Chapter 1

IMPLICIT AND EXPLICIT ALCOHOL, SMOKING AND DRUG-RELATED COGNITIONS AND EMOTIONS

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ABSTRACT

Why are addictive behaviors continued once negative consequences become evident? Until recently, many psychological theories of addictive behaviors were derived from models of rational decision making, while addictive behaviors are often irrational even to drug abusers themselves. Recent psychological research has begun to explore a variety of implicit or indirect measures to assess more automatic cognitive motivational processes which play a role in addictive behaviors. These are reviewed here, with a focus on alcohol misuse and smoking. A number of studies have now shown that implicit measures predict unique variance in addictive behaviors. One of the most often used measures, the Implicit Association Test (IAT) has generated a robust paradoxical effect: heavy drinkers and smokers demonstrate strong negative associations with alcohol and cigarettes, while on explicit measures indicating that they are positive (especially for alcohol). These findings may have to do with specific measurement properties of the IAT, which are discussed. Alternatively they may represent negative events related to substance use, which may exist next to positive representations (ambivalence). Further, it has been demonstrated in this domain that it may be beneficial to assess not only valence associations (or implicit attitudes), but also associations in other emotionally relevant dimensions like arousal vs. sedation and approach vs. avoidance. We argue that there is suggestive evidence that implicit measures at least partly tap into automatic emotional processes which play an important role in the irrational aspects of addictive behaviors.

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INTRODUCTION: RATIONAL DECISION THEORY AND IRRATIONAL BEHAVIOR

Consider a problem drinker who has difficulty concentrating due to a hang-over, who is coughing badly from heavy smoking. Why on earth does he (given the gender-bias in addictive problems, let’s masculinize our imaginary person) continue to drink and smoke? Does he not know the negative consequences of heavy drinking and smoking? If so, why doesn’t he stop? These are a few of the simple questions that have motivated and plagued researchers in health and social psychology and in addiction and prevention research. As is often the case with simple questions, the answers are not so simple. It is now clear that a variety of factors on different levels of description are relevant, ranging from policy and environmental management strategies (e.g. Hingson and Howland, 2002) to sub-cellular processes that could be related to individual differences in the susceptibility for addiction (e.g. Ratsma, Gunning, Leurs and Schoffelmeer, 1999). Somewhere in the middle of these levels of description lies psychology, and at the psychological level of description a whole range of theories have been proposed to underlie substance abuse, related to different sub-disciplines of psychology (for reviews, see Leonard and Blane, 1999; Wiers and Stacy, 2006).

Traditionally, much research from a social and health psychology perspective has been conducted from a perspective influenced by classical decision theory approaches, such as the well known subjective expected utility theory and the theories of reasoned action and of planned behavior (for a recent overview, see Kuther, 2002). Central to all these theories is the concept of man as a rational decision maker, who weighs pros and cons of behavioral options (or more or less consciously calculates net expected utility), and then takes a rational decision. This model has been challenged in the decision making literature (e.g. Kahnemann and Tversky, 2000), but regardless of it’s general status to explain human decision making, it seems an odd choice to explain addictive behaviors, because addictive behaviors are almost prototypical examples of irrational behaviors. In many cases, addicts cannot explain their behavior in terms of expected advantages, and they know very well that there are many serious negative consequences. The problem is not that they don’t know that it would be better for them to stop, the problem seems rather that they do not know how to stop. However, when reasoning from a classical decision making framework (that may be shared by the addict and the researcher or therapist), it makes perfect sense to further stress the negative consequences of continued use. An example of this strategy is the recent magnification of warnings on cigarette packages (in The Netherlands by extreme size of the warning, in Canada by putting photos of aversive consequences of smoking on the packages). The reasoning is clear: when (health) decisions are made by weighing pros and cons, and many people still smoke, the cons are apparently not salient enough yet. So they are made bigger or more aversive. Further, from this perspective, it seems logical to try to better understand what the “pros” may be of this maladaptive behavior. If you know all these negative consequences, and still smoke, or binge-drink, or take hard-drugs, what good does it bring you? Are you more popular with your friends? Do you have more fun when you go out? Does it relax you? Etc.
The question is whether people have good self-insight with respect to what motivates their (addictive) behaviors. There are reasons to doubt that they always have. There is a long tradition of research in social psychology demonstrating that people are good in making up seemingly logical reasons for their behaviors, but that these reasons may have little to do with the variables that actually predict behavior (e.g. Nisbett and Wilson, 1977; Gazzaniga and LeDoux, 1978; Wegner, 2002; Wilson, 2002). For example, people tend to choose products more to the right, but when asked to explain their choice come up with reasons relating to more “rational” variables such as quality or price (Nisbett and Wilson, 1977). Translated to alcohol and drug-use, one may question to what extent reasons given by people really drives their substance use. For example, people often give reasons that contradict each other (e.g. “it gives me energy, makes me feel on top of the world” and … “it relaxes me”, see further Darkes and Goldman, 1993; Goldman, Brown and Christiansen, 1987). Our message in the rest of this chapter will not be that the approach of asking people to think about their reasons for alcohol or drug use is wrong, or that people do not weigh pros and cons at all, and that stressing cons is a useless strategy in alcohol- and drug-prevention, but rather to stress that there may be more going on at the psychological level of description, that may help to explain the irrational aspects of addictive behaviors.

