drinking can be related to regular heavy drinking or to binge drinking. It seems that
problematic drinking is often associated with higher levels of blood-alcohol concentration, decreased frontal lobe glucose utilisation, and reduced cerebral blood flow; these factors would probably increase the risk of alcohol-related damage to the frontal lobe (for a review see Moselhy, Georgiou, & Kahn, 2001). The present findings support the limited evidence that risky drinking can adversely affect the ECF performance of student non-dependent drinkers (e.g., Blume et al., 2000). The results of a study conducted by Luu, Collins, and Tucker (2000) revealed that emotional distress and its associated behavioural patterns were closely related to frontal lobe ECF. For example, Giancloa and Ziechner (1994) and Giancola et al. (1994, 1998) found that ECF was a risk factor for aggressive behaviour. Petri (1998) found that poor ECF was associated with a tendency to underestimate one’s drinking problems, poor ability to self-monitor, and problems in behavioural planning.

The second hypothesis of this study, that the interference scores on the alcohol-Stroop test reflect attentional bias for alcohol-related stimuli independently of participants’ ECF, was also confirmed. This finding supports the view that the emotional Stroop test reliably assesses non-clinical participants’ distractions for concern-related stimuli (see Chapter 2). The results also suggest that interference scores on an emotional test are not an artefact of participants’ general level of ECF; this finding does not support Bauer and Cox’s (1999) and Zack et al.’s (2001) suggestion that a generally poor inhibitory system affects alcohol abusers’ performance on the emotional Stroop test. The finding is consistent with that of Stetter et al.’s (1995) results, which suggested that alcohol abusers’ RTs on the alcohol-Stroop test are independent of their RTs on the classic Stroop test. The finding thus suggests that alcohol-Stroop test provides a valid measure of attentional distraction for alcohol-related stimuli. This finding is also consistent with the suggestions in Chapter 2 that, despite the fundamental similarity between the classic and emotional Stroop tests (i.e., the interference between stimuli that both of them measure), the mechanisms underlying participants’ reactions to emotionally salient words on an emotional Stroop test are different from those underlying their RTs to classic Stroop stimuli. Further study is needed to test the hypothesis among clinically diagnosed alcohol abusers. This issue is addressed in the next chapter.

The third hypothesis of this study, that poorer ECF is associated with a more maladaptive motivational structure among university students, was not supported. The hierarchical regression analysis testing the hypothesis included the classic Stroop interference scores (Step 5) after the effect of SILS AQ had been accounted for. The SILS AQ is an index of abstract thinking that can adversely be affected by problem
drinking (e.g., Beatty et al., 2000). The results indicated that neither SILS AQ nor the classic Stroop interference scores could significantly predict maladaptive motivational factor scores among the student sample. If ECF impairments predated drinking problems, one would expect maladaptive motivation to be related to ECF impairment; this relationship approached significance in the student sample (but inversely). This finding can be interpreted as possibly indicating that students' ECF has not yet been severely affected by the negative effects of alcohol consumption, or that the measure of ECF was not sensitive enough to detect minor ECF impairments. The latter possibility is probably incorrect, in that an earlier analysis in the chapter revealed that students' performance on the classic Stroop (ECF) was inversely related to their level of drinking problems. However, from the present data it is not possible to say how much impairment in ECF is necessary for it to manifest itself as maladaptive motivation. As discussed in Chapter 3, adaptive motivation is characterised by cognitive flexibility, behavioural planning, and the ability to manipulate data in effective ways. This point is further addressed in the next chapter, which reports a study with a sample of in-patient alcohol abusers.
CHAPTER SEVEN

Cognitive-Motivational Correlates of Alcohol Abuse

The results presented in Chapter 5 indicated that maladaptive motivational structure and attentional bias for alcohol-related stimuli were the best predictors of students' drinking behaviour.

Chapter 6 examined the effects of drinking on ECF. The results revealed that problematic drinking is associated with poorer ECF among a clinically non-dependent sample of drinkers. The results also indicated that level of ECF predicted neither the severity of maladaptive motivational structure nor attentional bias for alcohol-related stimuli. The present chapter focuses on the same issues among a group of dependent drinkers.

Recall that the frontal lobe, where the ECF processes are located, is responsible for prioritisation of relevant information in order to reduce unintended distraction for irrelevant information. ECF involves planning, guiding behaviour, and self-control (Cahn-Wiener et al., 2000; Espy et al., 1999); as such, it is involved in abilities which require holding and manipulating information in working memory (e.g., Cahn-Weiner et al. 2000; Hoaken et al., 1998). Evidence suggests that self-monitoring and self-control have a key role in sustaining excessive alcohol consumption (Lyvers, 2000a; Skutle & Berg, 1987). If poor ECF is common among alcohol abusers, it is reasonable to test its effects on both behavioural planning and attentional bias. As discussed, evidence supports the possibility that damages to the frontal lobe, resulting from or predating alcohol use, contributes to the development and progression of abusive drinking (e.g., Bowden et al., 2001; Giancola & Moss, 1998).

Although students' maladaptive motivational structure and attentional bias were documented as the most potent predictors of their alcohol consumption (Chapter 5), and a relationship between their problematic drinking and their ECF was also found, students' maladaptive motivational structure and attentional bias were not affected by their level of the ECF (Chapter 6). As discussed, the same issues should also be addressed among alcohol abusers. The questions addressed concern how maladaptive motivational structure is related to alcohol abusers' ECF and how their ECF affects their attentional bias on an alcohol-Stroop test.

This chapter tests the following hypotheses: (a) alcohol abusers have greater ECF impairment (i.e., larger interference on the classic Stroop test) than do non-abusers, (b) alcohol abusers have a stronger maladaptive motivational structure than do non-abusers,
(c) alcohol consumption can predict alcohol abusers’ ECF (i.e., classic Stroop interference scores), (d) among alcohol abusers, poorer ECF is associated with a stronger maladaptive motivational structure, and (e) alcohol-Stroop interference reflects abusers’ attentional bias for alcohol-related stimuli independently of their ECF.

Method

In general, the methodology was as that described in Chapter 4. The methodology covered here describes only those aspects of the study not described in Chapter 4.

Power Analysis

A power analysis was conducted to determine the sample size needed for the target sample in this study. A power analysis needs first to estimate the size of the effect that a particular study aims to identify. The results of previous research can be used to decide on an expected effect size. Because analyses planned for the present study included repeated measures analyses of variance and linear and logistic regression analyses, the power analysis had to meet the requirements of both types of analyses. The only study comparing the motivational structure of a clinical group with a non-clinical group was that of Man et al. (1998). The authors used the MSQ in their study to compare the two groups. There are some differences between the MSQ indices and those from the abridged version of the PCI used in the present thesis; therefore, only those indices from the MSQ that are similar to the PCI indices were selected for the effect size analyses.

The selected MSQ indices were Lack of Commitment (the reverse of Commitment), Goal Distance, Aversive Motivation, Composite Emotional Intensity (similar to the PCI Happiness and Sorrow indices), and Hopelessness (the reverse of expected Chances of Success). The effect sizes for these indices were calculated as that described in Chapter 1. A mean effect size of .65 was calculated from the individual indices. This effect size approaches a large value for Cohen’s $d$ (Cohen, 1992). Recall that based on the post hoc effect size analysis in Chapter 5, a Cohen’s $f^2$ of .35 (which is a large effect size) was calculated for the regression model predicting the amount of alcohol consumed.

As far as between-groups comparisons of the alcohol-Stroop results are concerned, there have been eight studies comparing social and abusive drinkers and five studies comparing light and heavy drinkers. Among studies comparing social and abusive drinkers, four studies did not report standard deviations of the interference scores
necessary for calculating pooled standard deviations in an effect-size analysis. The other four studies and their corresponding effect sizes were Stetter et al. (1995), $d = .52$; Bauer and Cox (1998), $d = .36$; Cox et al. (2000), $d = .32$; and Cox et al. (2002), $d = .85$. Among studies comparing light and heavy drinkers, Stewart et al. (2002) was not included in the power analyses because the authors limited the comparisons to two groups of participants who were classified as having either enhancing or coping motivates. For the remaining four studies, the following effect sizes were calculated: Stewart et al. (1997), $d = 1.53$; musical cues condition in Cox et al. (1999), $d = .33$; Sharma and Albery (2001), $d = 1.56$; and non-alcohol cue condition in Cox et al. (2003), $d = .32$. A mean effect size of $d = .73$ was calculated for the above studies, which is regarded as a large value (Cohen, 1992). With the large $f^2 (40)$ and $f^2 (.35)$ values and setting Power = 80, the G*power software (Erdfelder et al., 1996; see Chapter 5) was used to calculate an a priori effect size. A sample size of 50 ($50 \times 2$ for the two groups) for analyses of variance and a sample size of 49 for regression analyses (where $k = 7$) resulted.

**Participants and Procedure**

Participants were 50 in-treatment alcohol abusers who were residing in an alcohol detoxification unit. Three participants were not included in the sample because of data collection problems. All participants were tested after completion of the first 10 days of the detoxification programme. Exclusion criteria were obvious neurological impairment, apparent personality disorder or other types of clinically recognised psychopathology, as indicated by participants’ records in the detoxification centre. All data were collected individually, and all testing was conducted during afternoons. Each testing session varied between 1:45 and 2:15 hours.

Participants consisted of 47 alcohol abusers in the experimental group (females = 14, males = 33) and 50 randomly selected control participants from the student sample described earlier (females = 25, males = 25). There was an unequal number of male and female alcohol abusers in the sample because the number of male abusers admitted to the detoxification centre considerably outnumbered the female abusers. Nevertheless, there is no evidence for a gender difference in alcohol abusers’ attentional bias (see Chapter 2) or motivational structure (see Cox & Klinger, 2004). Thus, it appeared unlikely that the gender imbalance would affect the results. The procedure was as described in Chapter 4.
Results

Demographic Characteristics and Between-Group Comparisons

The means and standard deviations of the experimental and control groups’ age, years of education, Shipley Institute of Living Scale (SILS) scores, and Perceived Stress Sale (PSS) scores are shown in Table 7.1, separately for each gender.

Table 7.1. Mean and standard deviation of age, education, SILS score, and PSS for students and alcohol abusers, separately for each gender.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Students</th>
<th>Alcohol abusers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (N=25)</td>
<td>Females (N=25)</td>
</tr>
<tr>
<td>Variables</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Age</td>
<td>22.68</td>
<td>6.41</td>
</tr>
<tr>
<td>Education (in years)</td>
<td>14.36</td>
<td>.99</td>
</tr>
<tr>
<td>SILS Voc. T-score</td>
<td>54.92</td>
<td>7.18</td>
</tr>
<tr>
<td>SILS Abs. T-score</td>
<td>59.80</td>
<td>4.03</td>
</tr>
<tr>
<td>SILS AQ</td>
<td>107.08</td>
<td>8.99</td>
</tr>
<tr>
<td>IQ</td>
<td>112.12</td>
<td>7.04</td>
</tr>
<tr>
<td>PSS</td>
<td>4.96</td>
<td>3.01</td>
</tr>
</tbody>
</table>

Note: SILS Voc. T-score = Shipley Vocabulary T-Score, SILS Abs. T-score = Shipley Abstract T-score, SILS AQ = Shipley Abstraction Quotient, PSS = perceived stress scale score.

To determine whether alcohol abusers and non-abusers differed from each other on these indices, a series of t-tests (all two-tailed) was conducted. There were significant differences between the two groups on (a) age, $t_{(95)} = -12.40, p < .05$; (b) years of education, $t_{(95)} = 9.16, p < .05$; (c) PSS scores, $t_{(95)} = -10.15, p < .05$; (d) Shipley Vocabulary T-Score, $t_{(95)} = 6.05, p < .05$; (e) Shipley Abstraction T-score, $t_{(95)} = 6.40, p < .05$; and IQ, $t_{(95)} = 8.55, p < .05$. There was no significant difference between the two groups' Shipley Abstraction Quotient (SILS AQ), $t_{(95)} = 1.48, p > .05$, which was corrected for age and educational level. This finding suggests that, when the cognitive performance of social drinkers and alcohol abusers is being compared, the SILS AQ does not lead to the same result as the SILS Abstraction T-Score does.
The means and standard deviations for each group on amount of usual drinking per week, unusual drinking per week, weekly mean drinking, and age of first drink are shown in Table 7.2, separately for males and females. The table also includes a chronicity index (number of years of problematic drinking) for the alcohol abuser group.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Students</th>
<th>Alcohol abusers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usual drinking</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Unusual drinking</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Weekly mean drinking</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>Age of first drink</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Chronicity</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: The amount of drinking is in standard units.

A series of t-tests (all two-tailed) revealed that alcohol abusers reported drinking significantly more alcohol than students on the usual index of drinking, $t_{(95)} = -12.48, p < .001$; and on weekly mean drinking, $t_{(95)} = 13.95, p < .001$; but there was not a significant difference between the two groups on the unusual index of drinking, $t_{(95)} = -1.90, p > .05$. Alcohol abusers reported a significantly older drinking starting age than did students, $t_{(95)} = -3.60, p < .001$. This difference could have arisen from a younger age at which people start to drink in recent years; it could also have arisen from abusers' overestimating their drinking start age or because of their memory lapses.

**Stroop Paradigm**

**Neutrality of the Control Words**

In accordance with the discussions in Chapter 4 and Chapter 5, the neutrality of the control words for alcohol abusers in this study was tested before proceeding with further analyses involving the alcohol-Stroop data. In a similar way to Chapter 5, alcohol abusers were divided into two groups: those with (Group A, $N = 11$) and those without (Group B, $N = 36$) a current concern in the Home and Household. On the basis of number
of words from the neutral and the alcohol-related categories that were recalled just after the Stroop test, a series of \( t \)-tests (all two-tailed) was carried out on the 37 alcohol abusers who, after completing the Stroop test, received the recall and the emotional rating tasks. The results of the \( t \)-tests were as follows. First, Group A \((M = 2, SD = .86)\) did not remember more neutral words than Group B \((M = 2.75, SD = 1.71)\), \( t (35) = -1.25, p > .05 \). Second, Group A \((M = 4.63, SD = 2.82)\) did not rate the neutral words higher in emotional valence than did Group B \((M = 5.88, SD = 2.90)\), \( t (35) = -1.08, p > .05 \). Third, Group A’s \((M = 44.27, SD = 36.47)\) interference score on the alcohol-Stroop test did not differ from that of Group B \((M = 39.50, SD = 91.88)\), \( t (45) = .16, p > .05 \).

Paired \( t \)-tests (all two-tailed) limited to those who had a current concern in the Home and Household area (i.e., Group A) gave the following results. First, participants remembered significantly more alcohol-related words \((M = 5.19, SD = 1.89)\) than neutral words \((M = 2.57, SD = 1.57)\), \( t (35) = 8.25, p < .001 \). Second, their evaluation of the emotional valence of the alcohol-related words \((M = 4.50, SD = 3.24)\) did not differ from that of the neutral words \((M = 5.59, SD = 2.89)\), \( t (35) = 3.54, p < .001 \). These results confirmed that the building-related words were equally neutral for all alcohol abusers, regardless of their current concerns in the Home and Household area. This above conclusion is similar to the one drawn for the student sample described in Chapter 5.

**Analysis of the Stroop Tests Data**

The means and standard deviations for reaction times, interference scores, and the number of errors on the classic Stroop and alcohol-Stroop test, the number of words recalled, and the rated emotional valence of the words are shown in Table 7.3, separately for males and females in each study group.

To identify within- and between-participant differences in the latencies and the number of errors in response to the different word categories on the Stroop test, a series of repeated measures analysis of variance was conducted. Each analysis was programmed (by writing a SPSS syntax file) to examine the pairwise within- and between-participants comparisons in the same analysis. Word Category (congruent, incongruent, alcohol-related, or neutral) was the within-participants factor.

Mauchly’s \( W \) test was significant, indicating that the sphericity assumption was not met \((W(5) = .26, p < .001)\); accordingly, the Huynh-Feldt correction was applied. The main effect of Word Category was significant, \( F (1.66, 157.90) = 79.55, p < .001, \eta^2 = .46^1 \).

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1. \( \eta^2 \) = Eta squared: measure of strength of relationship
The interaction between Word Category and Group was also significant, $F_{(1.66, 157.90)} = 14.87, p < .001, \eta^2 = 14$.  

Table 7.3. Mean and standard deviations from the classic Stroop test scores, alcohol-Stroop test scores, the recall and emotional valence tasks scores for each gender in the student and alcohol abuser sample.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Students</th>
<th></th>
<th>Alcohol abusers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males(N=25)</td>
<td>Females(N=25)</td>
<td>Males(N=33)</td>
<td>Females(N=14)</td>
</tr>
<tr>
<td>Variables</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Congruent RT</td>
<td>774.16</td>
<td>95.98</td>
<td>732.29</td>
<td>102.30</td>
</tr>
<tr>
<td>Incongruent RT</td>
<td>867.45</td>
<td>123.43</td>
<td>845.97</td>
<td>14.82</td>
</tr>
<tr>
<td>Alcohol RT</td>
<td>816.31</td>
<td>98.85</td>
<td>774.56</td>
<td>105.07</td>
</tr>
<tr>
<td>Neutral RT</td>
<td>812.95</td>
<td>99.26</td>
<td>776.50</td>
<td>111.88</td>
</tr>
<tr>
<td>Congruent errors</td>
<td>3.16</td>
<td>2.62</td>
<td>5.08</td>
<td>4.43</td>
</tr>
<tr>
<td>Incongruent errors</td>
<td>3.36</td>
<td>3.43</td>
<td>4.48</td>
<td>5.09</td>
</tr>
<tr>
<td>Alcohol errors</td>
<td>3.28</td>
<td>2.46</td>
<td>3.88</td>
<td>2.40</td>
</tr>
<tr>
<td>Neutral errors</td>
<td>3.24</td>
<td>2.59</td>
<td>4.36</td>
<td>3.97</td>
</tr>
<tr>
<td>Cl. Stroop Int. score</td>
<td>93.30</td>
<td>52.43</td>
<td>113.68</td>
<td>56.76</td>
</tr>
<tr>
<td>Alc-Stroop Int. score</td>
<td>3.37</td>
<td>37.01</td>
<td>-1.94</td>
<td>3.84</td>
</tr>
<tr>
<td>Recalled alcohol words</td>
<td>6.38</td>
<td>2.16</td>
<td>5.19</td>
<td>4.03</td>
</tr>
<tr>
<td>Recalled neutral words</td>
<td>2.33</td>
<td>2.43</td>
<td>1.52</td>
<td>2.68</td>
</tr>
<tr>
<td>Em. Alc. Words</td>
<td>4.25</td>
<td>2.17</td>
<td>5.24</td>
<td>2.12</td>
</tr>
<tr>
<td>Em. Neutral words</td>
<td>4.00</td>
<td>2.09</td>
<td>2.90</td>
<td>1.95</td>
</tr>
</tbody>
</table>

Note. Cl. Stroop Int. score = classic Stroop test interference score, Alc-Stroop Int. score = Alcohol-Stroop test interference score, Em. Alc. words = Emotional ratings of the alcohol words, Em. Neutral words = Emotional ratings of the neutral words.

Post-hoc comparisons were performed using the Bonferroni adjustment for multiple comparisons. The only non-significant difference was that between RTs for congruent colour-words and RTs for neutral words. Performing pairwise comparisons using the Least Significant Difference (LSD) within each group of participants revealed
that, for the student group, there was no significant difference between RTs for alcohol words and RTs for neutral words. For the abuser group, however, there was no significant difference between RTs for congruent colour words and RTs for neural words; the significant difference was between their RTs for alcohol-related words and RTs for neutral words. Therefore, whereas alcohol and neutral words did not result in different latencies for students, they did so for alcohol abusers.

Another repeated measure of analysis of variance was conducted to determine whether the number of errors that participants made differ across the word categories. Again, a significant Mauchly’s *W* test indicated that the sphericity assumption was not met (*W* = .26, *p* < .001); accordingly, the Huynh-Feldt correction was applied. The main effect for Word Category was significant, *F*(1.92, 182.22) = 4.44, *p* < .001, η² = .045. The interaction between Word Category and Group was also significant, *F*(1.66, 157.90) = 3.95, *p* < .001.

Post-hoc comparisons using the Bonferroni adjustment for multiple comparisons revealed that participants made significantly more errors in responding to incongruent colour words than in responding to both alcohol words and to neutral words. Pairwise comparisons using LSD test identified the source of the difference within each group of the participants. For the student group, there was no significant difference between numbers of errors across the word categories. However, in comparison to their errors on the other word categories, the alcohol abusers made significantly more errors in reacting to incongruent colour words.

To determine whether the alcohol abusers differed from the students on (a) classic Stroop interference scores, (b) alcohol-Stroop interference score, (c) number of words recalled, and (d) emotional ratings of the alcohol and neutral words, a series of *t*-tests (all tests one-tailed) was conducted.

The first comparison above tested the hypothesis that alcohol abusers have greater ECF impairment than non-abusers. It was found that alcohol abusers' interference score on the classic Stroop test (*M* = 195.36, *SD* = 155.54) was significantly larger than that of students (*M* = 103.50, *SD* = 55.05), *t*(95) = -3.92, *p* < .05. Similarly, alcohol abusers' interference score on the alcohol-Stroop test (*M* = 40.62, *SD* = 81.96) was significantly larger than that of students (*M* = .71, *SD* = 33.80), *t*(95) = -3.17, *p* < .05. There was neither a significant difference between the two groups in number of alcohol or neutral words recalled, nor in their emotional ratings of the alcohol words; however, the alcohol
abusers rated the house-related words significantly more pleasant ($M = 5.60, SD = 2.90$) than did the students ($M = 3.50, SD = 2.07$), $t(77) = -3.76, p < .05$.

**Factor Analysis of the PCI for Both Groups Combined**

Based on the guidelines discussed in Chapter 4 and 5, the data collected with the PCI were factor analysed to characterise participants' motivational structure. For this analysis, the two groups were combined into one. All data considerations were similar to those described in Chapters 5 and 6, under *Factor Analysis of the PCI*.

Prior to performing the factor analysis, the suitability of the data for factor analysis was assessed. The correlation matrix for the 10 PCI variables revealed that 52% of variables were significantly correlated, suggesting a common factor shared by the variables. Bartlett's test of sphericity, a measure of the variable relatedness to itself, reached the statistical significance ($X^2(45) = 434.36, p < .0001$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy resulted in a higher value (.71) than the recommended value of .60 (Kaiser, 1974), supporting the factorability of the correlation matrix.

As in Chapter 5, Principal Axis Factoring (PAF) and maximum Likelihood (ML) with and without rotations were used, again leading to an initial three-factor solution. The three-factor solution was not interpretable in terms of an adaptive and a maladaptive motivational pattern. Again, limiting the number of factors to two did not lead to an appropriate solution because the eigenvalues exceeded 1.00 on 25 Iterations (SPSS default); decreasing the number of iterations led to a factor solution which was not interpretable. The slope of the two largest factors tapered between the second and the third factors, indicating that a two-factor solution was optimal. Accordingly, the PCI indices were factor analysed using Principal Component Analysis (PCA). An interpretable two-factor solution was attained. Because oblique rotations improved the factor patterns, the rotated solution (Oblimin) was selected. Factor 1 accounted for 35.77% of the variance, and Factor 2 for 17.23%; a total of 53.00% of the variance was explained by the two factors. The loadings on the two factors are shown in Table 7.4.