In the past decade, researchers in experimental (social) cognition have increasingly employed implicit assessment techniques to study cognitive determinants of behavior (e.g. Fazio, 1990; Greenwald and Banaji, 1995; Wilson et al., 2000). A large variety of implicit measurement techniques have been employed, and what they have in common is that “they all seek to provide an estimate of the construct of interest without having to directly ask the participant for verbal report. Their major appeal is that these indirect estimates are likely to be free of social desirability concerns. Often, though not necessarily true for all of the measures, the participant is unaware that attitudes, stereotypes, etc. are even being assessed.” (Fazio and Olson, 2003, p. 300). Implicit measures are contrasted with explicit measures that rely on self-report and introspection and that are therefore more sensitive to self-presentation concerns. Greenwald and Banaji (1995, p. 4) note that the implicit-explicit distinction partly overlaps with dichotomies like unaware-aware, unconscious-conscious, intuitive-analytic, indirect-direct, procedural-declarative, and automatic-controlled, and that these dichotomies vary in the amount and nature of implied theoretical implications. This remark is echoed in recent discussions on the nature of the implicit-explicit distinction, where one position is that the distinction only applies to different measurement strategies (e.g. Fazio and Olson, 2003, who plea in accordance with this position for using the distinction “indirect-direct”, for a similar argument in the field of addiction, see Goldman, Del Boca and Darkes, 1999). Another position is that these techniques tap into different underlying cognitive motivational processes (e.g. Wilson et al., 2000; Wilson, 2002, for similar arguments in addiction research, see Stacy, 1997; Wiers and Stacy, 2006). This issue is further discussed in the third section.

First, we present some recent studies of our own lab and from others in which we applied the Implicit Association Test (IAT, Greenwald, McGhee, and Schwartz, 1998) to alcohol use and abuse smoking. In it’s short existence, the IAT has become the most widely used measure of implicit associations (Fazio and Olson, 2003). The IAT is a reaction time test, in which participants react to two times two categories of stimuli that are presented one by one on the screen. The one pair of stimuli are the target stimuli, two sets of objects the researcher wants to assess the implicit associations with. These can be white and black faces (when assessing implicit racial attitudes, e.g. Cunningham, Preacher and Banaji, 2001) or names of alcoholic
vs. soft drinks (to assess implicit alcohol associations, Wiers, van Woerden, Smulders and De Jong, 2002). The other pair of stimuli-categories constitute the attributes. In the vast majority of IAT studies these are positive and negative words, to assess implicit attitudes, but some other dimensions have been used, especially in relation to psychopathology (e.g. Teachman, Gregg and Woody, 2001; Wiers et al., 2002b; 2005). In the critical parts of the IAT, the performance on the one possible coupling of targets and attributes to a response button are compared with performance on the other coupling of targets and attributes. For example: is performance better when the response button for black faces and positive words are shared (and white faces go with negative words), or when black faces and negative words share the same response button (and white faces go with positive words). The IAT is based on the assumption that when two concepts are more related in memory, performance is better. Performance is measured with reaction times (faster is better) and by counting errors (less errors is better). Hence, the extent to which a participant performs better when black faces are combined with negative words, as compared with performance when black faces are combined with negative words gives the IAT effect, or an implicit measure of white over black preference. Typically, correlations between the IAT scores and scores on (explicit) questionnaires are low but not zero, and predict other aspects of behavior (Dovidio, Kawakami and Beach, 2001; Greenwald and Nosek, 2001).

When applied to addictive behaviors, the general finding across studies has been that heavy drinkers and smokers are negative in their implicit associations: they were much faster and made less errors when words relating to alcohol (or smoking) combined with negative words than when combined with positive words. These strong negative implicit associations contrasted with their positive explicit attitudes (generally found for drinking alcohol, and sometimes for smoking). In the remainder of this chapter, three possible explanations are discussed for the robust finding that implicit attitudes for alcohol and smoking are negative, when assessed with the IAT:

1. In addictions not valence but implicit arousal associations may be most relevant (Wiers et al., 2002; 2005, see below) and they may represent a representation of a neurobiological mechanism proposed for the etiology of addictive behaviors, a sensitized psychomotor stimulant reaction after drug use, that develops with repeated use.
2. It is mainly a measurement artifact: the negative implicit associations are due to specific properties of the IAT, and are only found when the IAT is used to assess implicit associations, not when other assessment strategies are used. The IAT has been criticized for a number of measurement issues. These will be discussed in the second section. Then we will discuss different ways in which researchers have dealt with these problems within the IAT, as well as results obtained with more recently developed varieties on the IAT and other implicit measures.
3. Implicit and explicit cognitions represent different underlying cognitive motivational processes, and are influenced by different factors, and differentially influence addictive behaviors. This possibility is discussed in the third section, along with a number of conceptual issues; focusing on the central question what exactly these implicit measures assess, to what extent implicit and explicit processes can be distinguished, how the relate to emotional processes, what we know about the origins of implicit and explicit drug-related cognitions and about how to change them. In the final section, implications for social and health psychology and addiction research are discussed.
Implicit and Explicit Alcohol, Smoking and Drug-related Cognitions

Implicit Associations for Alcohol and Smoking: Initial Findings with the Implicit Association Test (IAT)

Implicit Alcohol Associations Measured with the IAT: Our First Studies

In the first study in which the IAT was used to assess implicit alcohol-related cognitions (Wiers, et al., 2002a,b), we compared the implicit associations of 24 heavy drinkers (half males) with those of 24 light drinkers (half females). Heavy drinkers consumed an average of 32 alcoholic drinks per week, and reported alcohol-related problems at levels just below those of clinical samples. When using the IAT to measure implicit associations in a certain domain, one has to make several decisions. The first concerns the choice of the target category and exemplars for which the associations are measured. In the racism example, the often used choice is “Black” vs. “White”, and as exemplars both common names for both categories have been used (e.g. Greenwald et al., 1998), as well as pictures (e.g. Cunningham et al., 2001). When adapting the IAT to study implicit alcohol associations, we decided to use soft drinks as contrast category for alcoholic drinks, since this seemed an obvious distinction, reflecting an everyday choice of drink-type. The second choice concerns the attribute categories. In the large majority of IAT research, this has been valence (positive vs. negative; or pleasurable vs. non-pleasurable), because attitudes are defined as global evaluations of an attitude object (see Greenwald and Banaji, 1995). However, when developing our “alcohol-IAT”, we decided to assess implicit alcohol-related cognitions in two dimensions: valence and arousal. This choice was made for three reasons: first, alcohol-expectancy research using multidimensional scaling has consistently found that alcohol-expectancies can be represented in a two-dimensional space, with the dimensions representing valence and arousal (Goldman et al., 1999). Further, several studies using multidimensional scaling have found that the difference between heavy and light drinkers is primarily found on the arousal dimension: heavy drinkers expect positive arousal effects and light drinkers positive sedation effects. Second, this two dimensional representation is consistent with several approaches in emotion research (e.g. Lang, 1995; Larsen and Diener, 1992) that propose the same two basic emotion dimensions (as noted by Goldman et al., 1999). This correspondence is not illogical, when one considers that an important part of the motivation to use alcohol and other drugs comes from the desire to influence one’s emotions, either to enhance positive emotions (positive reinforcement) or to alleviate negative emotions (negative reinforcement, Cooper, Frone, Russell, and Mudar, 1995; Cox and Klinger, 1988; 2002). Third, an influential recent theory in addiction from Robinson and Berridge (1993; 2003) states that an important neurobiological mechanism in the etiology of addictions concerns the development of a sensitized psychomotor stimulant reaction to the drug of abuse. Sensitization means that with repeated use, the physiological reaction becomes stronger. Note that this is the opposite of tolerance (also called “reverse tolerance”), a more widely known adaptive response related to addictive behaviors. Both processes occur: the initial psychomotor stimulant reaction to the drug sensitizes, while the later sedative response shows tolerance (see also Newlin and Thompson, 1990). Sensitization has now been demonstrated for a variety of psycho-active drugs, including alcohol, nicotine and all common hard drugs. Moreover, recently cross-sensitization has been demonstrated for a variety of drugs (sensitization of response to drug A transfers to drug B, see Schoffelmeer, De Vries, Wardeh, Van de Ven, and Vanderschuren,
2002). Since the sensitized psychomotor stimulant response develops as the addiction develops, we hypothesized that this sensitized response would be reflected in implicit alcohol-arousal associations that would have to be present in heavy drinkers who show signs of a developing addiction (as also indicated by their scores on alcohol-related problems and their level of consumption), and not in light drinkers.

The latter prediction was confirmed. Heavy drinkers were faster when they had to associate alcoholic drinks with arousal words (and sodas with sedation words) than when they had to associate alcoholic drinks with sedation words (and sodas with arousal words), \( p < .001 \), with a large effect size, \( d = .83 \), indicating that heavy drinkers hold implicit arousal associations. Light drinkers did not show a reliable difference in RTs for these two phases of the arousal-IAT \( (p > .25) \), indicating that they did not have implicit arousal associations.

On the valence-dimension, results were rather surprising: both groups were much faster in the phases where alcoholic drinks were associated with negative words (and sodas with positive words) than in the phases where alcoholic drinks were associated with positive words (and sodas with negative words). These findings indicate that both groups had strong negative implicit alcohol associations, \( (p's < .001, \text{again with large effect sizes, } d = 1.43 \text{ for light drinkers and } d = .83 \text{ for heavy drinkers}) \). As indicated by the effect sizes, heavy drinkers tended to be somewhat less negative on the valence IAT, but this difference was not significant, \( p = .18 \). Interestingly, on VAS-scales using the exact same words as used in the IAT, both groups were positive (above the midpoint of the scale) and heavy drinkers were significantly more positive than light drinkers. Hence, there was a dissociation for both groups between implicit negative associations with alcohol and explicit positive association. On the arousal dimension, there was no such dissociation: on the VAS scales, heavy drinkers also expected significantly more arousal than light drinkers. Finally, with respect to the predictive validity of the measures, the combined score of the two IATs significantly increased the prediction of retrospective alcohol use and problems and of prospective alcohol use, after controlling for age, gender and explicit measures.

In a second study (Wiers et al., 2003a; 2005), we administered the same two IATs in a large group of heavy drinking college students (92, half female). The goal of this study was to investigate the effects of a brief cognitive intervention (an “expectancy challenge”, see Darkes and Goldman, 1993; 1998; Wiers and Kummeling, 2004) on implicit and explicit alcohol-related cognitions and on drinking behavior. Participants were randomly assigned to the brief intervention or to a control alcohol experiment in the same bar-lab. One week before and one week after the intervention, their implicit alcohol associations were assessed (alcohol-valence IAT and alcohol-arousal IAT). The main finding relevant here, was that we replicated the IAT-effects described above: these heavy drinkers showed implicit arousal associations and implicit negative associations with alcohol. Further, analyses of the control-group showed that the test-retest reliabilities were adequate (.66 for the Valence-IAT and .72 for the Arousal-IAT), and that the intervention changed explicit arousal expectancies, in the absence of a reliable effect on the implicit alcohol associations (for a further discussion of this dissociation in effect of the intervention on the implicit and explicit measures, see Wiers, De Jong, Havermans and Jelicic, 2004; Wiers et al., 2005).