Respondents who scored high on Factor 1 felt optimistic (i.e., high feelings of likelihood about achieving their goals and hope about achieving them if they tried). They reported strong commitment to achieve their goals and they believed that they had control over achieving them. They knew what to do to achieve their goals and expected to achieve them in the near future. They were emotionally involved in their goal pursuits, expecting moderate happiness if they succeeded in achieving them and mild sadness if
they did not. Although they showed a strong appetitive style in their goal pursuits, they did not show aversive motivation for avoiding things that they did not want.

Table 7.4. Principal factor loadings with Oblimin rotation of the PCI

<table>
<thead>
<tr>
<th>The PCI variables</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood of achieving goals</td>
<td>.804</td>
<td></td>
</tr>
<tr>
<td>Control over achieving goals</td>
<td>.713</td>
<td>-.308</td>
</tr>
<tr>
<td>Knowledge about how to achieve goals</td>
<td>.775</td>
<td></td>
</tr>
<tr>
<td>Hope about achieving goals</td>
<td>.817</td>
<td></td>
</tr>
<tr>
<td>Happiness from achieving goals</td>
<td>.477</td>
<td></td>
</tr>
<tr>
<td>Commitment to achieving goals</td>
<td>.704</td>
<td></td>
</tr>
<tr>
<td>Distance from goal achievements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sadness from failure at goal achievements</td>
<td>.347</td>
<td></td>
</tr>
<tr>
<td>Appetitive motivation index</td>
<td></td>
<td>-.868</td>
</tr>
<tr>
<td>Aversive motivation index</td>
<td></td>
<td>.933</td>
</tr>
</tbody>
</table>

Note. Loadings less than .30 are suppressed. Highest loadings are in bold.

Participants who scored high on Factor 2 showed a strong tendency to avoid things that they did not want. In addition, they had a strong negative loading on Appetitive Motivation, suggesting that they did not strive for attractive things that they wanted. This aversive style of motivation was accompanied by a moderate sense of having no control over goal attainments. Factor 2 was unrelated to hope about achieving goals, knowledge about how to achieve them, and happiness from achieving or sadness from failure to achieve them. Accordingly, Factor 1 was defined as adaptive motivation and Factor 2 as maladaptive motivation.

The pattern of results from the factor analysis is similar to that reported in Chapter 5 and Chapter 6, except that this time Factor Two was further characterised by a negative loading on perceived control over goal achievements.

To test the second hypothesis that alcohol abusers are higher in maladaptive motivation than non-abusers, a hierarchical logistic regression analysis was conducted. It showed whether or not the participants' factor scores could predict their membership in the student or alcohol-abuser group.
Unlike discriminant analysis, logistic regression is not based on the assumption of normal distribution of the data; it is used for dichotomous dependent variables; and it allows hierarchical analysis. Logistic regression coefficients are based on the estimation of odds ratios for each of the independent variables in the model. The significance levels are defined as -2 Log Likelihood (-2 LL). This is a chi-squared logarithmic measure of the odds ratio. It shows how well the model fits the data; the smaller the value of -2 LL, the better the fit. In a backward logistic regression model, the change in -2 LL tests the null hypothesis that the coefficients of the variables removed from the model equal zero. The -2LL values are usually reported as chi-square coefficients (Miles & Shevlin, 2001).

The present logistic regression model comprised three steps. Step One included gender, education, and IQ as the controlling variables. Age was not entered as a control variable because of the large difference (a mean of approximately 20 years) between the ages of the two groups. In other words, group membership was confounded with the ages of the two groups. Step Two added PCI Factor 1, and Step Three added PCI Factor 2 to the model. Table 7.5 shows the intercorrelations among group membership, gender, education, PSS, and IQ.

Table 7.5. Intercorrelations among the variables group membership, age, gender, education, PSS scores, and IQ.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Gender</th>
<th>Education</th>
<th>IQ</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>-.76***</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>-.71***</td>
<td>NS</td>
<td>.46***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 1</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Factor 2</td>
<td>-.20*</td>
<td>.25*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Note: Intercorrelations reported for binary variables are achieved using Spearman's rho formula, Gender was coded as male = 0, female = 1, Group: 0 = students, 1 = alcohol abusers, *p <.10, *p <.05, **p <.01, and ***p<.001, One-tailed.

Table 7.5 shows that membership in the abuser group is negatively correlated with Gender, Education, IQ, and Factor 2. There are also positive correlations between gender and Factor 2 and between education and IQ. The logistic model regressed group membership onto Factor 1 and Factor 2, while the effects of other variables entered in the earlier steps in the model were controlled.

Table 7.6 shows the result of the logistic regression analysis.
Table 7.6. Results of the logistic regression results for predicting group membership based on Factor 1 and Factor 2.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Coefficient (B)</td>
<td>Wald t-stat</td>
<td>Coefficient (B)</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>48.09***</td>
<td>16.50</td>
<td>91.26**</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td>-1.11*</td>
<td>15.28</td>
<td>-2.24*</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>-.32***</td>
<td>13.78</td>
<td>-.59**</td>
</tr>
<tr>
<td>IQ</td>
<td></td>
<td>-2.48***</td>
<td>5.16</td>
<td>-2.32**</td>
</tr>
<tr>
<td>Factor 1</td>
<td></td>
<td>-5.47*</td>
<td>6.24</td>
<td>-.52*</td>
</tr>
<tr>
<td>Factor 2</td>
<td></td>
<td>-5.19</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Model Chi-Square [df]</td>
<td></td>
<td>97.22 [3]**</td>
<td>109.28 [4]***</td>
<td>109.67 [5]***</td>
</tr>
<tr>
<td>Block Chi-Square [df]</td>
<td></td>
<td>-</td>
<td>12.06 [1]**</td>
<td>.39 [1]</td>
</tr>
<tr>
<td>% Correct Predictions</td>
<td></td>
<td>92.60</td>
<td>94.70</td>
<td>94.70</td>
</tr>
<tr>
<td>-2 Log Likelihood ($\chi^2$)</td>
<td></td>
<td>32.71*</td>
<td>2.65</td>
<td>2.60</td>
</tr>
<tr>
<td>Goodness of fit ($\chi^2$)</td>
<td></td>
<td>5.22</td>
<td>2.06</td>
<td>2.13</td>
</tr>
</tbody>
</table>

Note: Group: 0 = students, 1 = alcohol abusers, n: the initial -2 Log Likelihood = 129.93, the Wald statistics (t-stat) are distributed chi-square with 1 degree of freedom. * $p < .10$, * $p < .05$, ** $p < .01$, and *** $p < .001$.

As Table 7.6 shows, all three variables in the first model significantly predicted membership in the alcohol-abusers group. An initial -2 LL (a $\chi^2$ value = 129.93, with no variables in the model but only constant) showed a significant improvement (a $\chi^2$ value = 97.22) by inclusion of the gender, education, and IQ at the first step. Inclusion of Factor 1 at the second step improved the model's predictability for another -2 LL of 12.06 ($p < .001$). The negative coefficient for Factor 1 in predicting group membership means that lower scores on Factor 1 (adaptive motivation) predict membership in the alcohol abuser group. On the other hand, the addition of Factor 2 in the third step did not improve the predictability of the model. The two-way interaction terms between each PCI factor and gender, education, and IQ did not lead to a significant improvement. Factor 1 but not Factor 2 remained a negative predictor of membership in the alcohol abuser group over the other variables.
To identify further the origin of this difference between the alcohol abusers and students, another logistic regression analysis was conducted with group membership as the dependent variable and PCI indices as the predictor variables. First, Table 7.7 shows the intercorrelations among the PCI indices and group membership.

### Table 7.7 Intercorrelations among group membership and the PCI indices.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Liklih</th>
<th>Contr</th>
<th>Knowl</th>
<th>Hope</th>
<th>Happin</th>
<th>Comm</th>
<th>Distan</th>
<th>Sadness</th>
<th>App. M.</th>
<th>Ave. M.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelih</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>NS</td>
<td>.64**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowl</td>
<td>NS</td>
<td>.60**</td>
<td>.58**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hope</td>
<td>NS</td>
<td>.64**</td>
<td>.58**</td>
<td>.69**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happin</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comm</td>
<td>NS</td>
<td>.46**</td>
<td>NS</td>
<td>.39**</td>
<td>.41**</td>
<td>.45**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distan</td>
<td>NS</td>
<td>NS</td>
<td>.30*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sadness</td>
<td>.27**</td>
<td>NS</td>
<td>.048</td>
<td>NS</td>
<td>NS</td>
<td>.41**</td>
<td>.24*</td>
<td>NS</td>
<td>.22*</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>App. M.</td>
<td>.18*</td>
<td>.23*</td>
<td>.324</td>
<td>.25*</td>
<td>.21*</td>
<td>NS</td>
<td>.22*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Ave. M.</td>
<td>NS</td>
<td>NS</td>
<td>-.277</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>-.89**</td>
</tr>
</tbody>
</table>

Note: Gender: male = 0, female = 1, Group: 0 = students, 1 = alcohol abusers, Likelih = Likelihood, Knowl = Knowledge, Happin = Happiness, Comm = Commitment, Distan = goal distance, App. M. = Appetitive motivation, Ave. M. = Aversive motivation. *p < .10, *p < .05, **p < .01, and ***p < .001, two-tailed.

As Table 7.7 shows alcohol abusers were characterised with more sadness from failure in achieving their goals than students. The hierarchical logistic regression model was based on Wald's backward procedure which led to the most potent predictors among the PCI indices for the group membership.

Table 7.8 shows the logistic regression results for the fitted model.
Table 7.8. Logistic regression results predicting group membership from the PCI indices.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Step 1 Coefficient (B)</th>
<th>Step 1 Wald t-stat</th>
<th>Steps 2-to-5 Coefficient (B)</th>
<th>Steps 2-to-5 Wald t-stat</th>
<th>Step 6 Coefficient (B)</th>
<th>Step 6 Wald t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood</td>
<td>-.347</td>
<td>1.76</td>
<td>NR</td>
<td>NR</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Control</td>
<td>-.540*</td>
<td>5.19</td>
<td>NR</td>
<td>NR</td>
<td>-.699**</td>
<td>1.40</td>
</tr>
<tr>
<td>Knowledge</td>
<td>-.124</td>
<td>.28</td>
<td>NR</td>
<td>NR</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Hope</td>
<td>.645*</td>
<td>4.86</td>
<td>NR</td>
<td>NR</td>
<td>.39</td>
<td>3.41</td>
</tr>
<tr>
<td>Happiness</td>
<td>-.140</td>
<td>.22</td>
<td>NR</td>
<td>NR</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Commitment</td>
<td>.095</td>
<td>.17</td>
<td>NR</td>
<td>NR</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Distance</td>
<td>-.350#</td>
<td>3.52</td>
<td>NR</td>
<td>NR</td>
<td>-.31*</td>
<td>3.91</td>
</tr>
<tr>
<td>Sadness</td>
<td>.316*</td>
<td>5.24</td>
<td>NR</td>
<td>NR</td>
<td>.27*</td>
<td>5.40</td>
</tr>
<tr>
<td>Appetitive Motivation</td>
<td>.330</td>
<td>1.57</td>
<td>NR</td>
<td>NR</td>
<td>.26*</td>
<td>4.16</td>
</tr>
<tr>
<td>Aversive Motivation</td>
<td>.051</td>
<td>.035</td>
<td>NR</td>
<td>NR</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Model Chi-Square [df] 24.86** Sig.** 22.19***
Block Chi-Square [df] - Sig.** 22.19***
% Correct Predictions 69.10 NR 69.10
-2 Log Likelihood 109.61° NR 112.28
Goodness of fit $x^2$ 8.61 NS 4.81

Note: NR = Not reported, Group: 0 = students, 1 = alcohol abusers, n: the initial -2 Log Likelihood = 134.47, the Wald statistics (t-stat) are distributed chi-square with 1 degree of freedom. *p < .05, **p < .01, and ***p < .001

As Table 7.8 shows, the last step of the model had four significant predictors of being a member of the alcohol abusers' group. The direction of the coefficients of the significant predictors indicates that, in comparison to the student sample, alcohol abusers reported more appetitive motivation to achieve their goals, shorter goal distances, and more sadness if they failed to achieve their goals. However, the remaining difference between the two groups, related to perceived control over goals attainment, indicates that alcohol abusers had less perceived control than did the students. The implications of the apparent contradiction in the characteristics of the two groups are discussed later.
Analyses Limited to the Alcohol Abuser Sample

To test the study hypotheses (c, d, and f) limited to the alcohol abuser sample, a series of regression analysis was conducted. As described at Chapter 5, all regression models were tested to ensure that the regression assumptions were met. In addition, a factor analysis of the PCI data, limited to the alcohol abuser sample, was conducted with data considerations and methodological issues similar to the earlier factor analyses.

To test the hypothesis that alcohol consumption can predict alcohol abusers’ ECF (i.e., classic Stroop interference scores), a hierarchical regression analysis, with only abuser participants included, was conducted. The model was fitted to measure the effect of the alcohol consumption indices (amount of alcohol consumed and chronicity of consumption) beyond the effects of other variables controlled for in the model. The controlled variables were gender, age, years of education, PSS scores, and IQ.

Table 7.9 shows the intercorrelations among the variables entered into the regression model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>The ECF</th>
<th>Gender</th>
<th>Age</th>
<th>Education</th>
<th>PSS</th>
<th>IQ</th>
<th>Week-d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.20*</td>
</tr>
<tr>
<td>Education</td>
<td>-.23*</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td>.35**</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>-.30*</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week-d</td>
<td>NS</td>
<td>-.41**</td>
<td>NS</td>
<td>-.26*</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronicity</td>
<td>.37**</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>.21*</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

Note: Gender was coded as male = 0, female = 1, week-d = weekly mean drinking. *p < .10, *p < .05, **p < .01, and ***p < .001, two-tailed.

As Table 7.9 shows, there were negative significant correlations between ECF, and IQ, between gender and weekly mean drinking, and between education and weekly mean drinking. There were also positive correlations between ECF and chronicity of alcohol consumption and between age and PSS.
With the procedures described in Chapter 5, all variables were tested for the regression analysis assumptions before entering them into the regression model. To meet the underlying regression assumptions of linearity and normal distribution, normalised z-scores (using area transformation; see Chapter 5) were calculated for the classic-Stroop interference scores, weekly mean drinking, and the chronicity index (years of problematic drinking). Diagnostic tests were run to assure that all the assumptions of the regression model had been met.

Table 7.10 shows the hierarchical regression model to predict ECF from the drinking indices.

In the regression model, Steps One -to Four showed that neither gender ($\Delta R^2 = .030, p > .05$), age ($\Delta R^2 = .001, p > .05$), years of education ($\Delta R^2 = .058, p > .05$), nor PSS scores ($\Delta R^2 = .096, p > .05$) were significant predictors of ECF. Inclusion of IQ in Step Five led to a significant change——by 9% in the variance accounted for beyond the other variables in the model, $F(5, 47) = 1.75, t= -2.09, p< .05$. Step Six showed that the amount of alcohol consumed per week was not a significant predictor of ECF ($\Delta R^2 = .001, p > .05$). The chronicity index (Step Seven) indicated that years of problematic drinking was a significant predictor of ECF impairment, producing a 12% increment in $R^2$ beyond the proportion already explained in the earlier steps, $F(7, 47) = 2.22, t=2.40, p <. 05$. The final step included seven predictors, with two significant predictors (IQ and chronicity of alcohol consumption); together they accounted for 30% of the variance in ECF.

The model (including seven predictors) was subjected to post hoc effect-size and power analyses. With the G*power software (Erdfelder, et al., 1996), $\eta^2 = .42$ was obtained. This corresponds to a large effect size (Cohen, 1992). A post hoc power analysis using the same software yielded a power of .87.
Table 7.10. Results of the hierarchical regression analysis for drinking indices predicting ECF (i.e., classic Stroop interference scores).

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>-.403</td>
<td>.356</td>
<td>.030</td>
<td>-.174</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>-.415</td>
<td>.367</td>
<td>.001</td>
<td>-.180</td>
</tr>
<tr>
<td></td>
<td>Gender</td>
<td>.004</td>
<td>.023</td>
<td></td>
<td>.027</td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>-.412</td>
<td>.361</td>
<td>.058</td>
<td>-.178</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.002</td>
<td>.023</td>
<td></td>
<td>-.016</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>-.116</td>
<td>.074</td>
<td></td>
<td>-.245</td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
<td>-.424</td>
<td>.365</td>
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<td>-.184</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.007</td>
<td>.024</td>
<td></td>
<td>-.047</td>
</tr>
<tr>
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<td>Education</td>
<td>-.116</td>
<td>.074</td>
<td></td>
<td>-.243</td>
</tr>
<tr>
<td></td>
<td>PSS</td>
<td>.038</td>
<td>.069</td>
<td></td>
<td>.091</td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>-.462</td>
<td>.350</td>
<td>.095*</td>
<td>-.200</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.008</td>
<td>.023</td>
<td></td>
<td>-.058</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>-.113</td>
<td>.071</td>
<td></td>
<td>-.238</td>
</tr>
<tr>
<td></td>
<td>PSS</td>
<td>.041</td>
<td>.066</td>
<td></td>
<td>.099</td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>-.030</td>
<td>.014</td>
<td></td>
<td>-.309*</td>
</tr>
<tr>
<td>6</td>
<td>Gender</td>
<td>-.500</td>
<td>.393</td>
<td>.001</td>
<td>-.216</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.009</td>
<td>.024</td>
<td></td>
<td>-.066</td>
</tr>
<tr>
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<td>.076</td>
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</tr>
<tr>
<td></td>
<td>PSS</td>
<td>.045</td>
<td>.069</td>
<td></td>
<td>.108</td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>-.030</td>
<td>.015</td>
<td></td>
<td>-.310*</td>
</tr>
<tr>
<td></td>
<td>Weekly mean drinking</td>
<td>-.073</td>
<td>.326</td>
<td></td>
<td>-.040</td>
</tr>
<tr>
<td>7</td>
<td>Gender</td>
<td>-.345</td>
<td>.375</td>
<td>.12*</td>
<td>-.149</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.005</td>
<td>.023</td>
<td></td>
<td>-.037</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>-.110</td>
<td>.072</td>
<td></td>
<td>-.231</td>
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<tr>
<td></td>
<td>PSS</td>
<td>.007</td>
<td>.067</td>
<td></td>
<td>.016</td>
</tr>
<tr>
<td></td>
<td>IQ</td>
<td>-.031</td>
<td>.014</td>
<td></td>
<td>-.323*</td>
</tr>
<tr>
<td></td>
<td>Weekly mean drinking</td>
<td>-.048</td>
<td>.307</td>
<td></td>
<td>-.026</td>
</tr>
</tbody>
</table>
|       | Chronicity                     | .385 | .160  |      | .354*

Note. Gender was coded as males = 0, females = 1. *p < .05.

To determine whether gender, age, and IQ moderated the effects of weekly mean drinking and the chronicity index in the model, a series of two-way interactions was tested (all tests two-way). In all, 2 two-way interactions involving gender, 2 two-way
interactions involving age, and 2 two-way interactions involving IQ were tested. There was no significant interaction between gender, age, and IQ with the alcohol consumption indices.

After the significant relationship between the chronicity index and ECF (i.e., classic Stroop interference scores) had been established, further hierarchical regression analyses were conducted to determine whether the alcohol abusers' SILS scores were adversely affected by their abusive drinking. In three hierarchical regression analyses, after the effects of gender, age, years of education, and PSS scores had been controlled; the weekly mean drinking was entered at the fifth stage and the chronicity index at the sixth stage of the regression model. It was found that weekly mean drinking and chronicity of drinking were not significant predictors of SILS Vocabulary T-scores ($F(5, 47) = .87, t = -.57, p > .05$; $F(6, 47) = .80, t = .75, p > .05$; respectively), SILS Abstraction T-scores ($F(5, 47) = .20, t = .47, p > .05$; $F(6, 47) = .17, t = -.11, p > .05$; respectively), nor the SILS Abstraction Quotient ($F(5, 47) = 2.49, t = .90, p > .05$; $F(6, 47) = 2.07, t = -.49, p > .05$; respectively).

In another series of hierarchical regression analyses, the alcohol consumption indices in the earlier regression model were replaced with the ECF scores; this was to determine whether ECF could predict the abusers' SILS scores. It was found that, although the ECF was not a significant predictor of either SILS Vocabulary T-scores ($F(5, 47) = .82, t = -1.23, p > .05$) or the SILS Abstraction Quotient ($F(5, 47) = 2.81, t = -1.40, p > .05$), it significantly negatively predicted the alcohol abusers' SILS Abstraction T-scores.

Table 7.11 shows the intercorrelations among the variables entered into the regression model to test the ability of ECF to predict the abusers' SILS Abstraction T-scores.

<table>
<thead>
<tr>
<th>Variable</th>
<th>SILS Ab. T</th>
<th>Gender</th>
<th>Age</th>
<th>Education</th>
<th>PSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td>.21*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>NS</td>
<td></td>
<td></td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>PSS</td>
<td>NS</td>
<td></td>
<td></td>
<td>.35**</td>
<td></td>
</tr>
<tr>
<td>ECF</td>
<td>-.28*</td>
<td></td>
<td></td>
<td>-.23*</td>
<td></td>
</tr>
</tbody>
</table>

Note: SILS Ab. T = SILS Abstract T-score. *$p < .10$, **$p < .05$, ***$p < .01$
As Table 7.11 shows, there were negative correlations between the ECF, SILS Abstract T-scores, and education. There was also a positive correlation between PSS scores and age.

The results of a hierarchical regression analysis of variables predicting the SILS Abstract T-scores are shown in Table 7.12.

Table 7.12. The results of hierarchical regression analysis of ECF (classic Stroop interference) scores predicting SILS Abstract T-scores.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>1.23</td>
<td>2.940</td>
<td>.004</td>
<td>.064</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>1.11</td>
<td>3.039</td>
<td>.001</td>
<td>.058</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.035</td>
<td>.189</td>
<td>.029</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>1.11</td>
<td>3.051</td>
<td>.017</td>
<td>.058</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.007</td>
<td>.193</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>-.52</td>
<td>.625</td>
<td>-.131</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
<td>1.20</td>
<td>3.086</td>
<td>.006</td>
<td>.063</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.040</td>
<td>.206</td>
<td>.034</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>-.52</td>
<td>.631</td>
<td>-.133</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS</td>
<td>-.28</td>
<td>.587</td>
<td>-.082</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>.038</td>
<td>3.013</td>
<td>.100*</td>
<td>.002</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.021</td>
<td>.198</td>
<td>.018</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>-.84</td>
<td>.625</td>
<td>-.214</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS</td>
<td>-.18</td>
<td>.565</td>
<td>-.052</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ECF</td>
<td>-2.76</td>
<td>1.323</td>
<td>-.33*</td>
<td></td>
</tr>
</tbody>
</table>

Note. Gender was coded as males = 0, females = 1. * p < .05.