A recent study by researchers from a different lab in a different country replicated both findings using both IAT in a clinical sample (De Houwer, Crombez, Koster and De Beul, 2004): alcohol dependent patients also demonstrated negative implicit alcohol associations and implicit arousal associations. Hence, the findings seem to be robust, but what do they
mean? Are heavy drinkers “really” negative about alcohol, even though they explicitly state that they are positive? Do they have a “dual attitude” (Wilson et al., 2000)? Before turning to a discussion of the IAT and findings with other related measures, we first consider IAT-findings for smoking.

Implicit Smoking Associations, Measured with the IAT

In the first study to apply the IAT to addictive behaviors, Swanson, Rudman and Greenwald (2001) used a variety of contrast-categories to contrast with smoking: sweets or exercise (positive contrast); stealing (negative contrast), and non-smoking (neutral contrast). With the first contrast, smokers and non-smokers showed strong negative implicit associations, with no difference between the groups ($p = .37$). When smoking was compared with a behavior that is more negatively stereotyped (stealing), both groups showed positive associations with smoking, the difference between smokers and non-smokers was again not significant (smokers were slightly more positive, $p = .13$). On the “empty” contrast IAT (that used pictures containing smoking elements or not, we use the word “empty” to distinguish it from a neutral other category), again both groups showed negative implicit associations with smoking, but now the difference between smokers and non-smokers became significant ($p = .008$), with smokers being less negative than non-smokers. Hence, the use of pictures and an “empty” contrast category seemed optimal to find differences in implicit attitudes between smokers and non-smokers. This contrasted somewhat with a study by Huijding and colleagues (Huijding, De Jong, Wiers and Verkooijen, 2005), who found a larger difference between smokers and non-smokers for a positive contrast category (exercise) than for a neutral contrast category (reading and writing). On both versions, smokers and non-smokers had negative implicit attitudes, and smokers were significantly less negative than non-smokers. In a recent study, Sherman and colleagues (Sherman, Presson, Chassin, Rose, and Koch, 2003, Study 2) compared light and heavy smokers’ IAT scores after mild deprivation of cigarettes (4 hours) or after recent smoking, contrasting pictures highlighting the sensory aspects of smoking with pictures of either normatively positive pictures (babies, cuddly animals) or normatively negative animals (bugs). A significant smoker-type x state interaction was found, indicating that light smokers were negative in both conditions, and that heavy smokers were negative in the recent exposure condition and slightly positive in the deprivation condition. In a study comparing smoking IAT (with a neutral contrast category: writing) scores in a smoking vs. neutral environment, Huijding and colleagues (Huijding, et al., 2005), recently found negative IAT scores in smokers in both conditions (no significant difference). Finally, Rudman and Heppen (2003, see Rudman, 2004) found negative implicit attitudes for smokers, with the non-smoking empty contrast category. In a second experiment, they showed that negative priming (reading an article on the tragic effects of smoking on loved ones) made smokers’ implicit (but not explicit) attitude for smoking more negative. In summary, implicit smoking attitudes as measured with the IAT depend to some extent on the contrast target category used. When using a neutral target category or an “empty” target category (non-smoking pictures), smokers and non-smokers are both negative, and smokers are less negative than non-smokers. When a positive target-category is used, the difference between smokers and non-smokers sometimes becomes smaller and often non-significant. Further, smokers’ implicit negative associations have been shown to be malleable, perhaps not by smoking context (at least not in our study, Huijding et al., 2005, but we did not use an
IAT focusing on the sensory aspects), but in deprived heavy smokers the negative implicit attitudes are no longer found (Sherman et al., 2003). Further, negative affective priming makes the implicit attitudes even more negative (Rudman and Heppen, 2003; Rudman, 2004). One recent study tested other affective dimensions in smoking (Houben et al., submitted) and found negative and relaxation associations.

When the IAT results for smoking are compared with our results for alcohol, it is remarkable that in both cases the implicit associations found are predominantly negative, with those of non-smokers or light drinkers being somewhat more negative than those of smokers or heavy drinkers. Further, these negative implicit attitudes contrast with the explicit positive attitudes, that are generally found for drinking (with heavy drinkers reporting more positive attitudes than light drinkers), and that are sometimes found in smokers (e.g. Rudman and Heppen, 2003). What does it mean that smokers and drinkers are negative negative about smoking and drinking on implicit measures, while scoring (more) positive on explicit measures? The smoking studies demonstrate that the effect-size for the difference between smokers and non-smokers depends on the contrast target category used. Therefore, one interpretation of our results on the alcohol valence-IAT is that the negative alcohol-associations are due to positive associations people have with sodas, and that a difference between heavy and light drinkers on implicit attitudes would become stronger when a neutral contrast category was used (see section 2.2). Further, using pictures that highlight the sensory aspects of the drug may elicit more positive associations too. Other potential confounds related to the IAT method are discussed next, before we turn to findings with other versions of the IAT and related tests and to further interpretations of possible dissociations between implicit and explicit measures.

**MEASUREMENT ISSUES**

**General Issues Concerning the Measurement of Implicit Associations with the IAT**

The past few years, there has not only been an explosion in IAT-research, but also a growing criticism of the measure, accompanied by the development of alternative measures to assess implicit associations. Four influential criticisms are briefly described and related to the addiction-related IAT studies discussed previously.

**Environmental Associations Account**

Karpinsky and Hilton (2001) assessed a candy bar-apples IAT and found that participants were much faster when combining apples with positive words and candy-bars with negative words than vice versa, hence they showed an implicit preference for apples. The IAT scores did not correlate with the explicit measures, which showed an approximately equal distribution of people reporting preferences for apples and candy bars. Most concerning was the finding that IAT-scores did not predict behavior (the actual choice of an apple or candy bar after the experiment), while the explicit measures did. From their results, the authors concluded that the IAT may primarily pick up environmental associations, or a “general opinion” about an object (“apples are good for you”, “candy bars are bad for you”), and not
personal attitudes. Hence, the negative implicit attitudes for smoking and drinking alcohol could simply reflect the negative general opinion about these behaviors.

The environmental association account may help to understand the negative attitudes generally found for smoking, but the statement seems too strong that the IAT only picks up society’s general attitude. In relation to addictive behaviors, this account does not explain that implicit associations as measured with the IAT differentiate smokers from non-smokers when an empty or neutral contrast category is used (Rudman, in press; Swanson et al., 2001; Verkooijen and De Jong, 2002), and that IAT scores are related to deprivation state (Sherman et al., 2003). Further, the alcohol arousal-IAT has been found to differentiate heavy from light drinkers and to predict retrospective as well as prospective drinking behavior, after controlling for age, gender and explicit measures (Wiers et al., 2002b). Hence, the conclusion that the IAT only picks up environmental associations seems too strong. On the other hand, part of the generally large IAT-effect does probably represent society’s general negative attitudes toward addictive behaviors rather than an individual’s attitudes, and the negative implicit associations for alcohol and smoking found with the IAT could be a case in point (see further De Houwer, 2001; 2002).

From an environmental association account, one could argue that the differences found between smokers and non-smokers, or between heavy and light drinkers are related to the more positive general opinions in different micro-environments or subcultures. However, this microenvironmen will be part of all possible variables in which users differ from non-users (or heavy users differ from light users), that are likely to be largely determined by interactions between person-related variables (e.g. genetic factors) and unique experiences of an individual related to substance use, that are thought to be represented in memory (e.g. Goldman, 1999; Stacy, 1997; Wiers, 1999). If the IAT picks up these relevant differences between these subgroups with predictive value, it seems unconvincing to argue that the IAT only picks up the general opinion of a culture.

“Label-effect”

De Houwer (2001) demonstrated with an elegant experiment that the IAT primarily measures implicit attitudes at the category level, and not at the level of the exemplars that are presented. He tested British participants on an IAT comparing “British” with “Foreign” targets. Unlike most IATs, he varied the valence of exemplars so that some of the “British” exemplars were positive (e.g. Diana) and some were negative (e.g. a recently convicted mass murderer), and the same was done for the “Foreigners” (e.g. Gandhi and Hitler). As expected, there was an overall IAT effect, indicating that participants find it easier to respond to the combinations “positive” - “British” and “negative” – “Foreign” than vice versa, representing a country-men bias effect. Most interestingly, no difference in RT was found between positive and negative exemplars of both categories, despite the large differences in (explicit) liking of the exemplars used. Hence, the IAT results suggested that people prefer countrymen over foreigners, even in case of a very negative countryman (a mass-murderer) and a much-liked foreigner (Gandhi). Perhaps the result reported by Greenwald et al. (1998) that the number of exemplars used does not make much of a difference for the implicit attitude as measured with the IAT, can be interpreted in the same vein: if the IAT primarily measures associations at the category level, it is not surprising that the number of exemplars makes little difference. A recent experiment by Olson and Fazio (2004) also indicates that the IAT primarily assesses implicit attitudes at the level of the category: race-IAT scores correlated
significantly with a priming measure when participants had to categorize exemplars (count faces from different races) and not when no instruction was given that encourages categorization. However, the conclusion that exemplars do not matter has to be qualified. Some recent research shows that the choice of the exemplars can influence the IAT-effect, when exemplars of one type are chosen (e.g. only positive vs. only negative), which are more specifically related to the target-objects measured. For example, when one assesses an implicit gender bias with an IAT, the IAT effect differs when one uses gender-neutral positive and negative words, or when one uses gender-biased positive and negative words (e.g. positive female-linked words such as “intuitive” vs. negative male-linked words such as “brutal” or vice versa, Steffens and Plewe, 2001; in De Houwer, 2002). Further, a recent series of experiments by Mitchell, Nosek and Banaji (2003) indicate that both the category and the exemplar level are important, and that most likely implicit attitudes are dynamic in the sense that they are construed on the spot from long term memory, under the influence of contextual factors, including exemplars and situational variables (e.g. task instruction).