It was confirmed that the model met all the assumptions of validity. In the regression model, ECF significantly predicted Abstract T-scores, independently of all the other variables in the model; it accounted for 10% of the variance, \( F_{(5, 47)} = 1.11, t = -2.09, p < .05 \).
Chapter 7

Factor Analysis of the PCI for the Alcohol Abuser Sample

The results reported in this chapter indicate that, in comparison to students, alcohol abusers were significantly lower on adaptive motivational structure. These results also indicate that, among other features, the most important motivational characteristic of the abuser sample, distinguishing them from the student sample, was their feeling of having little control over their goal achievements.

In this section, an attempt is made to see whether a motivational distinction within the alcohol abuser sample is possible. The data considerations before conducting the factor analysis were the same as those described elsewhere in this chapter and in earlier chapters.

Again, using PCA, an interpretable two-factor solution was obtained. The oblique rotation improved the factor pattern; therefore, the rotated solution (Oblimin) was selected. Bartlett’s test of sphericity ($X^2_{(45)} = 246.48, p < .0001$) and the KMO test of sampling adequacy with a high value (.71) confirmed that the PCA could be proceeded with confidence. The slope of the two largest factors tapered between the second and third factors, indicating that a two-factor solution was optimal. This conclusion was further supported by the proportion of variance explained by the first two factors. Factor 1 accounted for 38.36% of the total variance, and Factor 2, for 18.60%; a total of 57% of the variance was explained by the first two factors.

The loadings on the two factors are shown in Table 7.13.

Participants who scored high on Factor 1 felt optimistic about accomplishing their goals, as indicated by high loadings on perceived likelihood of success and hope (about achieving their goals if they tried their best). These participants believed that they knew what to do to achieve their goals and expected to achieve their goals in the near future (as indicated by a loading less than .30 on Goal Distance). They reported being committed to achieving their goals; this was accompanied by perceived control over goal achievements. They were emotionally involved in their goal pursuits, through stronger expectations of happiness (if they succeeded at achieving their goals) than feelings of sadness if they did not. In contrast to earlier factor analyses, Factor 1 for the alcohol abuser sample was neither characterised by a strong positive loading on appetitive motivation nor by a strong negative loadings on aversive motivation.
Table 7.13. Principal factor loadings with Oblimin rotation of the PCI

<table>
<thead>
<tr>
<th>The PCI variables</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood of achieving goals</td>
<td>.82</td>
<td></td>
</tr>
<tr>
<td>Control over achieving goals</td>
<td>.71</td>
<td>-.52</td>
</tr>
<tr>
<td>Knowledge about how to achieve goals</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>Hope about achieving goals</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>Happiness from achieving goals</td>
<td>.52</td>
<td></td>
</tr>
<tr>
<td>Commitment to achieving goals</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>Distance from goal achievements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sadness from failure at goal achievements</td>
<td>.38</td>
<td></td>
</tr>
<tr>
<td>Appetitive motivation index</td>
<td></td>
<td>-.93</td>
</tr>
<tr>
<td>Aversive motivation index</td>
<td></td>
<td>.95</td>
</tr>
</tbody>
</table>

Note. Loadings less than .30 are suppressed. Highest loadings are in bold.

Participants who scored high on Factor 2 were characterised first by a strong tendency to avoid things that they did not want; this was accompanied by almost no tendency to approach or attain things that they did want. On the other hand, the strong aversive style of goal pursuits was accompanied by a moderate sense of poor control over goal achievements. In addition, Factor 2 was related to neither feelings of hope about achieving goals, nor having knowledge about how to achieve them. Participants scoring high on Factor 2 seemed emotionally indifferent about goal attainment. In conclusion, Factor 1 was defined as a more adaptive style of motivation and Factor 2 as a more maladaptive style.

To further explore this motivational distinction, based on the median scores of the two factors, participants were allocated to one of two groups: those scoring high on Factor 1 ($N = 15$) or Factor 2 ($N = 15$). To determine whether the two groups differed on the PCI indices, a series of independent $t$-tests (all tests one-tailed) were conducted. In comparison to participants allocated to Factor 2, those allocated to Factor 1 scored significantly higher on the optimistic indices (i.e., feeling strong likelihood of achieving their goals, $t_{(28)} = 7.42, p < .001$; and hope about achieving their goals, $t_{(28)} = 8.28, p < .001$). They also reported stronger feelings of control over achieving their goals, $t_{(28)} = 6.23, p < .001$; thought they knew how to achieve them, $t_{(28)} = 5.88, p < .001$; and felt
committed to achieving them, $t(28) = 4.05$, $p < .001$. They also scored higher on the appetitive motivation index, $t(28) = 5.48$, $p < .001$; and lower on the aversive motivation index, $t(28) = -3.23$, $p < .001$; than did participants allocated to Factor 2. There was no significant difference between the two groups' scores on their expected emotional reactions to goal attainments: happiness from achieving their goals, $t(28) = 1.98$, $p > .05$; and sadness if they did not achieve them, $t(28) = 1.47$, $p > .05$. They did not differ from each other on their ratings of distance from achieving their goals, $t(28) = .81$, $p > .05$. The above results corroborated the idea that participants who scored high on Factor 1 had a more adaptive motivation than did those who scored high on Factor 2.

To test the fourth hypothesis of this study that alcohol abusers' poorer ECF (i.e., larger interference scores on classic Stroop test) was associated with a more maladaptive motivational structure, a hierarchical regression analysis was conducted—in the same way as that described in Chapter 6 with the student sample.

Table 7.14 shows the intercorrelations among the variables entered into the regression model to test this hypothesis.

Table 7.14 Intercorrelations among PCI Factor 2, Gender, Age, PSS scores, SILS AQ, and ECF (classic Stroop interference) scores.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 2</th>
<th>Gender</th>
<th>Age</th>
<th>PSS</th>
<th>SILS AQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td>.21*</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PSS</td>
<td>NS</td>
<td>NS</td>
<td>.35**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILS AQ</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>The ECF</td>
<td>.41**</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Note: Shipley AQ = Shipley Abstraction Quotient, * $p < .10$, * $p < .05$, ** $p < .01$, and *** $p < .001$, two-tailed.

As Table 7.14 shows, there were positive correlations between ECF and PCI Factor 2 and between PSS scores and age. Based on the intercorrelations matrix, there was no evidence to suspect collinearity among the variables.

The hierarchical regression model comprised five steps, in which the power of SILS Abstraction Quotient and ECF to predict PCI Factor 2 was tested beyond the effects of gender, age, and PSS scores.
The results of the hierarchical regression analysis for the variables predicting ECF are shown in Table 7.15.

Table 7.15. The results of hierarchical regression analysis of SILS Abstraction Quotient and ECF predicting the PCI Factor 2.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>.34</td>
<td>.33</td>
<td>.026</td>
<td>.16</td>
</tr>
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<td>2</td>
<td>Gender</td>
<td>.41</td>
<td>.34</td>
<td>.021</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.02</td>
<td>.021</td>
<td>-.15</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gender</td>
<td>.41</td>
<td>.34</td>
<td>.001</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.018</td>
<td>.022</td>
<td>-.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS</td>
<td>-.012</td>
<td>.064</td>
<td>-.031</td>
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</tr>
<tr>
<td></td>
<td>SILS Abstraction Quotient</td>
<td>-.006</td>
<td>.011</td>
<td>-.088</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Gender</td>
<td>.44</td>
<td>.35</td>
<td>.008</td>
<td>.20</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.017</td>
<td>.023</td>
<td>-.13</td>
<td></td>
</tr>
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<td></td>
<td>PSS</td>
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<td>-.036</td>
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</tr>
<tr>
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<td>SILS Abstraction Quotient</td>
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<td>.011</td>
<td>-.088</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Gender</td>
<td>.58</td>
<td>.32</td>
<td>.19**</td>
<td>.27</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>-.015</td>
<td>.021</td>
<td>-.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSS</td>
<td>-.019</td>
<td>.059</td>
<td>-.049</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SILS Abstraction Quotient</td>
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<td>.010</td>
<td>-.039</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ECF</td>
<td>.003</td>
<td>.001</td>
<td>.44**</td>
<td></td>
</tr>
</tbody>
</table>

Note. Gender was coded as males = 0, females = 1. ** p < .01.

In the regression model, only ECF (Step Five) accounted for a significant increment in the variance (19% out of 24% for the entire model) predicting PCI Factor 2, \(F_{(5,47)} = 2.41, t = 2.42, p < .05\). The model indicates that longer classic Stroop RTs (i.e., poorer ECF) were associated with higher scores on PCI Factor 2. Inclusion of Shipley AQ (Step Four) did not produce a significant change (\(ΔR² = .08\%\)) in the prediction of PCI Factor 2.

To test the fifth hypothesis of this study that interference scores on the alcohol-Stroop test reflected abusers' attentional bias for alcohol-related stimuli, independently of
their ECF (i.e., their interference score on the classic Stroop test), a hierarchical regression analysis was conducted in which interference scores on the alcohol-Stroop test were regressed onto the classic Stroop interference scores.

Table 7.16 shows the intercorrelations matrix for the variables entered into the regression model.

Table 7.16. Intercorrelations among alcohol-Stroop interference scores, gender, age, IQ, PSS scores, and ECF (classic Stroop interference) scores.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Alc-Stroop</th>
<th>Gender</th>
<th>Age</th>
<th>IQ</th>
<th>PSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>NS</td>
<td>.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>PSS</td>
<td>-.32*</td>
<td>NS</td>
<td>.35**</td>
<td>-16*</td>
<td></td>
</tr>
<tr>
<td>The ECF</td>
<td>.24*</td>
<td>NS</td>
<td>NS</td>
<td></td>
<td>-.28*</td>
</tr>
</tbody>
</table>

Note: Alc-Stroop = alcohol-Stroop interference score. *p < .10, *p < .05, **p < .01

As Table 7.16 shows, there was a negative correlation between the alcohol-Stroop interference scores and PSS scores and a positive correlation that approached significance between the alcohol-Stroop interference scores and ECF (classic Stroop interference) scores. Age was also positively correlated with PSS. IQ showed negative correlations with PSS scores and ECF (classic Stroop interference) scores. This means that increases in classic Stroop interference scores (i.e., poorer ECF) was associated with lower IQ. Based on the intercorrelations matrix, there was no evidence to suspect strong collinearity among the variables.

The hierarchical regression analysis comprised five steps; each estimated the unique effect of the entered variable over and above the variables entered in the earlier steps.

The results of the hierarchical regression analysis of variables predicting the alcohol-Stroop interference scores are shown in Table 7.17.
Chapter 7

Table 7.17. The results of hierarchical regression analysis for ECF (classic Stroop interference) scores predicting alcohol-Stroop interference scores.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Variables</th>
<th>B</th>
<th>SE B</th>
<th>ΔR²</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gender</td>
<td>-.068</td>
<td>.323</td>
<td>.001</td>
<td>-.032</td>
</tr>
<tr>
<td>2</td>
<td>Gender</td>
<td>-.018</td>
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Note. Gender was coded as males = 0, females = 1. *p < .05.

In the regression model, no variable was a significant predictor of the alcohol-Stroop interference score, including ECF, $F(5, 47) = 1.66, t = 1.59, p > .05$; thus supporting the study's hypothesis of a lack of relationship between ECF and alcohol-Stroop interference.

To further test the above hypothesis, a univariate analysis of covariance (ANCOVA) using GLM was conducted, in which alcohol interference scores were entered as the dependent variable, Group (i.e., alcohol abusers vs. students) as the independent variable (the fixed factor), and classic Stroop interference scores (ECF) as the covariate. A Cook's distance statistics equal to 2 (see page 133) suggested that one of the alcohol abusers interference scores be eliminated from the analysis because of his extreme RTs. In addition, based on the guidelines provided by Pallant (2001, pp. 233-
primary checks were conducted to ensure that there was no violation in the assumptions of ANCOVA. These were the assumption of linearity (a scatter plot confirmed that the general distribution of scores for each group was linear), and the assumption of homogeneity of regression slopes (there was no significant interaction between Group and classic Stroop interference scores). For the corrected model, all of Cook's distance statistics were zero. The results showed that after controlling for ECF (i.e., classic Stroop interference scores) as the covariate ($F(1,92) = 3.40, p > .05, \eta^2 = .035$), alcohol abusers ($M = 30.52, SD = 44.38$) had significantly larger interference scores for the alcohol-related stimuli than did the students ($M = 1.02, SD = 34.10$), $F(1,92) = 7.80, p < .01, \eta^2 = .080$. This finding suggests that the attentional bias difference between controls and alcohol-abusers is not an artefact of their differences in ECF.

**Discussion**

The first hypothesis of this study, that alcohol abuse predicts reductions in alcohol abusers' ECF (i.e., classic Stroop interference scores) more than it does in non-abusers' ECF, was confirmed. Alcohol abusers needed significantly more time to respond to all word categories than did students. Alcohol abusers also made significantly more errors on incongruent words than did students, suggesting a poorer cognitive flexibility in successfully completing the highly conflicting part of the task. In addition, their interference score on the classic Stroop test significantly differed from that of students, indicating that the alcohol abusers needed more time to suppress the task-irrelevant aspect of the incongruent stimuli (word meaning) in order to respond to the task-relevant aspect (ink colour). This finding is consistent with that of Maylor and Rabbitt (1993), who conducted a meta-analysis and concluded that alcohol impairs information processing and increases the length of task performance. However, based on the present findings, it is difficult to comment on the authors' suggestion that alcohol has a general *slowing-down* effect, or whether the effects of alcohol are limited to *specific* cognitive operations (e.g., Ryan, Russo, & Greeley, 1996).

The study's finding that alcohol abusers have poorer ECF than students is consistent with prior evidence (e.g., Beatty et al., 2000; Bowden et al., 2001; Dao-Castellana et al., 1998; Hoaken et al., 1998; Lyvers, 2000a; Mantere et al., 2002; Noel et al., 2001). It is inconsistent with the Stetter et al.'s (1995) finding, which reported no significant difference between the alcohol abusers' and controls' neuropsychological performance.
The second hypothesis of this study that, alcohol abusers suffer from a more maladaptive motivational structure than do non-abusers, was supported. After the effects of gender, education, and IQ in a hierarchical regression analysis model had been controlled, lower scores on PCI Factor 1 (adaptive motivation) significantly predicted membership in the alcohol abuser group.

The results of the second logistic regression model indicated that the alcohol abusers, compared to the non-abusers, expected to achieve their goals within a shorter time, showed greater appetitive motivation in goal pursuits, and expected greater sadness from failure to achieve their goals. At first glance, all of these differences suggest that alcohol abusers have a more adaptive motivational structure than do students. However, alcohol abusers also reported feeling less control over their goal attainments. This contradicts the view that alcohol abusers have an adaptive motivational structure. An appetitive motivation directed at goal achievements in the near future, which is not accompanied by feelings of control over goal attainments, would appear to be self-defeating. The likely negative consequences and such a motivational pattern would appear to lead to sadness from failure at expected goal attainments.

As noted, alcohol abusers showed a combination of conflicting motivational tendencies on the PCI. An expectation to achieve goals within a short (probably unrealistic) period of time probably reflects alcohol abusers' low frustration tolerance (e.g., Virkkunen et al., 1994). Participants' perceptions of goal distance are probably also related to their age. Being older can mean that one has less time available in which to achieve goals. It can also mean that being older is associated with more experience, knowledge, and skills to be used in future goal pursuits. If these interpretations are correct, a feeling of having control over goal attainments should accompany these other motivational characteristic, but this was not true of the alcohol abusers tested in this study. Having appetitive motivation without perceiving control over goal achievements could lead to anxiety about the goal pursuits. A tendency to avoid negative feeling together with a reward seeking orientation (as reflected in high scores on the PCI Appetitive Motivation index) could fuel alcohol-seeking behaviours.

The results of the first regression model indicating that alcohol abusers have less adaptive motivation than non-abusers was corroborated by the results of the second logistic regression analysis. It indicated that alcohol abusers lack a feeling of control over achieving their goals.

Because of the importance of loss of control in traditional definitions of alcohol abuse (e.g., Lyvers, 2000; Room, & Leigh, 1992), attention needs to be called to the
concept of control in two respects. First, lack of perceived controllability characterises alcohol abusers' motivational structure, as reflected in their scores on the PCI. Second, the lack of controllability characterises alcohol abusers' cognitive performance, as reflected in their performance on both the classic and alcohol-Stroop tests that is poorer than that of non-abusers.

The motivational differences found between students and alcohol abusers is consistent with the results of Man et al. (1998), who, using the MSQ, found motivational differences between a clinical and a non-clinical sample of drinkers.

The third hypothesis of the study stated that alcohol consumption can predict alcohol abusers' ECF. It was found that the chronicity of alcohol abuse, not the current level of drinking, significantly predicted poorer ECF among the abuser sample. This finding is not consistent with findings (e.g., Beatty et al., 2000; Emmerson, Dustman, Heil, & Shearer, 1988) that the quantity of alcohol consumed, rather than the length of alcohol consumption, is associated with poor ECF. As a review by Moselhy et al (2001) suggests, a longer history of abusive drinking is associated with a greater risk of long-lasting cortical and sub-cortical impairments, such that some of the impairments will persist for years after a successful detoxification. Although some of the cognitive impairments associated with alcohol consumption could predate abusive drinking (Giancola & Moss, 1998), neurological studies show that the harmful effects of alcohol on an impaired brain is worse than its effects on an intact brain (Moselhy et al, 2001).

The fourth hypothesis of this study, that poorer ECF is associated with a stronger maladaptive motivation among alcohol abusers was supported. The finding is different from the results from students described in Chapter 6, which showed that the relationship between students' ECF and their motivational pattern was not significant. Such a difference between the two groups of participants might have arisen from differences between the two groups' degree of ECF impairment. The alcohol abusers were more impaired in ECF than were the students. The above findings are consistent with the findings (e.g., Cahn-Weiner et al., 2000; Espy et al., 1999; Lyvers, 2000; Skutle & Berg, 1987) that self-control is related to executive cognitive functioning and that ECF has its greatest contribution to sustaining self-control, planning, awareness of problems, organization, and the ability to manage the instrumental activities of daily living.

The fifth hypothesis of this study, that interference scores on the alcohol-Stroop test reflect abusers' attentional bias for alcohol-related stimuli independent of their ECF was also supported. The finding is consistent with the results from students described in Chapter 6. This finding further supports the view that the alcohol-Stroop test is a reliable
and valid measure of drinkers’ distractions for alcohol-related stimuli. Consistent with
the findings reported in Chapter 6, this result suggests that interference scores on the
alcohol-Stroop test are neither an artefact of nor are they confounded with participants’
general level of ECF.

To conclude:

ECF plays an important role in motivational structure. It seems that ECF not only
affects the way that people set goals in their lives but also the ways in which they feel
about achieving their goals. There are important implications of the finding that a faulty
ECF is associated with a faulty motivational system. For instance, this finding suggests
the possibility of developing general ECF training for use with people with poor ECF.
Further research is needed to investigate this possibility. Although poor ECF was found to
be associated with maladaptive motivation, poor ECF was not related to attentional bias
for alcohol-related stimuli. This finding, however, does not mean that RTs on a Stroop
test are not affected by a person’s ECF. Alcohol abusers made significantly more errors
in response to incongruent words than did students. In addition, alcohol abusers’
latencies were significantly longer than those of students. However, the alcohol abusers’
significantly larger interference scores on the alcohol-Stroop test than the students’
indicates that emotionality has specific effects beyond the effects of a faulty ECF (see
Table 7.17 for the results of ANCOVA analysis).

The results of the research in this thesis indicated that motivational structure and
attentional bias for alcohol-related stimuli were the most potent determinants of the
quantity of alcohol that participants consumed. These variables were the ones that best
distinguished the alcohol-dependent, clinical sample from the non-clinical one. It was
also found that attentional bias predicted the quantity of alcohol that the participants
consumed after the influence of motivational structure had been controlled. This finding
suggests that although ECF is associated with maladaptive motivation, ECF is not the
exclusive determinant of drinkers’ attentional bias for alcohol-related stimuli. The
specificity of attentional bias for salient stimuli, along with the important role that
attentional bias plays in sustaining drinking habits (including relapse into drinking after
treatment) is promising for the development of an alcohol-specific attention control
programme to help drinkers overcome their attentional bias for alcohol. Such a
programme might focus on correcting drinkers’ faulty attentional system, which gives rise
to the bias specifically for alcohol-related stimuli. The next chapter presents such a
programme.
Alcohol Attention Diversion Training in the Treatment of Alcohol Abuse

Two issues have been of core importance in addictive behaviours: (a) why many people continue their harmful pattern of drug or alcohol use despite their knowledge of the harmful effects and (b) why many newly abstinent abusers cannot resist the temptation to use alcohol or other drugs and resume their abusive behaviour.

Evidence demonstrates that alcohol abuse, as an addictive behaviour, has subjective, emotional, and motivational characteristics (Hillebrand, 2000). It is subjective and emotional because it is accompanied by strong urges to drink after a period of abstinence, and it is motivational because in many cases the alcohol urges lead to alcohol-seeking (i.e., goal-directed) behaviour. Traditional behavioural models of alcohol urges suggest that the urge is a prerequisite of alcohol-seeking behaviour. However, there is evidence that alcohol urges do not always lead to actual drinking (e.g., all detoxified alcohol abusers experience urges, but many remain abstinent). Therefore, Tiffany (1990, 1999) distinguished alcohol urges from alcohol use. He suggested that automatic cognitive processes leading to alcohol urges are supplemented by conscious and non-automatic cognitive processes; the individual is aware of the urge state and has the opportunity to decide whether to remain abstinent or to drink alcohol. Therefore, the urge experience does not mean that drug-seeking and drug-taking behaviour would be activated in an irresistible way. On the other hand, chronic abusive drinking of alcohol causes many aspects of alcohol seeking and alcohol use gradually to become independent of conscious thoughts, taking the form of fast, automatic processes. External cues (i.e., alcohol-related stimuli) can trigger the previously well-established automatic chain of alcohol-seeking and alcohol-using behaviours. Craving occurs when external or internal obstacles block the automatic behavioural chain. In Tiffany's theory, however, craving is neither necessary nor sufficient to explain uncontrollability.

A person can consciously decide to overcome the obstacles to having another drink, or he or she can decide to remain abstinent. According to Tiffany (1990, 1999), the effort to maintain abstinence requires non-automatic processes, mainly because alcohol urges are based on non-automatic processes. These processes are slow, intentional, and effortful. Two kinds of situations can invoke these non-automatic processes: abstinent-avoidance situations and abstinent-promotion situations. Abstinent-avoidance situations are not characterised by a wish to stop consuming alcohol or to remain abstinent from it; however, some environmental obstacles hinder or postpone drinking. The individual
Chapter 8

seeks suitable conditions to satisfy his or her desire, and, in some cases, effortful problem-solving behaviour begins to overcome the obstacle. Abstinent-promotion situations, on the other hand, are characterised by an intentional struggle to remain abstinent from alcohol. This is not an easy struggle, because its roots lie in an approach-avoidance conflict. The approach behaviour is automatic, and environmental alcohol cues can easily trigger alcohol-seeking behaviour and actual drinking. Nevertheless, the avoidance rests on the intention to inhibit the automatic cognitive-behavioural chain.

There is evidence to support Tiffany's theory. For example, Hillebrand (2000) investigated relationships between negative affect and drug cues, and drug urges and automatic processes. Her findings suggested that drug cues can activate drug urges. Cue-related urges, as non-automatic processes, interfered with participants' performance on a dual-task paradigm, and this led to longer RTs. Moreover, Hillebrand reported that drug cues can provoke drug-related urges beyond the role that negative affect contributes. Therefore, this finding is in contrast to the earlier accounts of the relationship between negative affect and drug use (e.g., Brandon, Wetter, & Baker, 1996; Tiffany & Drobes, 1990). Hillebrand's finding is in accordance with Sherman, Zinser, Sideroff, and Baker's (1989) finding that heroin cues prompted strong self-reported urges. Moreover, Sherman et al. found that no particular kind of negative affect was correlated with craving inductions, but that craving was accompanied by many kinds of negative affect.

According to Sherman et al., it is possible that affective states can influence craving through users' attributions. Generalising the above findings from drug to alcohol abuse, alcohol-related stimuli would appear to play an important role in activating the automatic chain of events resulting in alcohol urges, alcohol-seeking schemata, and consumption. Unwanted social and environmental alcohol-related stimuli challenge the drinker's efforts to remain abstinent from alcohol. There is, in fact, sufficient evidence in support of alcohol abusers' automatic attentional bias for alcohol-related stimuli (see Chapters 2, 5, and 7).

According to Waters and Feyerabend (2000), attentional bias for addiction-related stimuli is important for a number of reasons. First, it means that alcohol abusers become more easily aware of alcohol-related stimuli in their environment than do other people. This is potentially problematic if an alcohol abuser is trying to remain abstinent. Second, the automatic processing of alcohol-related stimuli may elicit conditioned responses such as withdrawal or compensatory responses, and these may increase the desire to drink or invoke automatic patterns leading to alcohol use (see Niaura, Rohsenow, Binkoff, Monti, Pedraza, & Abrams, 1988; Tiffany, 1990). Third, attentional bias for alcohol-related
stimuli is undesirable for abstainers. It disturbs their mood and interferes with their daily activities.

The inability to shift attention away from addiction-related stimuli can lead to relapse (Johnsen et al., 1997). Paradoxically, abstinence can intensify this inability. Gross et al. (1993) found that abstinent smokers had longer RTs to smoking-related stimuli (e.g., smoking) than non-abstinent smokers. This suggests that withdrawal increases the attentional bias, and this may interfere with cessation attempts. Regarding alcohol, evidence indicates that there is a relationship between attentional bias and (a) drinking in non-dependent drinkers (see, Chapter 5), and (b) the risk of relapse among detoxified alcohol abusers (see, Cox et al. 2000; Cox, et al., 2002). Cox et al.'s (2002) findings suggest that alcohol abusers who become increasingly preoccupied with alcohol have greater difficulty remaining abstinent than those who do not.

In summary, attentional bias for alcohol-related stimuli is a risk factor that intensifies the malicious cycle seen in alcohol abuse and increases the probability of relapse among detoxified alcohol abusers.

**Why An Attention Diversion Programme?**

Recovery from alcohol abuse starts with the abuser's struggle to complete detoxification and remain abstinent from alcohol. Abstinence requires non-automatic processing in order to avoid further automatic drinking (Hillebrand, 2000; Tiffany, 1990). The struggle to cease an addictive behaviour is threatened by an approach-avoidance conflict. This situation produces continuous ambivalence. For example, Cox et al. (2002) reported an increase in attentional bias for alcohol-related stimuli among in-treatment alcohol abusers during a four-week interval. The researchers also suggested that as the length of abstinence increases the more difficult it becomes for alcohol abusers to resist their urges to drink. This finding has implications for treatment: if non-automatic processing is required to counteract the automatic chain of alcohol use, this processing has to compete with automatic processes.

The empirical data on automatic processes related to alcohol urges are not limited to Stroop studies. Cassisi, Delehant, Tsoutsouris, and Levin (1998) assessed light and moderate social drinkers' physiological reactions to alcohol-related and non-alcohol-related cues. They used slides of alcohol-related and non-alcohol-related pictures appearing in popular magazines. They found that heavy drinkers exposed to the alcohol pictures demonstrated changes in skin conductivity, indicating nervous system activity under anxiety. According to Litt and Cooney (1999), this anxiety reflects a heavy
drinker's paradoxical state of mind, in which he or she fluctuates between decisions to drink and not to drink. Accordingly, Townshend and Duka (2001) investigated the attentional bias among non-dependent heavy and occasional social drinkers using alcohol-related pictures and words in a dot-probe detection task. The heavy social drinkers showed a greater attentional bias for the alcohol-related stimuli than did the occasional social drinkers. The researchers interpreted the data as supporting cognitive theories of addictive behaviour, which suggest that attentional bias for alcohol and drug-related stimuli plays a part in alcohol and drug dependence, craving, and relapse.

On the other hand, it is important to recognise that automaticity is on a continuum. Automatic and non-automatic processes operate in parallel, and have reciprocal influences on each other (Kahneman, & Treisman, 1984; Shiffrin, 1997). The evidence (e.g., Holender, 1986; Jacoby, & Yonelynas, 1997; Neely, 1991) shows that conscious (non-automatic) processing can affect automatic information processes, just as automatic processes can affect conscious processes. Based on this evidence, it seems plausible to predict that a conscious training programme could affect the mechanisms underlying alcohol abusers' automatic distraction for alcohol-related stimuli.

Complementary to the above discussion is the role of attentional bias for alcohol-related stimuli in predicting quantity of alcohol use. Findings discussed in Chapter 5 indicate that, within the framework of the motivational model of alcohol use, attentional bias for alcohol-related stimuli predicts the amount of alcohol use beyond a maladaptive motivational structure. Chapter 1 discussed different theoretical viewpoints (e.g., classical conditioning accounts, the theory of the brain loci sensitisation, the theory of current concerns, and the automaticity viewpoints) on the importance of attentional bias in craving and alcohol-seeking and alcohol-using behaviours. The above theories, and the findings reported in Chapter 5, are in accordance with Breiner, Stritzke, and Lang's (1999) notion of the importance of a multidimensional model of the choice conflict in addictive behaviours. The motivational model of alcohol use discussed in this thesis embraces such multidimensionality.

The converging evidence thus suggests that recent abstainers experience a high level of approach-avoidance conflict. For example, newly abstinent smokers reported both strong approach and strong avoidance inclinations toward cigarette-related stimuli, distinguishing their motivation to change by high avoidance, not just high levels of craving (Breiner et al., 1999). These findings underscore a general belief about everyday human situations as related to more specific cessation attempts.
Humans usually operate under conditions of uncertainty caused by conflicting or incongruent information relative to the goal at hand. To meet their goals, humans must be able to focus attention, to process goal-relevant information efficiently, and to filter out goal-irrelevant information. (Demetriou & Spanoudis, 2002, p. 2)

A cognitive rehabilitation programme, which could help detoxified (or current) alcohol abusers strengthen their cognitive and attentional resources to overcome automatic processes, might be beneficial in the treatment and prevention of relapse. In a recent study, Bowden, Crews, Bates, Fals-Stewart, and Ambrose (2001) demonstrated indirect positive effects of executive training on the therapeutic outcomes of alcohol abusers. For example, the programme accelerated patients' cognitive improvement and increased their length of stay in the therapeutic programme.

However, no research or intervention has focused on alcohol-specific executive training, which directly targets alcohol abusers' attentional bias for alcohol-related stimuli. Such a programme could have important preventive and therapeutic outcomes. This is because previous research suggests that patients' rigid focus of attention or attentional biases play an important role in relapsing to the addictive behaviour in high-risk situations (Franken et al., 2000; Johnsen et al., 1994). Therefore, one can assume that by increasing the ability of inhibitory resources to prevent attention from being allocated to alcohol-related stimuli, the probability of automatic distraction by alcohol-related stimuli would decrease. ECF training, to prevent distractibility for alcohol, might play a role in neutralising the automatic chain of drink-seeking and drink-taking behaviour. It might help solidify abusers' decisions not to act on their automatic urges to drink, thereby helping to prevent relapse.

For these reasons, this chapter introduces a new therapeutic intervention aimed at helping newly detoxified alcohol abusers gain control over their less conscious attentional distraction for alcohol-related stimuli.

**How is Attentional Training Attainable?**

What kind of mechanisms could be utilised to help alcohol abusers attain control over their attentional bias for alcohol? In terms of Demetriou and Spanoudis' (2002) classification of sources of the Stroop effect (see Chapter 2), this goal would be attainable by considering three stages of processing. The first stage toward this goal would be to increase decision-making ability. This is the ability to encode and apply the target goal ($D_s$). The second stage would be to increase the ability of dimension identification ($D_{id}$), which is an index of processing speed. $D_{id}$ is defined as the time needed to identify the
relevant dimension when there is no interference between word and task (e.g., incongruent colour word). In a Stroop task, $D_{id}$ occurs after the activation of $D_{i1}$ and it is a meaning-making process that allows encoding and application of the target goal to the current task. The third stage would be to increase the ability to inhibit the interference from distracting stimuli. This ability is interference control ($I_{cl}$) in a dual task in which a more-practised but undesirable dimension should be ignored in favour of focusing on a desirable but less-practised dimension.

$I_{cl}$ is an important index of self-directed thinking and behaviour. It enables a person to sustain his or her attention on the current task until the goal has been achieved. A zero or negative interference means that the person has perfect ability to control his or her inhibitory attention resources (Demetriou & Spanoudis, 2002). According to Demetriou and Spanoudis, “these three component processes [$D_{i1}, D_{id},$ and $I_{cl}$] must be present in any conflict-generating situation where a weak dimension must be attended to and processed at the expense of a dominant but goal irrelevant dimension” (p. 5).

It is expected that invigoration of a person’s cognitive abilities—in each of the above stages of attentional processes—would help him or her to better neutralise the automatic chain of drug urges and behaviour. In real life situations, attentional reactions to disorder-related stimuli (e.g., pub, cider) are more important than they are to other stimuli (e.g., carpet, Pepsi). Therefore, in a therapeutic attempt two outcomes would be of potential benefit: decreasing the size of the $I_{cl}$ and increasing the speed of the $D_{id}$ (supported by A. Demetriou, personal communication, June 18, 2002). Speed of processing is important in various ways. First, it is an index of self-directed behaviour, self-concept, and the ability to control socially irrelevant (e.g., Demetriou & Kazi, 2001) and psychopathologically irrelevant stimuli (William et al., 1996, p. 19-21). Second, it is important in the sense of attention duration. Making a hypothetical comparison between two new abstainers (with approximately similar interference scores) helps clarify the issue. The first person has a slow reaction time (e.g., a mean RT of 2500 ms) for shifting his or her attention away from an alcohol stimulus, whereas the second person has a fast reaction time (e.g., a mean RT of 600 ms). This means that the first person is 1900 ms slower in withdrawing his or her attention from the triggering stimulus than is the second person. It would be reasonable to try to increase the first person’s speed of withdrawing his or her attention from the psychopathological stimuli.

Achieving these goals could also be facilitated by each individual’s striving to enhance his or her strategic variability and flexibility to overcome attentional distraction and speed up the ability to shift attention away from unwanted stimuli (Lovett, 2002).
Each particular individual might be unique in how he or she develops his or her strategic skills and manoeuvrability in encountering problem situations.

Therefore, there is debate about whether improvements in information processing arise because of increased efficiency, because of practice (as noted by Lovett, 2002), or because of the development of processing capacity. Because a therapeutic intervention seeks to improve the disordered behaviour as the ultimate goal (sometimes, the exact mechanisms in alcohol abuse are not clear), answering such disputes does not appear to be a prerequisite for employing an intervention programme. However, as Demetriou and Spanoudis (2002) established, the two dimensions have their root in two capabilities. Processing capacity depends on encoding ability, which is based on $D_{ad}$, but efficiency depends on control processes reflected in $L_{cl}$. These abilities systematically change with age, and establish an individual's upper and lower limits. However, actualising these limits depends on the amount of practice. The final performance is a function of the complexity of a task—regardless of the source of its complexity (e.g., colour-word incompatibility; intrusions of emotional salience). Less ability and more task complexity requires more practice to perform the task. Demetriou and Spanoudis (2002) found that both $D_{ad}$ and $L_{cl}$ are affected by development and practice.

Another reason to introduce a cognitive intervention for new abstainers arises from the evidence suggesting that brain impairment accompanies alcohol abuse, especially in the frontal cortices (see Chapter 3). The frontal cortices mediate working memory, which consists of short-term memory and ECF. ECF includes selective attention and task management (Albright et al., 2000; Smith & Jonides, 1999). ECF is important when less conscious cognitive processes are not adequate for goal-seeking behaviours, especially in dual-conflict tasks that require active inhibition of distracters. Chapter 8 demonstrated the role of ECF impairment in predicting alcohol abusers' maladaptive motivational structure.

When willed action characterises behaviour and there is a need to regulate complex cognitive responses, the need for ECF resources increases (e.g., Badgaiyan, 2000). As far as ECF rehabilitation is concerned, there is prior evidence for the efficiency of some ECF training programmes with clinical groups. For example, Delahunty and Morice (1996) developed a rehabilitation programme to improve specific impairments in the cognitive flexibility of schizophrenic patients, their working memory, and their planning ability. The authors interpreted the patients' impairments as reflecting ECF deficits. They developed tasks that provided relevant practice for executive abilities in the frontal and prefrontal loci. They, then, integrated the tasks (i.e., attentional, visual,
verbal, conceptual, and motor) into a specific programme to cover mental activities, such as cognitive shift, working memory, and planning modules. The patients practiced the training over 11 weeks (they completed some modules during two or three weeks). Results demonstrated improvement in neurocognitive performance following completion of the training programme. The researchers described the programme as user-friendly and recommended its application in therapeutic settings with schizophrenic patients.

There is evidence for the role of ECF in the management of learning new planned behaviours. Clark et al. (2000) investigated the cerebral regions involved in a task, including controlled updating of verbal working memory. The task comprised conditional decision-making for target words on a computer screen. The participants were to modify experimentally pre-established connections between a series of words. The task was based on goal-setting within the requirements of stimulus anticipation and response prediction. These requirements were related to working memory processes. Monitoring the brain activities during task management demonstrated bilateral activation of the dorsolateral prefrontal (middle frontal gyrus; MFG) and inferior parietal (supramarginal gyrus; SMG) areas of the brain. Clark et al. (2000) suggested that the MFG handles executive control through the activation of prefrontal regions over the updating processes of working memory. MFG links posterior representations of the anticipated stimulus to anterior representations of the planned response. Clark et al. proposed that connections between the MFG and SMG mediate the updating of the stimulus link, and that the combined activation of these regions is related to the executive control of goal setting in planned behaviour.

Not all people benefit the same from practice. Maylor, Rabbitt, James, and Kerr (1992) found that individual differences mediated the relationships between reaction time, alcohol use, practice, and task complexity. They noticed that alcohol influenced slow participants more adversely than fast participants. However, slow participants got more benefit from practice than did fast participants.

To summarise:

There is evidence for a relationship between ECF and abilities such as attentional control, mental flexibility, planning, self-monitoring, and inhibition of unwanted stimuli. Prior findings indicate that impaired performance of alcohol abusers on tests measuring ECF is related to the severity of the drinking consequences (Giancola, Zeichner, Yarnell, & Dickson, 1996). ECF deficiencies in handling the attentional resources interfere with recent abstainers' ability to remain abstinent from alcohol (Cox et al., 2002). The inability to withdraw attention from disorder-related triggering stimuli would seem to
profit from training. Therefore, prevention and treatment outcomes might be improved by incorporating cognitive rehabilitation into current interventions. Williams et al. (1996) emphasised the importance of conscious strategies to inhibit the psychopathological stimuli:

... breakdown occurs when an individual can no longer expend the extra effort required to override the tendency for concern-related stimuli to capture attention. When able to override attentional bias, non-clinical participants are able to "exit" the vicious spiral ...: emotional disturbance (associated with goal junctures) causing attentional bias, leading to increased salience of [pathological stimuli], leading to increased probability of harm and increased emotional disturbance. (p. 21)

Therefore, an intervention might focus on two possible goals: increasing the speed of processing (i.e., leading to shorter reaction times for shifting attention from alcohol-related stimuli) and decreasing the interference between task-relevant and task-irrelevant stimuli (i.e., faster reaction times for salient stimuli, so that RTs to these stimuli would approximate those to neutral stimuli).

**Alcohol Attention Diversion Training Programme (AADTP)**

The main purpose of developing an alcohol-specific attention diversion training programme is to increase cognitive controllability of detoxified alcohol abusers by strengthening their cognitive inhibitory and flexibility processes—to override the attentional bias. Because the target group in this research comprises detoxified alcohol abusers and the programme stimuli includes alcohol-related objects, the technical term for this programme might be *Alcohol-Specific ECF Rehabilitation Programme (AS-ECF-RP)*. However, AADTP was chosen as a simpler name.

**Stimuli**

The AADTP programme comprised two main kinds of stimuli: bottles (alcohol and soft-drink) and colours (i.e., blue, green, red, and yellow). Colours were selected as the stimulus dimension to be responded to in all stages of the training. Colours appeared as backgrounds or outlines for the bottles (see Figure 8.1).
There were two reasons for selecting colours as the target response. The first was that colours are commonly learned concepts; they are universal stimuli with universal responses (i.e., for naming the four colours used in this study). The second was that responses to colours are more automatic than responses to words or shapes, but they are not necessarily more automatic than responses to alcohol bottles for alcohol abusers. Nonetheless, one potential problem with the colours and the bottles was the colour of the bottles. This could produce another incongruous situation, which goes beyond the relationship between alcohol bottles and the colour-naming task. However, this incongruity could only increase the difficulty of the task and the attentional challenge to overcome it.

Figure 8.1. Samples of bottles used in the AADTP.
Cans and bottle tops were not included as stimuli in the programme. This was because the distinction between an alcoholic and a non-alcoholic can (or top) seems mainly dependent on logo identification and reading abilities. This distinction requires more detailed visual processing (in the absence of the bottles), and thereby could unnecessarily increase the difficulty of the task, and make it less effective. However, with bottles, various geometrical or postural characteristics are usually specific to a brand. In addition, some of these are characteristics mainly of alcohol bottles (e.g., wine bottles). Presenting an alcohol bottle provides more complete and faster information about a brand than does a logo or a bottle top.

Bottles consisted of alcoholic and non-alcoholic brands. Non-alcohol bottles were included for three reasons. The first concerned dimension identification \((D_a)\); non-alcohol bottles were included to increase the general speed of processing, with the assumption that there is less distraction for this kind of stimulus than for alcohol bottles. The second was that pairing non-alcohol with alcohol bottles in the third stage of the task was expected to increase the attentional challenge of the task. The third was to provide better feedback on the task by comparing RTs and response errors made for alcohol and non-alcohol bottles. It was hoped that this information would persuade the trainees to try to compensate for the difference in their performance on the two types of stimuli. The researcher expected that using only alcohol stimuli would not have allowed trainees to realise that they probably reacted differently to alcohol-related and non-alcohol-related stimuli.

Alcohol bottles. The alcohol-related stimuli used in this programme were compiled from a variety of alcohol bottles. To increase the representativeness of the materials, the researcher collected these bottles from public areas (mainly from streets and around pubs). Most of these bottles were collected during weekends. The most frequently collected bottles were included in an initial list (of 40 bottles).

Soft-drink bottles. Soft-drink bottles were collected in the same way as the alcohol ones, except that most of them were collected during weekdays. The most frequently collected bottles were included in an initial list (of 30 bottles).

Next, a photographer took digital photographs of the bottles. He then transferred the photos onto a computer and by using Photoshop software produced four formats of the bottles. Before including the bottles in the final list, the researcher showed all the bottles in the initial lists to four recovered alcohol abusers for less than a second (600 ms)
each and asked them to say whether it was an alcoholic or non-alcohol bottle. Based on these results and asking respondents their opinions, some of the bottles were deleted from the final list.

**The stimulus variations.** Initially, there were four types of stimuli in the AADTP. The first format consisted of bottles surrounded by a coloured frame (i.e., blue, green, red, or yellow) on the main black background. There were 25 soft-drink pictures and 25 alcohol pictures appearing twice in four different colours each—making a total of 200 pictures. The second format comprised bottles with thin coloured borders (outlines) on the main black background. There were the same number as in the first category. The third format consisted of two bottles in the same photograph, with the left/right position of brands counterbalanced. In this category, soft-drink bottles always appeared with a background colour, whereas the alcohol bottle always appeared with a coloured frame. However, this category was not used in the final format of the programme because it was very easy to distinguish the background colour of the soft-drink bottles. The fourth format was the same as the third, except that soft-drink bottles were encompassed by coloured outlines similar to those of the alcohol bottles. There were 21 photographs of this kind, and they appeared 105 times with different coloured outlines. The reasons for including fewer stimuli in this format were to decrease the difficulty of the task and ensure potency of the brands (for triggering the abstainers' attentional bias) in the task.

**Design**

This was a case study. There were three reasons for using this design. The first was the difficulty in accessing detoxified alcohol abusers in the detoxification centre. Some patients in the detoxification centre were very reluctant to take part in any other activities except their daily routine on the unit. The second reason concerned the individualised nature of the AADTP. Because it was the first time that such a programme had been administered, there was no practical information on the procedural considerations. The latter constitutes the third reason for using a case study design. In cases of introducing a new and personalised intervention (Davison & Lazarus, 1995), a case study provides unique opportunities which are not often available by using experimental designs (see Davison & Lazarus, 1995). In this kind of design, a researcher aims at an in-depth analysis of data with the highest possible control over the intrusive variables; it also provides a good opportunity to integrate the data from assessment, intervention, and results (Plaud, 1996). Case studies are common ways of transferring
new experiences in the field of clinical psychology to other clinicians (see, e.g., Oltmanns, Neale, & Davison, 1999).

**Training Procedure**

The training procedure was based on a goal-setting technique. This was to encourage participants to achieve the highest achievable level of performance. The technique is based on hierarchical steps of planned behaviour reinforced by immediate feedback (Clark et al., 2000).

The training procedure was based on a face-to-face individualised procedure. Before starting the programme, the researcher simply explained the meaning of attentional bias and its importance in sustaining alcohol problems. This was followed by an explanation of the goal of the training programme. The researcher informed the participant that the programme was developed to help “alcohol quitters” improve their abilities to overcome their preoccupation with alcohol. In addition, the researcher explained that the training would take a long time, but that participants would receive continuous feedback on their progress. The researcher also explained that, whenever they found the programme difficult to manage, they had the right to withdraw (either temporarily or permanently). Finally, the researcher explained that the ideal situation would be to complete two sessions of training per day (with a 20-minute interval between them) for three consecutive days.