What does this mean for the study of implicit associations for alcohol, cigarettes, and other drugs? First, it suggests that exemplars are less critical in the IAT than one might expect. From the studies cited above, one can tentatively conclude that the IAT primarily assesses associations at the level of the category (although this does not mean that they may not be influenced by measurement context and choice of exemplars). Depending on the research question, this may be more or less beneficial. For example, a researcher may be interested in attitudes about smoking in general or about more specific attitudes about a particular brand of cigarettes or about more specific smoking-related associations (e.g. tension reduction). It is not evident beforehand whether one should prefer to use a test that is most sensitive at the level of the category or a test that is most sensitive at the level of the exemplars. For example, a wrong choice of exemplars for an individual (e.g. pictures of beer-brands for a wine drinker who does not like beer) is likely to have a stronger influence when using an exemplar-sensitive test, then when using a test that is primarily sensitive to the category-level, such as the IAT. Second, the category label used may be very important. It is possible that the label “alcohol” that we used in previous studies (Wiers et al., 2002b; 2003a) enhanced the influence of society’s attitudes on the IAT scores: in the Netherlands, anti-alcohol advertising typically uses the word “alcohol” in combination with undesirable effects (“alcohol kills what you love”), whereas the alcohol-industry focusses on specific brand-names in combination with positive words (“*** beer goes well with every pleasure”). Hence the word “alcohol” may have pushed the general mean on the attitude-IAT to the negative side, similar to smoking. Still, these accounts do not explain away the implicit alcohol-arousal association we and others found in heavy drinkers and alcoholics (De Houwer et al., 2003; Wiers et al., 2002b, 2003; 2005). However, a recent study testing this hypothesis found that when “Beer” was used as a category label rather than “alcohol”, the strongest associations were still with negative valence, and this did not differ for a soda contrast category or an animals contrast category (Houben and Wiers, in press-a). Third, even though the IAT primarily assesses associations at the level of the category, the choice of exemplars may influence results, and in clinical research it may be beneficial to use personalized exemplars (for an example in alcohol research, see Cox, Hogan, Kristian and Race, 2002). Further, when the IAT is personalized, the IAT scores for apples and candy-bars better correlate with explicit preferences (Olson and Fazio, 2004). Recent studies applying varieties of the personalized IAT to alcohol (Houben and Wiers, submitted) and smoking (De Houwer,
Custers and De Clercq, in press) demonstrate more positive alcohol associations. One concern, however, is that the personalized IAT generates much slower reaction times, which brings the implicit nature of the test into question (see below).

**Figure-Ground Account**

Rothermund and Wentura (2004) demonstrated that the IAT may reflect salience of concepts rather than associations between concepts. In an impressive series of experiments, the authors demonstrated that predictable IAT effects can be obtained in the absence of associations, due to Figure Ground asymmetries. The reasoning is that participants choose a the most salient category is likely to be chosen as the “YES” (or Figure) category and the other category as the (back)ground category, both for the target and for the attribute categories. They demonstrated that unfamiliar and negative categories are most salient and most likely to be chosen as the “YES” category. They did this with an independent visual search reaction time task. Although these results demonstrated that IAT effect can be influenced and even elicited by figure-ground processes, this does not mean that all IAT-effects are due to these processes (De Houwer, 2002; Rothermund and Wentura, 2004).

Applied to the results with alcohol and cigarettes, there is a possibility that the negative implicit associations generally found for both substances are due figure ground processes, when one assumes that the substance and negative categories are most salient. In two recent studies Houben and Wiers (in press-a,b) showed that Figure-Ground effects partly but not fully explain the robust negative associations found in the alcohol IATs, nor the alcohol-arousal associations (Houben and Wiers, in press-a). Moreover, one could assume that only for heavy drinkers “arousal” and “alcohol” are salient categories and not for light drinkers, but that is what would be predicted from the idea that with increased drinking implicit alcohol-arousal associations develop as a result of a sensitized psychomotor stimulant reaction to alcohol (Wiers et al., 2002b). This reinterpretation of results does raise the question to what extent implicit arousal associations assess the same underlying construct as measures of attentional bias (cf. Wiers et al., 2006).

**Associations between Bipolar Targets and Bipolar Attributes**

As indicated earlier, the IAT measures the difference in response time between pairs of associations in a 2 x 2 matrix: category 1 – attribute 1 and category 2 – attribute 2 with category 1 – attribute 2 and category 2 – attribute 1. This design has two potential problems. The first is that an IAT effect can be explained by the pair of associations other than the investigator has in mind. For example, the results with the alcohol-arousal IAT have been interpreted as indicating that heavy drinkers have alcohol-arousal associations (De Houwer et al., 2004; Wiers et al., 2002b; 2005). However, one could argue that the IAT effect indicates that they have strong soda-sedation association. Unlikely as it may be, one cannot rule out this alternative explanation. In addition, from the IAT smoking research, it has become evident that the choice of the contrast target category matters (just as it does from the Figure-Ground account).

The second problem of the IAT’s 2 x 2 design is that not only the target, but also the attribute dimension is bipolar. This may be problematic, because people may have both positive and negative associations with substances (as will be discussed in section 3, a similar argument has been made in emotion research). Accordingly, it is possible that heavy drinkers have both arousal and sedation associations, and that the alcohol arousal-associations found in
heavy drinkers (De Houwer et al., 2003; Wiers et al., 2002b; 2003a) reflect stronger or more salient arousal associations than sedation associations. From these two considerations, it may be useful to use or develop tests that assess implicit associations in a unipolar rather than a bipolar fashion, both with respect to the target categories (drinks, smoking, other drugs) and with respect to the attribute dimensions (positive and negative and arousal and sedation and other potentially interesting dimensions).