Next, the participant was given information about the type of stimuli (the bottles) in the programme and the nature of the task. They were told that they should ignore the bottles and responding to the background or outline colours as fast and accurately as possible. They were shown the four coloured keys on the keyboard—each corresponding to one of the colours that appeared as the background or outline of the bottles used as the training stimuli. It was also explained to the trainees that they should only press the correct coloured key (i.e., no verbal responses were required). Each trainee carried out the first session of the training programme, with two minutes of rest between each of the three sections. However, the first session was not time-limited (defined by a 3000 ms) as were later sessions, although feedback displayed on the computer screen followed each error (i.e., NO!). At the end of each session, the trainee was provided with immediate feedback on the overall performance. Four kinds of feedback were presented at this stage: (a) the number of errors (both of commission and omission), (b) mean RTs to the alcohol bottles, non-alcohol bottles, and the pairs; (c) interference scores (the difference between RTs to alcohol bottles and non-alcohol bottles), and (d) what these scores meant.
The goal of providing each trainee with this information was to motivate him or her to take part actively in the programme in a meaningful and goal-directed way. Each participant was encouraged to set a goal to decrease his or her RTs for all categories of bottles, especially the alcohol bottles. The ultimate goal was to improve RTs within each time-limit until the level of learning plateaued. If a trainee expressed an interest in proceeding with a lower time-limit, the researcher adjusted the programme accordingly.

Before starting the second phase, the researcher asked the trainee to select his or her preferred time-limit, one that seemed achievable to him or her. The researcher helped the participant (by explaining the meaning of time-limits) to decide on a reasonable time limit to aim for, in terms of distance from his or her mean RT achieved during the previous phase. The programme had been organised into specific, predetermined time-limits. They were 3000 ms, 2500 ms, 2000 ms, 1500 ms, 1300 ms, 1100 ms, 900 ms, and 700 ms. A warning message was displayed if a participant did not make a response within the agreed-upon time-limit (i.e., Too Late!), or made a wrong response (i.e., NO!). However, to avoid frequent negative feedback, the selected time-limit was usually slightly higher than the trainee’s mean reaction time during the earlier stage.

For moving to a shorter time-limit, the researcher always took into consideration the trainee’s preference. There was no pressure to move to a more difficult time limit, because the programme depends on the trainee’s particular level of performance and motivation. However, the progress criterion was arbitrarily defined as the number of errors not exceeding about 15% during each training session. However, if a trainee felt comfortable remaining within a particular time-limit, the criterion was subjectively altered to allow a goal to be set that the participant could strive for. For example, either a 10 or 20 percent improvement from the previous mean RT or decreasing the number of error, or both, might be agreed on. The researcher was cautious that training sessions did not become exhausting or frustrating. Usually, two sessions per day were accomplished. Each session started with the single coloured background stimuli, which were interspersed by two minutes of rest before proceeding with the single stimuli with coloured borderlines. The latter set of stimuli was interspersed by another two minutes of rest before starting with the paired stimuli. Before starting the next training session on each day, 20 minutes of rest was compulsory. The researcher was cautious that participants always terminated the training sessions with a good feeling about their progress.

To summarise:
The goal of the *AADTP* was to increase the ability of trainees to shift their attention away from the alcohol bottles as fast as they could, and to foster their ability to divert their attention to the neutral stimuli. The programme was based on goal-setting and planned behaviour, and was adjusted to the limitations and preferences of each particular trainee.

**Participants**

The programme was run individually with volunteer participants. There were eleven participants (10 males and 1 female). All of them were recent abstainers from alcohol who were taking part in an in-patient detoxification programme, thus having met the medical criterion for alcohol detoxification before taking part in the training programme. They received formal information sheets about the research and signed the consent form. Next, each participant completed the classic Stroop test, the alcohol-Stroop test, SILS Parts 1 and 2, the PSS, the PCI, and the self-report alcohol use questionnaire. For various reasons, two participants were unable to finish the programme.

**Case Reports**

The first eight participants did not receive a pre- and post-test concern-related Stroop test. Two trainees decided to leave the centre prematurely, by which time they have finished just two of the training sessions. Another participant (Trainee C) withdrew from the training at the end of the fourth session. The results of the training procedure reported below do not include the two participants who dropped out of treatment. The report also does not include Trainee C when describing the results of the training sessions and the pre- and post-test results. The training results for the last three participants, who received a pre- and post-test concern-related Stroop test, are presented individually (Trainees G, H, and M). The section below discusses the first six trainees and their results.

**The First Six Trainees**

*Brief case-histories.* The first six trainees, whose results are reported below, were all British white males. On average, they were 39 years old and reported having completed an average of 10 years of formal education (see Table 8.1). None of them had a history of psychiatric or personality disorders. No signs of unusual thought processes, speech patterns, or behaviour were apparent. There was no history of medically
documented brain injury or cognitive impairment for five of the trainees. One of them (Trainee C) self-reported having been diagnosed as suffering from brain damage.

Table 8.1. The first six trainees' age, years of education, drinking indices, PSS and SILS scores.

<table>
<thead>
<tr>
<th>Trainee</th>
<th>Age</th>
<th>Edu.</th>
<th>Week D.</th>
<th>Age F.D.</th>
<th>Chron.</th>
<th>P.D.</th>
<th>PSS</th>
<th>VT</th>
<th>AT</th>
<th>AQ</th>
<th>IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>38</td>
<td>11</td>
<td>267</td>
<td>20</td>
<td>1.0</td>
<td>1</td>
<td>6</td>
<td>52</td>
<td>57</td>
<td>107</td>
<td>104</td>
</tr>
<tr>
<td>B</td>
<td>31</td>
<td>11</td>
<td>281</td>
<td>18</td>
<td>3.0</td>
<td>1</td>
<td>10</td>
<td>32</td>
<td>32</td>
<td>85</td>
<td>68</td>
</tr>
<tr>
<td>C</td>
<td>47</td>
<td>6</td>
<td>477</td>
<td>18</td>
<td>10.0</td>
<td>1</td>
<td>9</td>
<td>26</td>
<td>38</td>
<td>106</td>
<td>71</td>
</tr>
<tr>
<td>D</td>
<td>40</td>
<td>11</td>
<td>283</td>
<td>16</td>
<td>16.0</td>
<td>5</td>
<td>11</td>
<td>59</td>
<td>58</td>
<td>102</td>
<td>108</td>
</tr>
<tr>
<td>E</td>
<td>38</td>
<td>11</td>
<td>260</td>
<td>25</td>
<td>3.0</td>
<td>3</td>
<td>9</td>
<td>36</td>
<td>59</td>
<td>129</td>
<td>98</td>
</tr>
<tr>
<td>F</td>
<td>40</td>
<td>11</td>
<td>632</td>
<td>32</td>
<td>.5</td>
<td>2</td>
<td>9</td>
<td>32</td>
<td>58</td>
<td>131</td>
<td>94</td>
</tr>
<tr>
<td>Mean</td>
<td>39</td>
<td>10</td>
<td>367</td>
<td>22</td>
<td>6.0</td>
<td>2</td>
<td>9</td>
<td>40</td>
<td>50</td>
<td>110</td>
<td>91</td>
</tr>
</tbody>
</table>

Note: Edu = education in years, Week D. = weekly mean of drinking, Age F.D. = age of first drink, Chron. = chronicity of alcohol abuse (in years), P.D. = number of previous detoxifications, PSS = perceived stress score, VT = SILS Vocabulary-T score, AT = SILS Abstract T-score, AQ = SILS Abstract Quotient.

Alcohol consumption, PSS score, and SILS indices. As Table 8.1 shows, the first six trainees reported a weekly mean consumption of 367 units, and having drunk excessively (an average amount of 23 units, daily) for an average of six years prior to entering the detoxification programme. They had a relatively high score on the Perceived Stress scale (average PSS score = 9, whereas the average score for the male alcohol abusers on the scale was 10 (see Chapter 7). The mean of their SILS scores were (a) $T = 40$ on the Vocabulary scale, (b) $T = 50$ on the Abstraction scale, (c) 110 as the Abstraction Quotient, and (d) 91 as the estimated WAIS-R IQ score. The trainees' $T$-scores on the SILS scales approached the mean scores of the in-treatment male alcohol abusers in this study (see Chapter 7).
**PCI results.** Table 8.2 shows the first six trainees’ scores on the PCI indices.

Table 8.2. PCI indices of the first six trainees.

<table>
<thead>
<tr>
<th>The PCI variables</th>
<th>Trainees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Likelihood of achieving goals</td>
<td>7.60</td>
</tr>
<tr>
<td>Control over achieving goals</td>
<td>6.20</td>
</tr>
<tr>
<td>Knowledge about how to achieve goals</td>
<td>8.00</td>
</tr>
<tr>
<td>Hope about achieving goals</td>
<td>8.60</td>
</tr>
<tr>
<td>Happiness from achieving goals</td>
<td>9.40</td>
</tr>
<tr>
<td>Commitment to achieving goals</td>
<td>6.20</td>
</tr>
<tr>
<td>Distance from goal achievements</td>
<td>8.00</td>
</tr>
<tr>
<td>Sadness from failure at goal achievement</td>
<td>8.20</td>
</tr>
<tr>
<td>Appetitive motivation index</td>
<td>9.20</td>
</tr>
<tr>
<td>Aversive motivation index</td>
<td>.00</td>
</tr>
</tbody>
</table>

Apart from Trainee B, the PCI indices of the trainees were rather consistent with an adaptive motivational pattern—at least at the time of completing the PCI after having been successfully detoxified for alcohol. Trainee B’s PCI profile was characterised by high scores on aversive motivation, happiness from achieving his goals, and sadness from failure to achieve them. His low scores on the other indices indicate that he was not very optimistic about achieving his goals and did not feel much control over achieving them. However, he reported a high commitment to achieving his goals. Accordingly, apart from a high score on commitment, his motivation was characterised by an avoidant style and having strong expected feelings about his goal achievements. Nevertheless, he showed considerable progress on the AADTP; his alcohol interference score improved by 46 ms between the pre- and post-test (mean progress between pre- and post-test alcohol-Stroop interference score for the first five trainees was 30 ms). However, it is not clear whether or not Trainee B had a positive attitude toward the training programme.

**Reactions to the training.** Having completed the pre-training classic Stroop test and the other questionnaires, the trainees received simple explanations about the goal and the potential benefits of the training programme. All of them showed an interest in taking
part in the training. However, Trainee C did not show sustained interest in the task after having started. He was the one who complained about having brain injury and the only trainee who discontinued the training after three sessions. (As mentioned, the pre- and post-training results presented below do not include his results.) He showed little enthusiasm for completing the training, although he had agreed to participate. He frequently asked the researcher to explain the programme, before and during the training sessions. It seemed that he could not understand how pressing the coloured keys in response to alcohol bottles can be beneficial. Each time that the photograph showing *Frosty Jack* (his favourite strong cider) appeared on the monitor, he could not decide about the right colour key to press. The researcher’s attempts to help him to realise the mechanisms involved in “being stuck in the bottle” and their behavioural consequences, and the potential benefits of taking part in the programme did not interest him. On the second day of the training, he complained about his preoccupation with the colours. He non-verbally expressed his unwillingness to continue. For example, during his third session, the last one before his withdrawal, he frequently looked at his watch. The researcher asked about his interest in continuing the programme. Case C expressed hesitation about continuing; therefore, the training was stopped. Six months later, he again was admitted to the detoxification centre. Unlike him, the other five trainees showed continuing interest in completing the training tasks.

Figure 8.2 shows the first six trainee’s reaction times across the training sessions under different time-limits.
Figure 8.2. The first five trainee's reaction times to the bottles under different time limits.

Note: 1 = Soft-drink bottle, coloured background; 2 = Alcohol-bottle coloured background, 3 = Soft-drink bottle coloured outline, 4 = Alcohol-bottle coloured outline, 5 = Pairs of Soft-drink and Alcohol bottles. Numbers in parentheses in the legend indicate the time limit for each session (single bottles / paired bottles).

Although the time-limit for the first session was 3000 ms, the trainees' reaction time to all bottles was longer than their reaction time during next sessions with shorter time-limits. They continued to improve their reaction times across all of the training sessions—except for a small increase in time to react to the outlined bottles during the fifth session. The improvement in reaction times from Session One to Session Six was 309 ms for background coloured soft-drink-bottles, 310 ms for background coloured alcohol bottles, 234 for outlined soft-drink bottles, 249 ms for outlined alcohol bottles, and 234 ms for paired bottles. Recall that paired bottles are the most difficult stimuli to react to. The trainees responded fastest to soft-drink-bottles on coloured backgrounds (486 ms). They responded slowest to the pairs of bottles (837 ms).

Figure 8.3 shows changes of the trainees' reaction times across the five different word categories included in the pre- and post-training Stroop tests.
Figure 8.3. Mean number of failures across training sessions with decreasing time-limits for the first five trainees.

Note: 1 = Soft-drink bottle, coloured background; 2 = Alcohol- bottle coloured background, 3 = Soft-drink bottle coloured outline, 4 = Alcohol-bottle coloured outline, 5 = Pairs of Soft-drink and Alcohol bottles. Numbers in parentheses in the legend indicate the time limit for each session (single bottles / paired bottles).

As Figure 8.3 shows, the largest number of errors occurred during the first session. They were mainly a result of non-responses (missed trials) on the trials with paired bottles. During the first session, it was generally difficult for the participants to rapidly distinguish between the target stimuli and the distractors (alcohol bottles). As the training progressed, despite the decreasing time limits, the trainees were able to develop attentional skills for ignoring the distractor bottles and correctly respond to the target stimuli (the colour of the outlines around the soft-drink-bottles). However, decreasing the time limit on the trials with single bottles resulted in a small increase in failures on the next trial. Nevertheless, the number of failures during the shortest time-limit did not exceed 15% of the total number of trials. On the paired bottles, the number of failures decreased from 40% during the first session to 18% during the last session.

Figure 8.4 shows the changes in the trainees' reaction times across the five different word categories included in the pre- and post-Stroop tests. Recall that the pre- and post-tests included both the classic and the alcohol-Stroop test with coloured words.
Figure 8.4. The first five trainees' reaction times on the pre- and post-tests.

Note: Cong. = Congruent colour words, Incong. = Incongruent colour words, concern = concern-related words.

As Figure 8.4 shows, reductions in the post-test reaction times occurred in all word categories: for congruent colour words = 343 ms, for incongruent colour words = 475 ms, for alcohol-related words = 289 ms, and for neutral words = 261 ms. The reductions indicate that, between the pre-test and post-test the trainees appear to develop the ability more rapidly to suppress the semantic properties of the stimuli.

Comparing the pre-test and post-test results indicates that the trainees' improvement was greatest in reaction to the incongruent colour words and the alcohol words. These two categories of words are the most compelling ones for alcohol abusers to suppress. A reason for the reductions in RTs to the incongruent and alcohol-related words could be that, compared to the other categories, greater cognitive abilities were needed to inhibit the distracting dimension of the task in order to respond to the target dimension (the colour). The increased ability to suppress the distracting dimension of incongruent colour words implies an increase in general cognitive flexibility, whereas the increased ability to suppress the meaning of the alcohol-related stimuli implies an increased cognitive ability to suppress the distractability specifically of alcohol-related stimuli. Exploring the interference scores presented in Table 8.3 helps to clarify the accuracy of this explanation.
Table 8.3. The first five trainees’ interference scores on the pre- and post-Stroop tests

<table>
<thead>
<tr>
<th>Test order</th>
<th>Alcohol Int.</th>
<th>Colour-word Int.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>26</td>
<td>209</td>
</tr>
<tr>
<td>Post-test</td>
<td>-4</td>
<td>77</td>
</tr>
<tr>
<td>Change</td>
<td>30</td>
<td>132</td>
</tr>
</tbody>
</table>

Note: Alcohol Int. = Alcohol-related interference score, Colour-word Int. = Colour-word interference score.

As Table 8.3 shows, the first five trainees’ interference scores on both the classical and alcohol-Stroop tests improved between the pre- and post-tests. A 30 ms improvement in the alcohol-related interference score approaches the average interference score of a sample of alcohol abusers described in Chapter 7. A 132 ms improvement in the classic-Stroop interference score is two-thirds of the average interference score of the abuser sample described in Chapter 7. These improvements in interference scores further support the effectiveness of the AADTP as an attentional intervention for alcohol abusers.

Participants' Self-Reports about the Training Programme

Trainees D, E, and F were asked to provide the researcher with their comments on the training programme. Their reports are presented verbatim below.

Trainee D's Self-Report:

These tasks have been very beneficial for me. In respect that it has not only turned my mind towards non-alcohol products, but to dislike alcohol products immensely. It has come to a point that when I go shopping or down the street for anything, I disregard the isles, which have anything to do with alcohol completely. This task has been a major breakthrough for me and I know that it can be of benefit for others. It has also made my mind and reflexes more sharp. Reaction timings have become sharper when it is put against the clock. Well done and thank you for the challenge you have given me.
**Trainee E’s Self-Report:**
The programme is excellent and very clever. It makes you to ignore the bottles and pay attention to something else. At the moment seeing actual bottles does not bother me. And your programme I do believe has been very effective in this regard.

**Trainee F’s Self-Report:**
A sense of control over the choices I make regarding alcohol was very positive for me and I would view this as encouraging; a tool that I can see being helpful and confidence building. It was good to be able to see the improvement made from the 1st test on, as we as to feel more o ease as I progressed through the course. I could also say that I felt more in change of alcohol and a sense of being empowered rather than at the mercy of alcohol (being in the driving seat as opposed to being passenger). Breaks in-between [training] tasks were adequate and instructions verbal[ly] and otherwise good. I think I have benefited soon this experience and have been practically interested in the notion that you can challenge a way of thinking may even of a sub-conscious level even if this has become deeply ingrained over a period of years.

**Alcohol Specificity of the AADTP**

Despite the differential improvement of the trainees’ RTs among the word categories on the post-test, one question remained unclear: are the effects of the training alcohol specific?

To determine whether the AADTP is alcohol specific, the next three trainees were given an additional pre- and post-test: a concern-related Stroop test. The concern-related Stroop test comprised seven words representing each trainee’s areas of concerns on the PCI (e.g., family, children, wife, cash, money, study, mortgage, job, training, health). The words differed from one participant to another. Each word appeared in each of the four colours (red, green, blue, and yellow). Because of the individualised nature of the concern-related words, the researcher could not match them on different linguistic
dimensions with the neutral category. The neutral category comprised different words than the neutral category on the alcohol-Stroop test. The new neutral words were selected from office-related items, such as clips, envelope, and stapler. Like the alcohol-Stroop test, the concern-related Stroop test included congruent and incongruent colour words to make the two tests parallel in difficulty. The concern-related test also contained 10 alcohol words to control for the possibility that mere inclusion of alcohol words could influence participants' performance on the other word categories. However, only concern-related and neutral words were used in the analyses.

Below are the results of the three trainees who received pre- and post classic Stroop, alcohol-Stroop, and concern-related Stroop tests.

**Trainee G**

**Brief history.** Trainee G was a 43-year-old white British man. He had no history of psychiatric or personality disorders. He showed no signs of unusual thoughts, speech patterns, or behaviour. He had no history of medically reported brain injury or cognitive impairment. He was living as a single woman at the time of the experiment. This was his first admission to the in-patient detoxification programme.

**Alcohol consumption, PSS score, and SILS indices.** Trainee G reported that he had started drinking on a regular basis at the age of 36 and had drunk excessively (an average of 23 units daily) during the 12 months prior to his detoxification. He reported having drunk 15 units of strong cider immediately before admission to the detoxification unit. He had a relatively high score on the perceived stress scale (PSS = 9). Her SILS scores were (a) 28 ($T = 45$) on the Vocabulary Scale; (b) 20 ($T = 48$) on the Abstraction Scale; (c) 48 ($T = 46$) on the total scale; (d) 79 on the Conceptual Quotient index and 100 on the Abstraction Quotient; and (e) 91 as an estimated WAIS-R IQ. The trainee's $T$-scores on the SILS scales approached the mean scores of the in-treatment female alcohol abusers in this study (see Chapter 7).

**PCI results.** Trainee G reported having at least one concern in each of the five areas of life on the PCI, with corresponding appetitive ratings as follows: (a) Self-changes (Get = 10); (b) Finances and Employment (Get = 10); (c) Leisure and Recreation (Get = 10); (d) Health and Medical Matters (Get = 10); and (e) Education (Get = 5). (Recall that on the PCI all ratings are on a 0-to-10 scale; 0 refers to the least amount and 10 to the greatest amount.) This trainee's motivational profile based on his ratings of his goal strivings was characterised by high scores on control (10), expected happiness from goal
achievements (10), expected likelihood of achieving them (9), knowledge about what to do to achieve them (9), and a high score on the appetitive motivation index (9). He had relatively high scores on hope for achieving his goals (7.60), commitment to achieving them (7.60), and sadness from failure to achieve them (6.60). He had low scores on the goal distance (4.80) and aversive motivation (0) indices. Her profile, then, reflected an adaptive pattern of motivation.

Reactions to the training. After he had completed the questionnaires and the Stroop pre-test, Trainee G was provided with a simple but complete explanation of the rationale, features, and potential benefits of the training programme. This lasted 20 minutes. He readily understood the researcher’s explanations of the programme, both before and during the training sessions. He expressed interest in understanding the scientific explanation of the programme. Trainee G expressed strong interest in and energy for participating. At the beginning of the sessions, he was mildly anxious but, after completing the first two parts, he gained a sense of confidence.

Results. Figure 8.5 shows Trainee G’s reaction times across the training sessions under different time-limits.

![Figure 8.5. Trainee G’s reaction times to the bottles under different time limits.](image)

Note: 1 = Soft-drink bottle, coloured background; 2 = Alcohol- bottle coloured background; 3 = Soft-drink bottle coloured outline; 4 = Alcohol-bottle coloured outline; 5 = Pairs of Soft-drink and Alcohol bottles. Numbers in parentheses in the legend indicate the time limit for each session (single bottles / paired bottles).
The first session's time-limit was 3000 ms; however, the reaction time to all bottles during the first session was longer than it was during the other sessions. As shown in Figure 8.5, Trainee G achieved his fastest reaction times to stimuli during the sixth training session. Trainee G showed the greatest improvement in reducing his reaction times to the paired bottles; this part of the task is the most difficult one.

Figure 8.6 shows the number of failures (omission or commission) that Trainee G made across the training sessions. They are specified separately for single and paired-bottle trials.

As Figure 8.6 shows, decreasing the time-limit caused an increase in the number of errors; however, the trainee was able to reduce his errors during a later session with a similar time-limit. The abrupt increase in the number of failures to respond on paired-bottle trials during the fifth stage resulted from a 300 ms reduction in the time-limit. However, the trainee was able to compensate during the next stage, when the time-limit remained at 1100 ms.

Figure 8.7 shows changes of the trainees' reaction time across the five different word categories included in pre- and post-Stroop tests.
Figure 8.7. Trainee G’s reaction times on the pre- and post-tests.

Note: Cong. = Congruent colour words, Incong. = Incongruent colour words, concern = concern-related words.

Figure 8.7 shows reductions during the post-test in reaction times in all word categories. The reductions can be attributed to an increase in Trainee G’s ability to suppress the meaning of the words (the irrelevant aspect of the task) in order to respond to the colours. The trainee completed six training sessions between the pre- and post-tests. Each training session consisted of both single and paired bottles. The trainee started with a time-limit of 3000 ms and finished with a 1100 ms one for single bottles and a 1700 ms one for paired bottles.

Comparing Trainee G’s pre-test and post-test results indicates that his reaction times to the congruent and incongruent colour words decreased considerably from 1191 ms to 712 ms. The pre- and post test RTs to the alcohol (from 1154 ms to 689 ms) and neutral (from 1124 ms to 697 ms) words also improved considerably. If 640 ms is taken as the Trainee’s reaction-time plateau for congruent colour words, no further improvement could be expected. RTs to the alcohol and neutral words showed a large reduction on the post-test. In comparison to RTs to the neutral words, the larger reduction in RTs to the alcohol words could be explained by the lack of emotional valence of the neutral words. On the other hand, RTs to current-related stimuli showed the least reduction on the post-test. The unchanged emotional valence of the concern-related words appears responsible for the post-test longer reaction times to the words in
this category. The training appears to have differentially affected responses to the alcohol and other concern-related stimuli, an outcome that is consistent with the purpose of the training: to target only alcohol-related stimuli. Inspecting the interference scores, shown in Table 8.4, supports this explanation.

Table 8.4. Trainee G’s interference scores on the pre- and post-Stroop tests

<table>
<thead>
<tr>
<th>Test order</th>
<th>Emotional Stroop test</th>
<th>Classic-Stroop test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alcohol Int.</td>
<td>Concern Int.</td>
</tr>
<tr>
<td>Pre-test</td>
<td>30</td>
<td>-113</td>
</tr>
<tr>
<td>Post-test</td>
<td>-8</td>
<td>79</td>
</tr>
<tr>
<td>Change</td>
<td>-38</td>
<td>191</td>
</tr>
</tbody>
</table>

Note: Alcohol Int. = Alcohol-related interference score, Concern Int. = Concern-related interference score, Colour-word Int. = Colour-word interference score.

As Table 8.4 shows, the interference scores for the Classic-Stroop test and the alcohol-Stroop test show considerable improvement, whereas the mean interference score for the concern-related stimuli was considerably larger on the post-test than the pre-test. It is to be expected that recently detoxified alcohol-abusers would show an initial increase in their distraction for alcohol-related stimuli across time. However, making the decision to stop drinking, together with Trainee G’s increased cognitive ability to suppress alcohol-related stimuli, could have caused his attention to shift toward other concern-related stimuli.

**Trainee G’s self-report.** Trainee G described his experience with the training programme as follow:

*Before starting:* Very fearful. Thought I would be absolutely helpless. Very confused, like brain not connected to fingers. Panic causing keying errors. Not really able to decipher between groups, i.e., soft drink / alcohol drink at speed. Confidence very low. Very hard to make decisions, i.e., very indecisive person any way. Before starting this programme my first thought when entering a shop would be where is the alcohol.
Now: [...] is an excellent researcher. He instantly put me at ease. Confidence much higher. No panic but still making errors. Found sessions very interesting. Probably the best therapy at Hafan Wen for me personally. Feel more decisive in any situation. Self-esteem has improved greatly with this sessions. I already feel like a different person after only five [six] sessions to [the] person who entered Hafan Wen 3 weeks ago. Now when entering a shop or supermarket which I have done purposely to test myself alcohol has not even been of my mind. I have only been noticed it if I have walked passed it.

Conclusion. Trainee G successfully reduced his reaction times for alcohol-related stimuli. Her differential responses to alcohol and concern-related words on the post-training Stroop test cannot be attributed to acquiring keyboard skills and is not an artefact improvement from pre- to post-test session. The results of this case study support the alcohol specificity of the AADTP. It seems that Trainee G also developed a sense of self-confidence and decisiveness in dealing with alcohol as a result of taking part in the training sessions.

Trainee H

Brief history. Trainee H was a 55-year-old white British man. He had no history of psychiatric or personality disorders and showed no signs of unusual thoughts, or behaviour. He had no history of medically reported brain injury or cognitive impairment. He was married and living with his family at the time of the experiment. This was his second admission to an in-patient detoxification programme. He had successfully completed his first detoxification 12 year earlier, and had remained abstinent for 11 years.

Alcohol consumption, PSS score, and SILS indices. Trainee H reported that he had started drinking on a regular basis at the age of 17 and had drunk excessively (an average of 35 units of ordinary strength cider daily) during the 12 months prior to his admission to the detoxification programme. He reported having drunk 17 units immediately before entering the detoxification unit. He had a relatively high score on the perceived stress scale (PSS = 10). His SILS scores were (a) 36 (T = 62) on the Vocabulary scale; (b) 6 (T = 39) on the Abstraction scale; (c) 42 (T = 51) on the Total
scale; (d) 53 on the Conceptual Quotient index and 65 on the Abstraction Quotient (AQ) index; and (e) 91 as an estimated WAIS-R IQ score. The trainee's T-score on the SILS vocabulary scale was above the mean scores of the in-treatment alcohol abusers in this study; however, his T-score on the SILS AQ was considerably below the mean of the sample ($M = 101.77$ for males; see Chapter 7).

**PCI results.** Trainee H reported having at least one concern in each of eight areas of life on the PCI, with corresponding appetitive ratings as follows: (a) Home and Household Matters ($Get = 10$); (b) Relationships ($Get = 8$); (c) Love, Intimacy, and Sexual Matters ($Get = 9$); (d) Self-changes ($Get = 10$); (e) Finances and Employment ($Get = 5$); (c) Leisure and Recreation ($Get = 10$); (d) Health and Medical Matters ($Get = 10$); and (e) Education ($Get = 7$). Trainee H’s motivational profile based on his ratings of his goal strivings was characterised by high scores on expected happiness from goal achievements (9.25), goal distance (8.75), commitment to achieving his goals (8.13), and a high score on the appetitive motivation index (8). He had relatively high scores on sadness from failure to achieve his goals (7.88), knowledge about what to do to achieve them (7.13), control over achieving them (6.63), expected likelihood of achieving them (6.63), and hope for achieving them (6.5). His lowest score was on the aversive motivation index (0). His high ratings on goal distance can be interpreted as either being realistic or too conservative an estimation; however, apart from these possibilities about goal distance, his motivational profile reflected adaptive motivation.

**Reactions to the training.** After he had completed the questionnaires and the pre-training Stroop test, Trainee H was provided with a simple but complete explanation of the rationale, features, and potential benefits of the training programme. This lasted 20 minutes. He readily understood the researcher’s explanations of the programme, both before and during the training sessions. Trainee H expressed strong interest in and energy for participating in the Training programme. Although he returned home at the end of his detoxification programme (Day 30), he continued to take part in the training programme on a regular basis and showed great enthusiasm for it. He confidently started the training sessions and completed them with an increasing sense of confidence.

**Results.** Figure 8.8 shows Trainee H’s reaction times across the training sessions under different time-limits.
Figure 8.8. Trainee H's reaction times to the bottles under different time limits.

Note: 1 = Soft-drink bottle, coloured background; 2 = Alcohol- bottle coloured background, 3 = Soft-drink bottle coloured outline, 4 = Alcohol-bottle coloured outline, 5 = Pairs of Soft-drink and Alcohol bottles. Numbers in parentheses in the legend indicate the time limit for each session (single bottles / paired bottles).

The first session's time-limit was 3000 ms; however, the reaction time to all bottles during the first session was longer than it was during the other sessions. As shown in Figure 8.8, Trainee H reached his fastest reaction times to single bottle stimuli during the first three training session. Therefore, it was agreed that he would continue the training programme with only paired bottles, and he did so for another five training sessions. Trainee H showed the largest improvement reducing his reaction times to the paired bottles at the end of his seventh training session. The small increase in his reaction times to the paired bottles during the eighth session could have resulted from his efforts to decrease the number of errors (Figure 8.9). Figure 8.9 shows the number of failures (incorrect responses and missed trials) that Trainee H made across the training sessions. They are specified separately for single and paired-bottle trials.
As Figure 8.9 shows, decreasing the time-limit was associated with an increase in the number of failures on subsequent trials, especially in the case of the paired bottles; however, the trainee was able to overcome the failures during a later session with a similar time-limit. The abrupt increase in the number of paired-bottle trials on which he did not respond during the second and third sessions resulted from a 1700 ms reduction in the time-limit for the second session and a further 200 ms for the third session. The trainee was also able to avoid not responding (missed) trials during the next stages with only paired bottles included. Although the time-limit remained at 1300 ms during the seventh and eighth sessions, the trainee decreased the number of failures from 45 to 35.

Figure 8.10 shows changes of the trainees’ reaction time across the five different word categories included in pre- and post-Stroop tests.
Figure 8.10. Trainee H’s reaction times on the pre- and post-tests.

Note: Cong. = Congruent colour words, Incong. = Incongruent colour words, concern = concern-related words.

Figure 8.10 shows the reductions in the post-test reaction times for all word categories. The reductions indicate that Trainee H acquired the ability to suppress the meaning of words in all categories in order to respond to the colours. However, the reductions are more obvious for incongruent-colour and alcohol words than they are for the other kinds of words. The trainee completed six sessions of the AADTP between the pre- and post-test sessions. The first three training sessions consisted of single bottles, and the remainder consisted of paired bottles. The trainee started with a time-limit of 3000 ms and finished with a 1100 ms one for single bottles and a 1300 ms one for paired bottles.

Comparing the pre-test and post-test results indicates that Trainee H’s reaction times to the congruent and incongruent colour words decreased considerably from 979 ms to 669 ms. The pre- and post test RTs for alcohol (from 929 ms to 662 ms) and neutral (from 902 ms to 664 ms) words were considerably reduced. In comparison to the pre-test, the RTs to the alcohol words on the post-test were 25 ms faster than were the RTs to the neutral words and 66 ms faster than were the RTs to the concern-related words. The emotional valence explanation introduced earlier can be applied to the post-test differential reduction in the RTs to the alcohol-related words and that of the neutral words. The explanation for faster reaction times to alcohol words than to non-alcohol words is based on two components: (a) constant emotional valence of the neutral and
concern-related words from pre- to post-test and (b) Trainee H’s increased ability to decrease his reaction times for the alcohol-related words. Inspecting the interference scores (Table 8.5) helps to confirm the accuracy of this explanation.

<table>
<thead>
<tr>
<th>Interference scores in ms</th>
<th>Emotional Stroop test</th>
<th>Classic-Stroop test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test order</td>
<td>Alcohol Int.</td>
<td>Concern Int.</td>
</tr>
<tr>
<td>Pre-test</td>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>Post-test</td>
<td>-2</td>
<td>29</td>
</tr>
<tr>
<td>Change</td>
<td>-28</td>
<td>31</td>
</tr>
</tbody>
</table>

Note: Alcohol Int. = Alcohol-related interference score, Concern Int. = Concern-related interference score, Colour-word Int. = Colour-word interference score.

As Table 8.5 shows, the interference scores for the Classic-Stroop test and the alcohol-Stroop test show considerable improvement, whereas the mean interference score for the concern-related stimuli increased considerably on the post-test. The importance of the differential reduction in the alcohol-related interference scores and that of the neutral words becomes more striking in the light of related evidence in the field, which indicates that recent detoxification increases distraction for alcohol-related stimuli (e.g., Gross et al., 1993; Cox et al., 2003). However, making the decision to stop drinking, together with the trainee’s increased cognitive ability to suppress alcohol-related stimuli, could have caused his attention to shift to concern-related stimuli. As Table 8.5 shows, Trainee H’s attention to concern-relevant stimuli increased on the post-training concern-related Stroop test.

**Trainee H’s self-report.** Trainee H described his experience with the training programme as follow:

I found the tests [tasks] to be interesting and challenging. They were not too long. I felt a real sense of achievement. They provided me with the belief that I had the ability to deal with alcohol and not remain focused on the product. A real state of mind that can be used for other non-related concerns. I am more confident about the future because I can easily switch
any thoughts of alcohol onto something of more interest. Concentrating on the tests [tasks] has made me believe that I am capable of learning even at the age of 55. It has been a positive experience for me.
P.S. [...] is a very easy person to get on with. I found him easy to talk to, not at all patronising.

Conclusion. Comparing to other stimuli, Trainee H successfully reduced his distraction for alcohol-related stimuli. The findings suggest that his differential responses to alcohol and concern-related words on the post-Stroop test are a result of his improved ability to suppress his distraction for alcohol-related stimuli; therefore, acquiring keyboard skills or pre- to post-test improvements cannot be responsible for the differential responses to the two categories of words on the post-test. The results of this case study further supports that the AADTP had alcohol-specific effects. Trainee H’s progress on the AADTP suggests that his impaired abstract-thinking ability—as indicated by his performance on the SILS—did not interfere with his ability to profit from the programme. It seems that Trainee H developed a sense of self-confidence and decisiveness in dealing with alcohol as a result of taking part in the training sessions. His self-reported ability to generalise his newly acquired skills to the real word is also promising.

Note that Trainee H completed the PCI before participating in the AADTP programme. As one might surmise from his report, the programme likely enhanced his motivation, which might have been reflected in the PCI indices; however, a follow-up PCI was not administered in this study, which might have provided an objective evaluation of motivational improvements after successfully completing the ACCTP tasks.

Trainee M

Brief history. Trainee M was a 59-year-old white British man. He had no history of psychiatric or personality disorders. He showed no signs of strange thought, speech, or conduct. However, he was generally slow in understanding the tests and tasks. He had no history of medically reported brain injury or cognitive impairment. He was living with his wife at the time of the experiment, and he visited him regularly on the unit. He described to the researcher how his wife had been encouraging him to take part in additional activities offered on the detoxification unit. This was the first time that he had taken part in an in-patient detoxification programme.
Alcohol consumption, PSS score, and SILS indices. Trainee M reported that he had started drinking on a regular basis at the age of 10. He had started drinking excessively (an average of 30 units of ordinary strength cider daily) during the 48 months prior to his detoxification. He reported having drunk 9 units immediately before entering the detoxification unit. He had the highest possible score (16) on the Perceived Stress scale. His SILS results were (a) 24 ($T=41$) on the Vocabulary scale; (b) 16 ($T=50$) on the Abstraction scale; (c) 40 ($T=45$) on the Total scale; (d) a Conceptual Quotient of 80 and an Abstraction Quotient (AQ) of 107; and (e) an estimated WAIS-R IQ of 89. The trainee’s $T$-score on the SILS vocabulary scale was slightly below the mean score of the in-treatment alcohol abusers in this study. His $T$-score on the SILS AQ was slightly above the mean score of the sample ($M=101.77$ for males, see Chapter 7). His WAIS-R IQ was 10 points lower than the mean of the sample, as a result of his low score on the vocabulary scale.

PCI results. Trainee M reported having at least one concern in each of the eight PCI areas of life, and all of his goals were appetitive with Get ratings of 10 (the highest point on the scale). His motivational profile derived from his ratings of his goal strivings was characterised by high scores on the appetitive motivation index (10), commitment to achieving his goals (10), expected happiness from goal achievements (10), expected sadness from failure to achieve his goals (10), and a very high score on hope for achieving his goals (9.75). He had relatively high scores on expected likelihood of achieving his goals (8.13) and on control over achieving them (7.13). His mean rating on knowledge about what to do to achieve his goals was not as high as his ratings on the other scales (6.88). He reported a reasonably long expected goal distance (6.88). His patterns of ratings on the PCI indices (except for goal distance) mean that Trainee M had an adaptive motivational pattern at the time of the training. Alternatively, his ratings of his goal strivings could be exaggerated as a result of his being a patient in the detoxification programme. Nonetheless, the interest that he showed for participating in the training tasks was consistent with an adaptive motivational pattern.

Reactions to the training. After the trainee completed the questionnaires and the Stroop pre-test, the rationale, procedure, and potential benefits of the training programme were explained to him in a simple manner. Because he showed some uncertainty about understanding the explanations, the researcher explained all of the details to him again, this time using examples of attentional bias and its meaning and how the programme could correct it. Sketching the details on paper helped him better and
more quickly understand the explanation. The researcher was convinced that he has
completely understood all the necessary information before starting the first training
session. In contrast to his performance on the classic and alcohol-Stroop tests, he showed
difficulty managing the first training session. For example, he occasionally kept the
response key pressed while concentrating on the bottles. However, he was soon able to
grasp the task, and he proceeded to complete the task confidently and with interest.

**Results.** Figure 8.11 shows Trainee M's reaction times across the training
sessions under different time-limits.

![Figure 8.11. Trainee M's reaction times to the bottles under different time
limits.](image)

Note: 1 = Soft-drink bottle, coloured background; 2 = Alcohol- bottle coloured
background, 3 = Soft-drink bottle coloured outline, 4 = Alcohol-bottle coloured
outline, 5 = Pairs of Soft-drink and Alcohol bottles. Numbers in parentheses in the
legend indicate the time limit for each session (single bottles / paired bottles).

Trainee M started the first session with 3000 ms as the time limit; nevertheless,
similar to other trainees his longest reaction times were during the first training session.
He steadily improved his reaction times across all training sessions. It was during the
last training session that he achieved his fastest times (the fastest RT for the background
coloured soft-drink bottles = 713 ms; the fastest for paired bottles = 1041ms). However
an exception occurred during Session Five (when the time-limit decreased from 1300 ms
to 1100 ms): RTs to the background coloured soft-drink bottles and outlined alcohol-
bottles both slightly increased. On average, this trainee was slower than the others in reacting to the various bottles across the six sessions of the training. As Figure 8.12 shows, he had a generally slower reaction time on all word categories, and his classic Stroop interference score on the post-test did not show as much improvement as the other trainees.

Figure 8.12 shows the number of failures (incorrect responses and failures to respond) that Trainee M made across the training sessions. They are specified separately for single and paired-bottle trials.

![Figure 8.12](image)

Figure 8.12. Trainee M's number of failures across the training sessions.

Note. Errors = number of incorrect responses; missed = number of missed trials. Numbers on the X axis represent the time limit for each session (single bottles / paired bottles).

As Figure 8.12 shows, the largest number of errors occurred during the first session, mainly because the trainee did not feel confident reacting to the stimuli. The second largest number of errors, occurring during the third session, was a result of 500 ms reduction in the time-limit. Again, time-limit reductions usually resulted in an increase in the number of failures, especially on trials with the paired bottles; however, on the sixth session, this trainee made the fewest failures (no more than 12% in a set of stimuli), and these were with the paired bottles.
Figure 8.13 shows the changes in the Trainee's M reaction times across five different word categories included in pre- and post-Stroop tests.

As Figure 8.13 shows, reductions in the post-test reaction times were limited to the incongruent colour words and alcohol-related words. These reductions suggest that Trainee M acquired the ability to suppress attending to incongruent and alcohol-related stimuli. In contrast to the other trainees, he had a small increase in post-test RTs to congruent and neutral words, as shown in Table 8.6. Reaction times to congruent colour words increased from 837 ms on the pre-test to 873 ms onto the post-test. The increase may have resulted from a conscious effort to react as fast as possible to only to the more difficult words.

Comparing the pre-test and post-test training results indicates that Trainee M's reaction times to the incongruent colour words decreased from 1033 ms to 983 ms. The pre- and post-test RTs to the alcohol words (from 1005 ms to 887 ms) were considerably reduced, but there was a slight increase for the neutral words (from 882 ms to 891 ms). In comparison to the pre-test, the RTs to the alcohol words on the post-test were faster than were RTs to the neutral words (a change from 123 ms slower in the pre-test to 4 ms faster on the pre-test). On the post-test, the alcohol RTs were also faster than were RTs to the concern-related words (a change from 102 ms slower on the pre-test to 43 ms faster on the post-test). Again, reasons for the greater post-test reduction in RTs to the alcohol-related words than to the other word categories could be: (a) unchanged emotional
valence of the neutral and concern-related words from pre- to post-test and (b) Trainee M’s ability to suppress his distraction for the alcohol-related words on the post-test. Exploring the interference scores (Table 8.6) helps to confirm this explanation.

Table 8.6. Trainee M’s interference scores on the pre- and post-Stroop tests

<table>
<thead>
<tr>
<th>Interference scores in ms</th>
<th>Emotional Stroop test</th>
<th>Classic-Stroop test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test order</td>
<td>Alcohol Int.</td>
<td>Concern Int.</td>
</tr>
<tr>
<td>Pre-test</td>
<td>123</td>
<td>22</td>
</tr>
<tr>
<td>Post-test</td>
<td>-4</td>
<td>39</td>
</tr>
<tr>
<td>Change</td>
<td>-127</td>
<td>17</td>
</tr>
</tbody>
</table>

Note: Alcohol Int. = Alcohol-related interference score, Concern Int. = Concern-related interference score, Colour-word Int. = Colour-word interference score.

As Table 8.6 shows, the interference scores for both the classic Stroop test and the alcohol-Stroop test show considerable improvement—although the improvement on the classic Stroop test was less than for the other trainees. The mean interference score for the concern-related follow-up Stroop test increased slightly. The increase is in contrast to the reductions in the other interference scores; this suggests the continuing salience of the concern-related stimuli in the trainee’s attentional system.

The results from the ACCTP for Trainee M suggest that the attentional skills that he gained from the programme were effective in reducing his attentional bias for alcohol-related stimuli. In spite of his general slowness (which was somewhat improved on the post-test), he was still able to decrease his interference score on the alcohol-Stroop test.

**Trainee M’s self-report.** Trainee M described himself as “the worst writer in the world.” This is what he told the researcher about his experience with the training:

I enjoyed it. It was different. I was provided with immediate feedback. I was looking forward to do it. I was trying to ignore the alcohol bottles; instead, I was trying to pay attention to the soft-drinks. Because of practice [with the task] I have got a better sense of having control over the task.
Conclusion. Trainee M was generally slow on all categories of the stimuli. His large interference score on the classic Stroop test indicates poor ECF. The success of Trainee M in reducing his distraction for the alcohol-related stimuli indicates that even a person with generally poor ECF and cognitive slowness can still benefit from the ACCTP. This possibility awaits further confirmation.

Discussion

The results of these case studies reveal that training with the alcohol-specific AADTP can enhance volitional cognitive control over alcohol-related stimuli. Sceptics might suggest that improvements in interference scores after completing the AADTP are not due specifically to an improved ability to inhibit attention for alcohol-related stimuli. Even Stroop (1935) reported a reduction in interference scores after practice. Stroop's third experiment examined the effect of practice on interference. At the end of eight days of practice on the incongruent card, RTs had decreased from 49.6 to 32.8 seconds. He concluded that practice can reduce interference. However, MacLeod (1991) suggested that the apparent improvement may have been due to "general practice or a learning-to-learn effect" (p. 165).

There are several things to refute this argument. The first deals with using an alcohol-Stroop as the pre- and post-test measure of improvement. An emotional Stroop test, the alcohol Stroop is a reliable measure of attentional distraction for alcohol-related stimuli. MacLeod's (1991) suggestion that apparent improvement results from a general practice effect or learning-to-learn effect is based on findings with the classic Stroop test; therefore, generalising his suggestion to disorder-related biases seems unwarranted. Reasons for this stem from different sources of the interference effect on the classic and emotional Stroop tests (see Chapter 2).