A third potential problem is that associations are bidirectional, which makes them different from beliefs (De Houwer, 2002). For example, the association between “alcohol” and “negative”, can mean that alcohol is associated with negative outcomes, or that negative feelings are associated with drinking alcohol (e.g. a tension-reduction), or both (see Wiers et al., 2006). With some other techniques such as semantic priming (discussed below), one can make this distinction.

Recent Findings With Other Versions of the IAT and the EAST

One way to deal with the bipolarity issues, is within the design of the IAT used. As indicated above, in studies comparing different versions of a smoking IAT, a neutral or empty (“non-smoking”) contrast category has been used. Relatedly, Wigboldus, Holland, and van Knippenberg (2006) recently designed a single target IAT (stIAT) to deal with this problem. Using such a unipolar stIAT in the context of smoking we recently found positive implicit affective associations with pictorial smoking stimuli in habitual smokers rather than negative attitudes as was repeatedly found in previous studies using the conventional IAT (Huijding and de Jong, 2006). Clearly, this finding adds to the idea that the contrast category that is required in the conventional IAT may have an undesirable influence when measuring the implicit evaluation of unipolar concepts that have no immanent meaningful contrast such as smoking, and suggest that the stIAT might be a welcome alternative in these instances (but of course also in this design, the attitude dimension remains bipolar). In a recent study, Jajodia and Earleywine (2003) assessed positive and negative alcohol associations separately, while using a neutral contrast category (mammals), and in the first combination phase of the IAT, “alcohol” and “mammals” were coupled with “positive” and (matched) “neutral” adjectives and in the next combination phase the adjectives were reversed. The difference in RT between these two combined phases now gives an index of implicit alcohol-positive associations, independent from alcohol-negative associations. After completing the positive alcohol IAT, participants performed a similar negative alcohol IAT (again alcohol vs. mammals, combined with negative or matched neutral adjectives in two combinations). Interestingly, the authors found that participants (college students ranging from abstainers to heavy drinkers) demonstrated implicit positive alcohol associations and implicit negative alcohol associations. Further, only the positive alcohol associations correlated with drinking measures and increased prediction of retrospective alcohol use above prediction by gender and explicit measures. Unfortunately, the latter result is somewhat difficult to interpret. The reason is that the positive alcohol-IAT always came before the negative alcohol-IAT (fixed-order design and IAT effects decrease markedly over time, see Wiers et al., 2005).

A recent study by Houben and Wiers (in press-a) replicated and extended these results. Four unipolar IATs were administered in balanced order (positive, negative, arousal and sedation associations all compared with different neutral categories). The pattern of results was in line with our earlier findings using bipolar IATs: the strongest associations were with
negative valence, followed by arousal and positive associations, followed by sedation associations. Only arousal-associations significantly predicted alcohol use, and both arousal and sedation associations predicted alcohol-related problems.

In another recent study assessing implicit alcohol associations with an IAT, Palfai and Ostafin (2003) also used a neutral contrast category (electricity). As attribute categories, they used approach-avoidance, rather than positive-negative or arousal-sedation. This is a conceptually interesting variation, because it is linked to the idea that the motivational process underlying use of alcohol (and other substances) is a conditioned appetitive response (e.g. Baker, Morse, and Sherman, 1987). From this perspective, the implicit associations reflect an alcohol-specific approach tendency (the theoretical background is closely related to our inclusion of the arousal associations, but a different operationalization is used, see further below). The authors found that the implicit alcohol-approach associations were correlated with quantity of drinks per occasion (not with frequency) and with the reported number of binges during the past month. After the IAT, the participants (hazardous drinkers) participated in a cue-exposure experiment. Interestingly, the implicit alcohol-approach associations correlated with urge and arousal-reactivity during cue-exposure, in the absence of such correlations during baseline. This suggests that implicit alcohol-approach associations may index the strength of appetitive responses to alcohol in memory and that these are related to the actual appetitive responses to alcohol. To the extent that appetitive responses are positive, these results also further fuel the idea that the negative implicit associations found with the alcohol-soda IAT were related to measurement issues related to the IAT, discussed above.

De Houwer et al. (2004), assessed alcoholics’ implicit alcohol valence associations with a version of the Extrinsic Affective Simon Task or EAST (De Houwer, 2003), and also with the valence and arousal IAT discussed above. In the EAST, participants learn to associate one response with “positive” and one response with “negative” and then classify exemplars on a dimension that is irrelevant to the valence response (e.g. color or orientation). In the alcohol EAST by De Houwer et al. (2003), participants first learn to associate one response button with positive words and another response button with negative words (words presented in white font). In the second phase of the test, they learn to classify words on the basis of a meaning-irrelevant characteristic, here color (e.g. blue word press left, green word press right). In the third critical phase, target words (here alcoholic drinks and sodas) are presented in both colors and are mixed with white words that reaffirm the valence of the two response buttons. With this test, one can assess whether a target word (e.g. beer or coke) is faster responded to in blue (positive side) or in green (negative side). They found that participants were significantly more accurate in positive than in negative responses to sodas, with no significant difference for alcoholic drinks. The results on the IATs largely replicated our earlier findings with heavy drinkers: negative implicit alcohol associations and implicit arousal associations.