Regarding the effects of practice and expertise on performance on the emotional Stroop, two issues arise. The first issue is related to the effect of practice and expertise on interference for emotionally relevant stimuli. As discussed in Chapter 2, frequency of usage of words or frequency of otherwise encountering the stimuli neither explains the emergence nor the disappearance of attentional bias on the emotional Stroop test. As Williams et al. (1996) discussed, attentional bias is most reliably explained in terms of concern-relatedness, or the resting activation level of input units. Therefore, thinking in terms of an expertise effect, as described in Cohen et al.'s (1990) connectionist model of the Stroop effect, seeing hundreds of alcohol bottles in the AADTP should increase rather
than decrease the interference as measured on the post-test. Reduction in the interference on the post-test emanates from the volitional, goal-directed challenge by the participants to actively inhibit their attentional distraction for alcohol-related stimuli. The participants were not just being exposed to the bottles; they were practicing suppressing their attentional bias for them.

The second issue deals with learning to improve performance on the Stroop test. Regarding this issue, Sharma et al. (2001) found that there was no significant reduction in interference scores for alcohol stimuli between Blocks 1 and 5 of their alcohol-Stroop task. One should add that Sharma et al. had also administered a considerable number of practice trials before starting even the first block.

In addition, there is further support for the alternative explanation that is derived from the classic Stroop test used in the present research. Recall that the Stroop paradigm used in this study comprised four blocks. The participants completed the tests in four blocks, each containing 112 stimuli. The classic and alcohol-Stroop tests interference scores (Blocks 1 to 4), from the sample described in Chapter 7 (students = 50, alcohol abusers = 47), were subjected to two repeated-measures analyses of variance. For the student group, there was no main effect for Blocks on the interference scores on the classic Stroop test, Mauchly's $W > .05$, $F_{(1,147)} = .064, p > .5$. Although there was also no main effect for Blocks on the students' interference scores on the alcohol-Stroop test, Mauchly's $W > .05$, $F_{(1,147)} = 2.20, p < .01$, follow-up LSD tests revealed that interference on the second block was significantly smaller than it was on the fourth. This finding indicates that the non-abuser sample's performance was the same across the four blocks of the classic Stroop test; this suggests that they were quite able to use their ECF to counteract any "fatigue effect." However, their alcohol-interference score increased from Block 2 to Block 4; this suggests that, by becoming tired, they were unable to overcome the influence of the salient stimuli. However, different results were found for the alcohol-abuser sample. There was no main effect for Blocks on the abusers' interference scores on the alcohol-Stroop test, Mauchly's $W > .05$, $F_{(1,113)} = .34, p > .05$. On the other hand, although there was also no main effect for Blocks on the abusers' interference score on the classic Stroop test, Mauchly's $W < .05$, Huynh-Feldt corrected $F_{(2.10,94.67)} = 2.13, p > .05$; follow-up LSD tests revealed that the interference on the third block was significantly smaller than that on the first ($p < 0.05$). This suggests that, for the alcohol abusers, practice on the classic Stroop test did improve their performance on the incongruent colour words but it did not improve their performance on the alcohol-related words.
Therefore, the results showed that extensive practice on the emotional-Stroop and classic-Stroop tests can have different effects among non-abusers and abusers. For non-abusers, practice was not associated with a change in the magnitude of classic-Stroop interference scores, but it was accompanied by increments in interference scores among the abusers. The increase may emanate from the susceptibility of ECF to fatigue, but the pattern of the effect is different for the classic and the emotional Stroop tests. On the other hand, practice led to increments in alcohol-Stroop interference scores among the controls but not among the alcohol abusers.

To conclude:

As far as the effect of successive practice on an alcohol-Stroop test is concerned, one might expect no change or even an increase in interference scores on a post-test rather than a decrease, as was found with the student sample. This finding supports the view that the AADTP does reduce alcohol-specific attentional distraction.

Six alcohol Stroop studies have been conducted with in-patient alcohol abusers and control participants. In-patient participants have consistently demonstrated longer RTs for all word categories than have controls. No study has reported a smaller interference score for in-patient alcohol-abusers than for controls.

One should also consider the role of inhibitory deficiencies in alcohol abusers. Accepting the higher concern relatedness of alcohol stimuli for in-treatment alcohol abusers than non-abusers still does not indicate that the alcohol stimuli on the alcohol Stroop are always differentially appealing to the two groups. As Bauer and Cox (1998) noted, any inability to differentiate between neutral and alcohol stimuli by alcohol abusers—which they found—may come mainly from the abusers' inability to give differential responses to concern-related or other emotionally valenced stimuli in contrast to semantically related but unemotional words. If this is the case, training aimed at improving "general" inhibitory capabilities (a learning effect) should yield greater not less distraction for psychologically important stimuli. In addition, recall that the findings reported at Chapters 6 and 7 do not support the idea that attentional bias is affected by ECF.

Adding support to the above argument are the results of the second pre- and post-test Stroop, in which concern-related words from the other areas of the participant's life were included as stimuli. The last three trainees differentially reacted to the concern-related words (from other areas of life) and the alcohol-related words. This finding supports the specific, goal-directed effect of the AADTP with alcohol-related stimuli. The finding seems all the more interesting if one consider it in light of Cox et al's (2000)
study, in which alcohol abusers demonstrated greater distraction for alcohol-related than concern-related stimuli.

The results of the above case studies also imply that the effect of the AADTP is not dependent on the trainees’ general cognitive resources or their motivational structure—at least as assessed by the research version of the PCI at the time the trainees took part in the programme. Receiving immediate feedback on their progress during the programme could also have had some positive effects on the trainees’ motivational structure. In view of the fact that lack of controllability is a primary deficit in alcohol abusers, as described at Chapter 7, the frequent reports of the trainees about having gained a better sense of control followed by the training is noteworthy. The trainees’ increased sense of self-efficacy was secondary to the main goal of the training; nevertheless, it was an important outcome. In fact, gaining a feeling of control probably goes hand-in-hand with abusers’ ability to ignore alcohol stimuli.

From a therapeutic point of view, any improvement in attentional control that can help recent abstainers to overcome their distraction for alcohol would be valuable. There has been no prior evidence about the extent to which improvement on general executive control, or inhibitory processes, can be generalised to attentional control for alcohol-related stimuli. It is noteworthy, that because of their participation in the ACCTP, the trainees showed generalised improvement for overcoming classic Stroop interference. However, the important goal is to reduce the distraction for disorder-related stimuli (as reflected in measures of attentional bias). The reduction in RTs and interference scores implies that a participant has acquired the ability to control his or her attention in an intentional and desirable way. In this case, an explanation in terms of a general practice or learning-to-learn effect still would not undermine the value of the intervention that produces the desirable change.

Another improvement derived from the AADTP can be discussed in light of Cox et al.’s (2000) findings. These researchers found that those alcohol abusers who were highly distracted for alcohol-related stimuli (in comparison to concern-related stimuli) were also slower than were the other participants in responding to the neutral category. Cox et al. interpreted this finding as indicating that these participants had poorer cognitive proficiency, particularly at inhibiting reactions to motivationally irrelevant stimuli. The results of the post-tests presented here suggest that by the end of the training programme, the participants had become cognitively more adept.
What Was Established

The theoretical framework for the present thesis was Cox and Klinger's (1988, 1990, 2003) cognitive-motivational model of alcohol use. The model encompasses the followings: previous learning; attentional and cognitive processes; affective, physiological, and neurological states; and cognitive determinants of drinking. It does so in a unifying cognitive-motivational pathway leading to goal achievements. Among the factors in the pathway, some are more proximal determinants of alcohol abuse than are others. The more proximal components in the model, embracing the effects of the distal ones, are current concerns and net expected affective gain from pursuing an inventive. These lead a person to make behavioural decisions to become committed to pursuing a goal or to become disengaged from doing so. Current concerns can lead to and intensify the effects of attentional bias for the target incentive through the person's active involvement in goal-seeking behaviour. The pattern of goal striving is influenced by people's beliefs (e.g., their commitment) about achieving a goal and their emotional expectancies (i.e., happiness or sadness) about achieving or not achieving a goal. The model explains how drinking motivations are intertwined with people's wishes, hopes, and goals in other areas of their life. The relationship between alcohol use and its motivational components is reciprocal.

The interactions among alcohol use and motivational, attentional, cognitive, and neurobiological processes are brought together to specify the content of people's current concerns and the ways in which people are influenced in their attempts to attain their goals. All of this aims to explain the uncontrollable aspect of alcohol abuse. Establishing further the cognitive-motivational features of the uncontrollability phenomenon and developing a therapeutic variation based on the cognitive implications of the theory were the goals of the present research thesis.

The motivational model is a decision-making model. Each decision to pursue a goal corresponds to a motivational state called a current concern. People are emotionally involved in the pursuit of their goals; they expect to experience emotional reactions if they achieve their goals or fail to achieve them. Their faith in achieving or failing to achieve them is influenced by various factors specified in the model; these factors gradually lead to a series of more-or-less stable beliefs and habits of a person in his or her
goal-strivings. This corresponds to the person's motivational structure (see Chapter 1). An adaptive motivational structure is more likely to lead to goal achievements in various areas of life than is a maladaptive one. An adaptive motivational structure brings greater short-term and long-term happiness to a person than does a maladaptive motivational structure.

People do not like to experience negative affect; therefore, those with a maladaptive motivational structure, who have not been able to enjoy their life in other areas, are more likely to resort to the use of chemicals (e.g., alcohol) to remove bad feelings than are those with an adaptive motivational structure. Although there is evidence in support of the motivational model of alcohol use (see Chapter 1), the way it explains the relationship between cognitive and attentional processes needed further research.

The present thesis examined the way in which goal-seeking styles can predict drinking behaviour through cognitive-motivational pathways in relation to the drinker's degree of uncontrollability. The findings were presented in four experimental chapters.

The first finding of Chapter 5 was that a maladaptive motivational structure predicted the amount of drinking in a non-clinical sample (N = 87), independently of other variables in a hierarchical regression model. The factors controlled for in the model were gender, age, education, IQ, perceived stress, memory for alcohol-related stimuli, and adaptive motivational structure—a construct that is associated with non-problem drinking. The finding supports the model's propositions among a sample of university students (Cox et al., 2002).

The second result of the hierarchical regression analyses in Chapter 5 also revealed the power of attentional bias to predict the amount of alcohol consumed beyond other variables in the model, including maladaptive motivational structure. The relative power of automaticity in predicting the amount of non-dependent drinking had not been previously investigated.

The relationship between motivational style and its cognitive correlates can be conceptualised as follows. When a goal is sat and a current concern is formed, some cognitive changes are expected to guide the person's behaviour toward goal attainment. A valued goal makes the attentional system sensitive to goal-related stimuli in the environment; this process is important for survival. The attentional system includes neural circuits between the frontal lobes, where the executive cognitive functions are located, and prefrontal centres (including its communication with subcortical areas such as the amygdala), where emotional appraisals guide behaviour toward goal achievements.
When alcohol becomes the major source of pleasure or relief for a person, it establishes a priority in the cognitive system; the system gradually becomes sensitised to alcohol stimuli because of alcohol is valued and because of its chemical effects on the neural circuits. Alcohol wanting replaces alcohol liking (Robinson & Berridge, 1993, 2000, 2001, 2003) and comes to be seen as uncontrollable automatic thoughts and behaviours. In its extreme, it leads to a strong current concern for consuming alcohol.

A strong current concern for alcohol causes the attentional system to become highly sensitive to alcohol-related stimuli at a pre-attentive level (Ingjaldsson, Thayer, & Laberg, 2003) or at a supraliminal level, regardless of whether the person is a heavy social drinker (e.g., Cox et al., 1999; Cox et al., 2003; Stewart et al., 1997, 2002) or alcohol abuser (e.g., Bauer & Cox, 1998; Cox et al., 2000, 2002; Johnsen et al., 1994; Ryan, 2002; Stetter et al., 1995, 1994; Stormark et al., 2000). A maladaptive motivational structure, leading a person to “make a decision” to manipulate his or her mood chemically, and the decision is strengthened by automatic attentional processes. This instigates a vicious cycle.

Chapter 5’s finding on the importance of attentional bias supports the proposition that highly practised behaviours can be triggered by relevant stimuli, irrespective of the person’s motivation (Drobes et al., 2001; Tiffany, 1990; Tiffany & Conklin, 2000) and awareness (e.g., Wiers et al., 2002). When a stimulus is associated with a current concern, it acquires a degree of emotional salience. It could be said that, considering the role of humans’ motivational system in enhancing their positive affect and decreasing their negative affect, emotional regulation is the fundamental variable linking attention and psychopathology (Wilson & Gottman, 1996).

Nonetheless, it was not clear whether the automaticity finding was an artefact of the degenerative effects of alcohol on the general executive cognitive functions (ECF; Hoaken et al., 1998; Lyvers, 2000a; see Chapter 2). According to Wells and Mathews (1999), “Bias in selective attention is embedded within the system as a whole and cannot be understood without reference to both executive functions, specified computationally, and the person’s goals and self-knowledge” (p. 184). ECF plays a pivotal role in managing novel stimuli and performance on all divided-attention tasks that require cognitive flexibility to intentionally manage attention allocation to a target goal that is not in the same location on the automaticity continuum as is a distractor (Albright et al., 2000).

A large body of studies has demonstrated that alcohol-abusers are generally cognitively slower than controls (because of ECF differences between them), and that
alcohol abusers show greater attentional bias for alcohol-related stimuli than do non-abusers.

In alcohol-Stroop studies, attentional bias for alcohol-related stimuli is attributed mainly to the salience or emotional valence of these stimuli (Williams et al., 1996).

These studies have not systematically evaluated the possible effects of general deficiencies in executive and inhibitory processes of abusers on their attentional bias for alcohol-related stimuli. However, there were doubts about the validity of interference scores on the alcohol-Stroop test as valid measures of attentional bias for alcohol-related stimuli. For example, Bauer and Cox (1998) suggested that undifferential responses of alcohol abusers to alcohol and neutral words could have resulted from deficiencies in the participants’ inhibitory mechanisms. In a similar way, based on an investigation of the relationship between the classic Stroop and smoking-related Stroop, Zack et al. (2001) suggested that responses on the two versions of the Stroop task tap a common construct. The authors did not explain the nature of this common construct, but they might well have meant it to be the general inability to inhibit.

Stetter et al. (1995) also found a relationship between RTs on the classic and RTs on the alcohol-Stroop test. Based on finding no difference between the alcohol abusers’ and controls’ performance on the classic Stroop test, Stetter et al. suggested that performance on the classic and alcohol-Stroop tests are independent. However, they found a significant correlation between the participants’ RTs on the incongruent words category and their RTs on the neutral and alcohol-related word categories. Despite the researchers’ suggestion, the independence of the interference scores on the two tests warranted further investigation.

The thesis examined the above issues in a sample of non-dependent university students (N=101).

Because various forms of the Stroop test are based on a similar principle—inference (Pardo et al., 1990)—the classic Stroop test was deemed as the test of choice for measuring ECF in the current research (e.g., Ardouin et al., 1999; Carter et al., 2000). However, the Shipley of Living Scales (SILS) was also used to further investigate relationships between alcohol and verbal ability and abstract thinking (e.g., Beatty et al., 2000).

The first finding of Chapter 6 was that, even among a sample of young, non-dependent drinkers, excessive drinking was adversely related to ECF (i.e., classic Stroop interference scores). Weekly mean drinking, however, was not a predictor of the ECF impairment—the reasons for this are discussed in Chapter 6. The classic Stroop test was
found to be a more sensitive instrument for revealing such impairments than were the SILS indices.

The second finding of Chapter 6 was that attentional bias for alcohol-related stimuli was not an artefact of ECF. The ECF level, operationally defined by interference scores on the classic Stroop test, did not predict interference scores on the alcohol-Stroop test. The finding highlighted earlier propositions suggesting the importance of attentional bias in motivating alcohol consumption among non-dependent drinkers. The theoretical implications of this finding are discussed shortly.

The relationships among current concerns, motivational structure, and cognitive-attentional components of drinking were also addressed within a sample of alcohol abusers (Chapter 7).

The first finding was that alcohol abusers had less adaptive motivational structure than a student sample. This was in spite of the fact that the alcohol abusers were older than students (one would expect adaptive motivation to increase with age). The most distinguishing feature of the alcohol abusers' motivational structure, in contrast to that of the students, was their perception of having little control over attaining their goals. A within-sample factor analysis revealed that those participants allocated as having a more maladaptive motivation were also strongly aversively motivated. Alcohol abusers' feelings of having little control over their goals was associated with expecting sadness from failing to achieve them; this could have resulted from their exaggerated negative appraisals of failure, their tendency to avoid unpleasant things, and a reason for their coping with negative affect (as is discussed below) by resorting to alcohol.

These results can be interpreted in relation to other findings indicating relationships among personality, drinking motives—enhancement motives (EM) versus coping motives (CM)—and drinking. Cooper, Agocha, and Sheldon (2000) found that, although personality dimensions are important predictors of affect-regulation motives, EM and CM are direct and proximal predictors of both heavy drinking and risky drinking. Cooper and colleagues (1995, 2000) reported that people drink for both EM and CM. The authors also suggested that EM is more associated with non-problem drinking, whereas CM is associated with a lack of other more adaptive ways of dealing with life. Although EM and CM both predict drinking behaviour, they are psychologically distinctive constructs.

Recall from the previous chapters that maladaptive motivation was characterised by strong aversive motivation, whereas adaptive motivation was characterised by positive loadings on appetitive motivation accompanied by realistic feelings of commitment,
emotional investment in incentives, and being hopeful about and perceiving control over goal achievements. The distinction between an adaptive and a maladaptive motivational structure nicely corresponds to the distinction between different reasons for drinking according to the EM and CM constructs. Although CM drinking is believed to arise from a lack of coping skills in other areas of life, it doesn’t explain the mechanisms by which coping motivation develops and progresses into a hazardous drinking style. The theory of current concerns (Cox & Kilnger, 1988, 2003; Klinger & Cox, 2003) and motivational structure account for motivational deficits associated with abusive drinking. In comparison to adaptive motivation, a maladaptive motivational structure is characterised by frequent disengagements from goal, little satisfaction from goal pursuits, and a low tolerance for frustration (see Chapter 1). A person with a maladaptive motivation might resort to alcohol to compensate for the lack of satisfaction in other areas of his or her life. Alcohol is drunk in an attempt to counteract negative emotions emanating from such a motivational structure; however, the effects of alcohol last only as long as it remains in the body. A chemical short-term solution cannot bring the person a happy life; a malicious cycle emerges that becomes intensified by the side effects of frequent alcohol consumption.

The second finding was that alcohol abusers showed significantly more attentional bias for alcohol-related stimuli than did controls. This finding is consistent with many other studies comparing the attentional bias of alcohol abusers and control participants (Cox et al., 2000, 2002; Johnsen et al., 1994; Ryan, 2002; Sharma & Albery, 2001; Stetter et al., 1995; Stormark et al., 2000). However, it is not consistent with the findings of two studies which did not find such a difference (Bauer & Cox, 1998; Stetter et al., 1994). The inconsistency in the findings could have been arisen because of methodological differences.

The third finding was that alcohol abusers showed significantly greater ECF impairment than did student drinkers—a finding that adds to the existing body of knowledge in the field (e.g., Dao-Castellana, 1998; for a review see Moselhy et al., 2001). The degree of ECF impairment was significantly predicted by years of excessive drinking, but not by weekly mean drinking. Although alcohol abusers were significantly poorer on the SILS Vocabulary T-scores and the SILS Abstraction T-scores than were students, within-group comparisons revealed that neither weekly mean drinking nor chronicity of consumption predicted alcohol abusers’ performance on the SILS indices. However, interference scores on the classic Stroop test significantly predicted alcohol abusers’ poor performance on the SILS Abstraction T-Score. There was no significant
difference between the two groups' Shipley Abstraction Quotient. This supports the idea that the classic Stroop test is a more sensitive measure of ECF impairments than is Shipley Abstraction Quotient. Severe ECF impairment not only adversely affects decision-making on dual-attention tasks and abstraction thinking, it also adversely affects more intact verbal abilities. Although minor ECF impairment among problem drinking students did not predict their performance on either of the SILS indices, it was a negatively correlated with diminutions in alcohol abusers' abstraction scores—though the abusers were suffering from a generally more impaired ECF than students and, in comparison, they scored lower on all SILS indices. The chronicity of alcohol abuse was a stronger predictor of the degree of damage, a finding that is not consistent with Beatty et al.'s (2000) results.

As far as associations between ECF impairment and alcohol consumption are concerned, drawing firm conclusions about ECF impairment as a predating (Giancola & Moss, 1998) or postdating factor is difficult. There could be a reciprocal effect between the two variables. The significant difference between abstraction abilities and ECF of controls and alcohol abusers indicates there is little doubt that ECF impairment postdates abusive alcohol consumption. It also indicates that an intact ECF is necessary for adequate cognitive flexibility and planning and problem-solving abilities. The evidence indicates that poor ECF is associated with problems in self-monitoring, self-control, planned behaviour (Espy et al., 1999; Cahn-Weiner et al., 2000), and aggressive and non-aggressive antisocial behaviours (Giancola, Mezzich, & Tarter, 1998). Given that impairments in self-control are characteristic of alcohol abusers, ECF dysfunction may play a significant role in their compulsive behaviour (Lyvers, 2000b).

The fourth finding was that a poor ECF positively predicted a more maladaptive motivational structure among the alcohol abuser sample. The theoretical applications of this finding are discussed shortly.

The results of this study confirmed the role of a maladaptive motivational pattern in alcohol consumption and that non-dependent and dependent drinking affects selective processing of alcohol-related stimuli. These findings challenge traditional models of cognitive processing, but they support the theory of current concern which posits an interaction between cognitive and motivational processes. The results highlight once again the interactive nature of seemingly different aspects of motivation, and presumably place them under the umbrella of a more general supervisory system.

Fifth, the results of a hierarchical regression analysis, controlling for gender, age, IQ, and perceived stress, revealed that alcohol abusers' ECF impairment did not predict
their attentional bias for alcohol-related stimuli; the processing shifts toward selective attention were independent of a general ECF impairment.

To conclude:

The results of two hierarchical regression analyses in this research revealed that, neither for a sample of controls nor for a sample of alcohol abusers, attentional bias was a function of general ECF. This indicates that attentional bias for emotionally salient stimuli influences attention allocation over and above the level of ECF.

The above findings confirm Stetter et al.’s (1995) conclusion (based on simple correlations between RTs on classic and alcohol-Stroop tests) that information processing on the alcohol-Stroop test is independent of putative neuropsychological deficits in alcohol abusers. This outcome is inconsistent with Bauer and Cox’s (1999) result that alcohol abusers’ lack of differential responses to alcohol and neutral words emanates from a generally impaired inhibitory system. Accordingly, the finding does not support Zack et al.’s (2001) suggestion that, in a smoking-related Stroop study, the classic and emotional Stroop tests tap a common construct that is independent of the level of cigarette smoking. Emotional salience influences selective attention over and above a general inhibitory or attention regulatory system.

**What Was Developed: From Attentional Bias to Attentional Intervention**

There are many therapies and interventions that aim to help addicts gain control over their behaviour. Treatment (detoxification) sets into motion a change in roles from being an abuser to a non-abuser. It has been demonstrated that changes from one role to another may cause changes in attitudes (e.g., Aronson, Timothy, Akert, 1999); a change from being an abuser to a non-abuser is expected to change attitudes toward alcohol stimuli. But negative attitudes toward drinking and motivations for change do not always seem sufficient for the sobriety to be continued.

Many drinkers wish they could stop drinking—or at least reduce the amount that they drink. Among excessive drinkers who enter treatment, approximately 50% relapse within three months of completing their programme (Whitworth et al., 1996). These high failure rates are perplexing, especially given that problem drinkers readily recognise the negative consequences of their drinking and frequently resolve not to drink again. Such excessive drinkers are viewed as having lost control over their drinking (Tiffany, 1990). Recall that this is the first criterion for defining alcohol abuse in the DSM-IV.
classification system (American Psychiatric Association, 1994; see also Morse & Flavin, 1992; Roberts & Koob, 1997).

As discussed in Chapter 2, although the evidence for decreasing attentional bias following detoxification is inconsistent, it suggests that attentional bias for addiction-related stimuli is a high risk factor contributing to the loss of control over sustaining abstinence (e.g., Franken et al., 2000; Johnsen et al., 1994). The evidence suggests that attentional bias for addiction-related stimuli increases following detoxification (e.g., Cox et al., 2003; Gross et al., 1993). Such processing deficits are important in understanding relapse (McCusker, 2001).

Excessive and problematic drinkers’ decisions not to drink are often fraught with ambivalence, because of the influence of non-conscious cognitive processes that challenge conscious decisions to remain abstinent (Tiffany, 1990). When habitual drinkers encounter drink-related stimuli, a series of automatic cognitive processes is activated; these processes prompt alcohol-seeking behaviours that go beyond the drinker’s original intention not to drink (Tiffany, 1990, Tiffany & Conklin, 2000). Attentional bias for alcohol-related stimuli contributes to drinkers’ preoccupation with alcohol and their lack of confidence in their ability to control their urges to drink (see McCusker, 2001; Roberts & Koob, 1997). The response to these potent cues, involving the evaluative processes of the limbic system and ventro-medial prefrontal cortex, contributes to the defective decisions to drink too much or to break abstinence (Bernheim & Rangel, 2002). Cox et al. (2002) found that increases in in-treatment alcohol abusers’ attentional bias for alcohol-related stimuli predicts the risk of treatment drop-out.

The results reported in Chapters 6 and 7 support the proposition that attentional bias is an important determinant of drinking behaviour. The results also revealed the superiority of attentional bias over general ECF impairment—either pre-dating or post-dating the drinking—in predicting alcohol consumption. These results, in addition to the evidence suggesting the role of ECF as a holistic cognitive ability in treating the addictive behaviours (e.g., Noel et al., 2001; Bowden et al. (2001), gave rise to the idea of developing the Alcohol Attention Diversion Training Programme (AADTP).

The AADTP was developed to help alcohol abusers overcome their involuntary distraction by and preoccupation with alcohol. The AADTP is a computerised programme with various levels of difficulty in terms of stimulus types and response time-frames. It utilises trainees’ motivation and intentional struggles to contradict their pre-attentive selective attention for alcohol-related stimuli. Goal-setting and immediate feedback from participants’ reactions to a series of alcohol bottles is included in the
programme. The operation of the training programme was conceptualised in terms of Dimension Identification (Did) and Interference Control (Ii), adopted from Demetriou and Spanoudis' (2002) classification of sources of the Stroop effect. The deficit in disengaging attention (Did) is related to generally slowed reaction times due to poor inhibitory and executive cognitive functioning (ECF) associated with excessive drinking (e.g., Giancola & Moss, 1998); this reduces cognitive sharpness in responding to environmental stimuli (e.g., Stormark et al., 2000). Because of this impairment, heavy drinkers are less able than other people to effectively divert their attention away from distracting stimuli. Ii is the difference between Did related to alcohol stimuli and Did related to neutral stimuli—the interference score.

The results of nine case studies revealed that the intervention served two important functions.

First, it corrected the excessive drinkers' attentional uncontrollability for alcohol stimuli in favour of attending to other kinds of stimuli. The AADTP helps decrease attentional bias for alcohol-related stimuli but not for other salient concern-related stimuli in the person's life: it is an alcohol-specific programme.

Second, it decreased the length of time drinkers needed to divert their attention away from alcohol once it captured their attention. The results revealed that improvements on the training programme were generalised to a more general ECF, increasing the trainees' cognitive flexibility and sharpness in responding to incongruent stimuli. It was associated with self-reported increases in trainees' self-control and self-efficacy in dealing with alcohol.

Two sources of interference need distinction in relation to the post-training decreases in interference score. These correspond to Williams et al.'s (1996) account of the sources of the interference score in an emotional Stroop test. One source is the higher resting level (i.e., lower threshold) for emotional stimuli. The second source is the role of an intermediate neuromodulatory system. Emotionally salient stimuli have a higher activation level, or cause stronger connections in the neural pathways, for those stimuli. This higher activation output competes with other output activation that originates from colour naming. Because the capacity of intermediate units is limited, the stronger flow of information from concern-related stimuli increases colour-naming latencies.

It was uncertain whether the reduced latencies on the post-Stroop test arose only from the increased abilities in colour naming or from the increased neuromodulatory abilities in controlling the interference. If the reduction arises only from increased resting level for colour naming, it might not be of much therapeutic value; in this case, the trainee
should not show signs of interference in any emotional-Stroop tests using colours as the task-relevant dimension, irrespective of the content of the emotional words. In contrast, if training has targeted the neuromodulatory systems involved in reacting to alcohol-related stimuli (the training target stimuli), then, on a post-test Stroop, the trainee should show distraction for other emotionally salient stimuli but not for alcohol-related stimuli. The latter interpretation was supported by the trainees’ differential improvement in response to alcohol and other concern-related stimuli: on the post-test the trainees showed reductions in their interference scores for alcohol-related stimuli; their interference scores for other concern-related stimuli either increased or remained unchanged.

The effects of the AADTP on post-test interference reduction can be interpreted in different ways. One line of interpretation could focus on facilitatory and inhibitory processes involved in performing a Stroop test (MacLeod, 1991). It could focus on facilitation of colour-naming versus increased pre- or post-attentive inhibition for alcohol-related stimuli—or both.

An interpretation of the AADTP effect on reduction of interference scores can be stated as a result of increased facilitation for colour naming. In this case, colour naming, which was initially a difficult task, was facilitated by practice. Hence, what leads to reduced interference on the post-test, in comparison to the pre-test, is a faster colour-naming skill. This kind of reduction in interference would be of little therapeutic value, if any.

The facilitation view could also be re-stated in light of a parallel distribution model (competing processing pathways; see Chapter 2). The theory is based on the effect of relative practice on the speed of processing. More practice corresponds to higher levels of automaticity. A more automatic aspect of a stimulus is processed faster. In terms of this theory, more automatic alcohol-related stimuli compete with colour naming in a common pathway, leaving little space for the colours to be processed as quickly as alcohol stimuli are. Accordingly, the two possible interpretations about the effects of the AADTP on increasing colour-naming speed are (a) colour-naming becomes faster because of extensive training with colours, and (b) colour-naming becomes faster because there is not enough practice with alcohol-related stimuli. It is difficult to imagine that a post-training reduction in interference for alcohol-related stimuli can be a simple product of exercising more frequently with colours than with salient stimuli. Again, although there were reductions in reaction times to the alcohol-related stimuli, there were no reductions in the speed of reaction to a set of concern-related (but non-alcohol-related) stimuli.
On the other hand, reductions in attentional bias for alcohol-related stimuli as a result of taking part in the AADTP could be explained as a strengthened cognitive ability to inhibit alcohol-related stimuli at a pre- or post-attentive level; this would increase the ease of concentrating on and responding to the task-relevant dimension. It could be that, through exercise with the AADTP, inhibition of the irrelevant aspect of the stimulus increases while the targeted aspect becomes increasingly facilitated.

The differential results of trainees’ performance on the pre- and post-alcohol and concern-related Stroop tests cannot be interpreted solely in light of the facilitation paradigm. If facilitation (increased ability to colour-name) were the cause of the decreased attentional bias, the trainees would have shown similar improvements on the two versions of the emotional Stroop test. The increase in interference scores for the other concern-related stimuli indicates that the facilitation view is not sufficient to explain the effect of the AADTP; the view based on strengthened inhibitory processes resulting from the training is more plausible.

Nonetheless, it is not clear from the previous studies whether there is only one general ECF that is responsible for various kinds of task-relevant attentional management or whether each class of emotional stimuli set a specific ECF circuit within or outside of a more general ECF.

The AADTP results could be interpreted in favour of specific ECF circuits for each class of current concerns or each particular current concern.

The interface between emotions and cognitions is well-documented (Compton, in press; MacLeod & MacDonald, 2000). Each goal pursuit is intertwined with the emotions that give value to the goal pursuit. Recall from Chapter 3 that the anterior cingulated cortex, where the ECF is located in the frontal lobes, comprises distinctive areas for processing cognitive and emotional appraisals of an event. There are both top-down and bottom-up relationships between frontal lobe and sub-cortical circuits, especially the amygdala. Cortical and sub-cortical circuits are involved in rapid preconscious detection of the emotional significance of stimuli; this is what was termed the goal-lurking function of a current concern (see Chapter 1). If there were a general ECF circuit for all of emotionally salient stimuli, the inhibitory training (AADTP) should equally affect performance on all emotionally salient stimuli. This was not the case—the trainees’ performances on the alcohol-Stroop test and concern-related Stroop test were not equally affected by the programme.

The convergent evidence from emotional Stroop studies supports the notion that each current concern sets a specific ECF circuit that is different from the circuits for other
current concerns. For example, attentional bias in clinical samples has not been limited to mood-congruent stimuli (e.g., Bauer & Cox, 1988; Crombez, Hermans, & Adriaensen, 2000; de Ruiter & Brosschot, 1994; Kinderman, 1994) or mood-congruent states (e.g., Riemann & McNally, 1995; Spinks & Dalgleish; 2001), and participants have shown more differential reactions to alcohol-related words than to concern-related words (Cox et al., 2000), and more to positive and negative emotional words than alcohol-related words (Bauer & Cox, 1998).

A current concern acts as a prominent schema in modulating attention to and selection of wanted over unwanted stimuli. However, it is not a supervisory system in itself. This is because current concerns change from one point in time to another; nonetheless, the underlying mechanism, which allows non-conscious, time-binding, and automatic effects of current concern, remains stable across time. Each specific current concern corresponds to a specific executive cognitive function. To explain the path through which a current concern acts as a specific executive cognitive function, the following is re-stated from Chapter 1.

First, having a current concern causes the emotional salience of concern-related stimuli to develop. Second, this salience sensitises early perceptual pathways for analysing structural features of input stimuli; this analysis is limited to a global emotional evaluation (i.e., important vs. unimportant or critical vs. non-critical); this is equivalent to goal lurking and could closely interact with a more general ECF system. Third, those stimuli that are evaluated as emotionally significant become the focus of attention as the executive shuttle between cognition (in this context, semantic processing) and further emotional evaluation; this level of attentional activity is not necessarily conscious, although it might be at the threshold level for selective attention. Fourth, the product of these emotional and cognitive processes may be manifested in conscious cognitive and behavioural decision-making.

**Implications for Clinical Practice and Prevention Programmes**

Converging evidence from previous studies and the present study suggests that the theory of current concerns and motivational structure introduced by Cox and Klinger (1988, 2002) is a valid theory in predicting individuals' susceptibility to addictive behaviours. The theory provides health professionals with additional procedures to screen for high-risk individuals by using the MSQ or the PCI techniques. Such measures can have widespread applicability that is not limited to counselling or clinical settings. For example, secondary-school and university students and those in employment settings
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are non-clinical target populations who could be provided with self-administering versions of the PCI to evaluate their motivational structure. Self-help manuals based on the PCI might help some individuals to overcome their motivational deficiencies. Systematic Motivational Counseling (Cox & Klinger, 2004) could be employed in professional settings to enhance motivational structure of those clients who are at risk for developing malfunctional behaviours and those who are suffering from dysfunctional lifestyles.

Review of the literature and the present findings establish the importance of ECF in the development of motivational and behavioural anomalies (e.g., Giancola & Moss, 1998). For example, there is evidence (e.g., Noland et al, 2003) that a history of maternal drinking increases the risk of ECF deficiencies in childhood. The relationship between drinking and ECF deficiencies and its negative behavioural and motivational consequences was reviewed in Chapter 3 and was documented in Chapter 7. Therefore, attention should given to ECF deficiencies during childhood through the assessment of ECF of susceptible children. Rehabilitation of ECF deficiencies could prevent the exacerbation of the problem and the development of more severe negative consequences. Recall that the abusive drinkers in the present study had a poorer ECF than the students, and that among the students who drank, poorer ECF predicted more maladaptive motivation. Because of the importance of ECF in cognitive flexibility, planning, and problem solving, ECF rehabilitation for detoxified alcohol abusers could be extremely beneficial.

The AADTP was shown helpful in assisting the trainees in this study to overcome their attentional bias for alcohol-related stimuli. As discussed, smoking, gambling, opiate abuse, and other psychopathologies (see Williams et al., 1996) are associated with attentional bias for disorder-related stimuli. Modifications of the AADTP could be used with clinical groups whose attentional bias for disorder-related stimuli plays a vital role in their pathology.

Recommendations for Future Studies

It is unrealistic to suppose that motivational dysfunction in goal-setting, goal-seeking, and goal-appraisal (or, briefly, goal pursuits) play a role only in the development of problem drinking. The theory of current concerns and the importance of motivational structure in the development of other forms of psychopathology await investigation.
The MSQ and the PCI have been shown to be valid and reliable measures of people's motivational structure. However, additional work can be done to improve these instruments. It is not clear to what extent results from particular respondents could be contaminated by their intentional or unintentional attempts to present a false picture of their goal strivings. The measures are based on self-reports. Attempts might be directed toward developing more objective evaluations of people’s motivational structure using computer technology. The current test results could be misleading for particular individuals as a result of their recent major life events, causing them to under estimate or exaggerate their appraisal of their motivation. Based on the current version of the MSQ and PCI, it is hard to determine whether people’s motivational appraisals of their goal pursuits are momentary, retrospective, prospective, or a combination of these.

There are varieties of the emotional Stroop test. Even within the domain of alcohol abuse, there is a huge variation in the number and type of stimuli used, length of inter-trial intervals, and other important methodological details of alcohol-Stroop tests. A task for future studies is to decide on a standardised procedural methodology in constructing and administering the emotional Stroop paradigm. Attention should be paid to software and hardware considerations, too.

Attentional bias in alcohol studies has been studied mostly in isolation.

The relationship between personality type and the degree and harmful effects of attentional bias for addiction-related stimuli is not clear. Broadbent (1958, cited in Revelle, 1995) presented evidence suggesting that extraverts are more likely to show decrements in performance on tasks that require continuous concentration than are introverts. Revelle (1995) presented evidence that extraverts’ performance deteriorates more rapidly than introverts’ in terms of the ability to detect infrequent signals, variability and speed of continuous reaction times, and in the ability to stay awake on long-distance drives. Revelle argued that this decrement in performance can occur very rapidly. The relationship between personality type and attentional bias for addiction-related stimuli, especially under constraint circumstances, warrants investigation.

The Behavioural Approach System (BAS; Gray & McNaughton, 2000) activates approach behaviours in response to cues for reward or non-punishment. It can be conceptualised as the engine of behaviour. It has been argued that the BAS fuels an extroverted personality and that extroversion is characterised by a set of approach traits, impulsivity, novelty seeking, positive affectivity, energetic arousal, and positive affect (Cooper et al., 2000; Revelle, 1995). The BAS is associated with enhancement
motivation (EM). There is a tendency engage in behaviours that enhance positive emotions (Cooper et al., 2000).

On the other hand, the Behavioural Inhibition System (BIS; Gray & McNaughton, 2000) activates avoidance behaviour. It can be conceptualised as the blocking system of behaviour. It has been argued that the BIS fuels a neurotic personality and that neuroticism is characterised by a hypersensitivity to stimuli signalling punishment, innate fears, novel stimuli, and non-rewarding stimuli in the environment. The BIS leads to behavioural inhibition, increments in tense arousal, and vigilance (Revelle, 1995). In contrast to the BAS, the BIS is characterised by a set of avoidant and inhibitory traits, anxiety, and neuroticism in its extremes (Gray & McNaughton, 2000). Negative affect and state anxiety both fuel BIS activation. It is argued that depression reflects high levels of the BIS and low levels of the BAS activity (Revelle, 1995). The BIS is associated with coping motivation (CM) (Cooper et al., 2000). This is a tendency toward behaviours that hamper negative emotions (Cooper et al., 2000).

If an individual drinks alcohol mostly for enhancement reasons, he or she might have developed a different sensitivity for alcohol-related stimuli than a person who drinks mostly for coping reasons. It can be assumed that alcohol-stimuli could be a signal of something positive for the first person but could be a signal of something negative for the second. On the other hand, people governed by either the BAS (sensitive to reward signals) or the BIS (sensitive to punishment signals) demonstrate different levels of sensitivity to cues for reward and cues for punishment (Gray & McNaughton, 2000). Reaction to alcohol-related stimuli as a function of the BAS or the BIS warrants research. The effect of these distinctive motives and personality dimensions on drinkers’ ability to profit from the AADTP could also be important to establish.

The current AADTP results are from a series of case studies. Based on results presented in this thesis research, it is unclear whether the training would lead to changes among trainees in comparison to those recent abstainers who have not received the training. A longitudinal study could help to cast light on long-range outcomes of the training and factors that may influence its effectiveness.

Future research on the AADTP could assess the physiological changes associated with the training programme. For example, in a similar way to Greeley, Swift, Prescott, and Heather’s (1993) and Stetter et al.’s (1994) study, skin conductance responses (SCR) and heart rate of the trainees could be monitored during the alcohol-Stroop pre-test, during the AADTP programme, and during the alcohol-Stroop post-test. Recall that Stormark et al. (2000) found lower SCR in reaction to alcohol words, whereas Greeley et
al. found higher SCR in reaction to alcohol cues than to neutral stimuli among alcohol abusers. Such discrepant findings need to be resolved in future research.

The Cardiac vagal control could be relevant: it affects the ability to regulate attention. The cardiac vagal control is an index of heart-rate variability: the greater the heart-rate variability, the greater the ability to regulate attention. Cardiac vagal control indices can reflect tendencies to accept (characterised by decelerated heart rate) or reject (characterised by accelerated heart rate) a stimulus (Friedman, & Thayer, 1998; Porges, 1992). Evidence indicates that alcohol consumption decreases the heart-rate variability and the ability to sustain attention (e.g., Suess, Newlin, & Porges, 1997). Stormark et al. (1997) found a smaller cardiac variability among a sample of alcohol abusers after being exposed to a series of alcohol-related cues. It would be useful to study AADTP trainees’ cardiac vagal control before, during, and after completion of the programme and compare the with a control group of alcohol abusers.

Feelings of poor self-control seem to be a core issue among alcohol abusers (Lyvers, 2000a; Skutle, 1999; see also Chapter 7); poor self-control is reflected not only in abusers’ motivational structure and their inability to control their attentional bias for alcohol, but also in their feelings regarding alcohol cessation. The content of the trainees’ self-reports following the AADTP indicates that it had a positive effect on their sense of self-control and self-efficacy. These feelings could calibrate any practical benefits of the AADTP. One task for future evaluations of the AADTP is to concentrate on the effects of the programme on the length of sobriety following detoxification (or the subsequent amount of alcohol consumed) differentiating the effects of attentional and motivational outcomes of the programme on the therapeutic outcomes. For example, studies are needed to examine the effect of the programme on trainees’ self-efficacy, as a prospective measure of treatment progress (Greenfield, Hufford, Vagge, Muenz, Costello, & Weiss, 2000), and to explore its association with treatment outcomes.

Stimuli used in the AADTP were mainly alcohol and soft-drink bottles. The responses were also limited to four coloured keys. The programme could be expanded to include more diverse stimuli and responses. Statistical and graphical feedback at the end of each training session could be more automated.

**Limitations of the Research**

The study hypotheses were tested among a group of students and alcohol abusers. Generalisation of the results to the general population is problematic. This said, students
come from diverse regional, social, and familial backgrounds; many studies conducted using student samples assume that the findings generalise to the broader population.

Although there is evidence that the Stroop test primes short-term memory (see Chapter 4), other instruments for addiction-related memory could not be used in the study because of time constraints. However, the post-test Stroop recall tasks were deemed appropriate to assess Stroop-related memory, based on those suggestions in the field that attribute interference scores mainly to primed semantic memory for emotional stimuli. The results of two regression analyses revealed that the attentional bias was a significant predictor of drinking indices over and above the effects of memory.

As explained, the AADTP results were based on case studies. The study's time limitations did not allow further development of the programme into a between-participants experimental design. The trainees' drinking patterns were also not followed up because of this limitation.

All participants who successfully completed the AADTP were male. However, it seems highly unlikely that gender-specific effects of the intervention will be found.

**A Final Word**

There are no panaceas in the treatment of addiction.

Disappointing findings on some medications, such as Naltrexone, which had at first been postulated to be magical solution for the prevention of relapse (e.g., Volpicelli, Alterman, Hayashida, & O'Brien, 1992), have astounded the pioneers of the treatment; this has led them to suggest that such medicines are effective in treating alcohol abuse only when used in conjunction with psychosocial therapies and for those patients who comply with treatment (Morris, Hopwood, Whelan, Gardiner, & Drummond, 2001).

Humans' cognitive system is dedicated to its duty as a mood manager; its task is to ensure that human lives with positive feelings. "The human cognitive system is designed for flexibility, and can carry out any particular task in many different ways" (Rabbit, 1986, p. 155).

The present study suggests the following:

- The cognitive-motivational model of alcohol use is a valid model for predicting drinking behaviour.
- Executive cognitive functioning influences people's motivational structure; a successful motivational structure depends on people's cognitive flexibility, self-monitoring, and behavioural planning.
• Psychopathological attentional bias is a by-product of addicts’ maladaptive motivation, which leads to a dysfunctional current concern (embracing dysfunctional emotional salience) and the addicts’ extensive experience with the addictive substance.

• People are influenced by automatic, uncontrollable processes of addiction to the extent that they do not have opportunities to gain conscious and voluntary control over those processes.

• The Stroop test is a valid instrument for the assessment of participants’ attentional bias for their current concerns.

• Modifications of the Stroop paradigm are possible for training participants’ cognitive and attentional processes; the AADTP is an instance of such modification.

• The attempt to correct attentional bias has benefits. Goal setting and immediate feedback are key elements in guiding participants’ conscious struggles to strengthen their specific inhibitory processes to overcome the most compelling part of their uncontrollable behaviour: the attentional bias.

• The AADTP enhances the trainees’ self-confidence and sense of control over the automatic behaviour; this could result in desirable alterations in a poor motivational structure.

In standard theory and research, many authors and researchers seek to confirm that addiction is an instance of uncontrollability; their attempts have been intertwined with the concept of attentional bias. Despite the indisputable evidence on the importance of attentional bias in sustaining addictive behaviours, there has been no prior therapeutic intervention to correct addicts’ attentional bias. The results of this thesis suggest that, in this respect, the gap has been seriously neglected.
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Appendices 1 – 9, pages 284 – 309

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