In a recent experiment, De Jong, Wiers, and Van de Braak (2003) compared the implicit attitudes in light and heavy drinkers as assessed with the alcohol-soda valence IAT with a different version of the EAST. In this version, the irrelevant feature was that a superordinate category was used for classification: participants had to categorize stimuli into “solids” vs. “fluids”, on buttons that had been associated with “positive” and “negative” adjectives (we only tested valence in that study, because we were primarily interested in to find out to what extent the negative implicit associations found earlier were due to specific characteristics of the IAT). Within the category of “fluids” there were alcoholic and non-alcoholic drinks that
could now be compared with respect to performance on the positive and on the negative side. In contrast to the IAT, where we replicated strong negative alcohol associations for heavy and light drinkers, the EAST indicated that all participants had positive implicit associations with sodas, in the absence of an implicit valence effect for alcohol (or: implicit positive and negative associations were equally strong). However, relatively positive implicit alcohol associations as measured with the EAST (and not with the standard IAT) correlated significantly with alcohol-related problems and retrospective alcohol use.

In another recent study (Wiers, Ganushchak, Van de Ende, Smulders and De Jong, 2003b) we compared scores of heavy and light drinkers on the arousal and valence IAT, on three varieties of the EAST: a valence EAST, similar to the one described above, an arousal-sedation EAST, in which the two response buttons were first associated with arousal or sedation words, and an alcohol-soda EAST, in which the two response buttons were first associated with alcohol and soda. (Note that with the latter version the alcohol-soda bipolarity returns, with associated potential problems discussed earlier. However, the potential advantage of this measure is that a whole number of potentially interesting dimensions can be assessed in a single test). Preliminary results on the Valence EAST indicated that there were no reliable differences in performance on the positive and negative side, which could reflect about equally strong positive and negative associations. On the arousal-EAST, heavy drinkers made less errors for alcoholic drinks on the arousal side than on the sedation side, in the absence of reliable differences in light drinkers. Results of the alcohol-soda EAST were particularly interesting with respect to the arousal dimension: heavy drinking males showed significant alcohol-arousal and significant alcohol-sedation associations. Again, no reliable differences were found for either positive or negative implicit associations (that were assessed separately in this version of the EAST).

Taken together, these recent and sometimes still preliminary results of recent variations of the IAT and the EAST indicate that part of the negative implicit associations for alcohol may well be due to specific characteristics of the IAT, as discussed above: light and heavy drinkers are more negative about alcohol than about soda. Recent studies indicated that this reliable finding is partly, but not fully explained by alternative theoretical accounts such as Figure-Ground effects. However, results with varieties of the EAST by no means indicate that heavy drinkers are positive about alcohol, generally no difference is found between responses on the positive and on the negative side. This could mean that they are ambivalent, and hold both positive and negative associations, in accordance with the IAT results in which positive and negative associations were assessed separately (Houben and Wiers, in press-a,b; Jajodia and Earleywine, 2003). Further, results across different tests underscore the idea that other dimensions than valence alone may be important in relation to the assessment of implicit associations with alcohol or other drugs: arousal (Wiers et al., 2002b; 2003b: 2005) or approach (Palfai and Ostafin, 2003). Our preliminary results with the alcohol soda-EAST also indicate that it may be useful to also assess arousal and sedation in a unipolar rather than a bipolar fashion: heavy drinkers may hold both associations (see also Houben and Wiers, in press-a; Stewart, Hall, Wilkie and Birch, 2002).

Recent Findings with Other Tests of Implicit Associations

The IAT is one of the instruments developed to assess implicit associations. As indicated above, recently some other instruments have been developed to address some of the potential
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limitations of the IAT, such as the EAST, (De Houwer, 2003). One other variation on the IAT is the Go/No-go Association Task (GNAT: Nosek and Banaji, 2001). A potential advantage of the GNAT is that it measures single associations between one target concept and one attribute concept, rather than relative category-attribute associations. Preliminary data assessed with a palm-top version of the GNAT demonstrated that smokers had more positive implicit attitudes towards smoking than did nonsmokers (Dabbs, Bassett, Brower, Cate, DeSantis and Leander, 2003). Other studies assessing implicit associations for alcohol, smoking or drugs, can be categorized into four categories: those using semantic priming, those using evaluative priming, those using memory accessibility techniques, and those using other memory-techniques.

**Semantic Priming**

In semantic priming tasks, a prime word is briefly presented before a target word, which has to be processed by the participant to generate a response (often a lexical decision, such as word or non-word). The prime presentation can be very brief (subliminal priming) or brief enough to increase the likelihood of automatic processing but long enough to reach conscious awareness (usually between 250 and 750 ms). In the analyses, it is investigated whether the processing of the second word was influenced by the prime, which is interpreted as indicating a (unidirectional) association between prime and target. Whether this influence is a faster or a slower response to the target-word depends on the nature of the task for which the target word is used: in a lexical decision task (word/non-word) typically faster responses are found when two concepts are assumed to be related (Zack, Toneato and McCloud, 1999), whereas in the primed Stroop task a slower response is found (Stewart et al., 2002), which is thought to be due to the difficulty to disengage attention from the semantic contents of relevant words to the required (color) response.

Kramer and Goldman (2003) used alcoholic drinks and non-alcoholic drinks as primes and words from four categories as targets: negative words, positive-arousal words, sedation words and words from an irrelevant category (furniture). Task of the participants was to indicate the color of the target word (primed Stroop test). They found that heavy drinkers were significantly slower on positive arousal words and that light drinkers were significantly slower on sedation words, when paired with alcoholic drinks in comparison with non-alcoholic drinks. One difficulty in the interpretation of this study is that the primes were presented for an unusually long duration (2 seconds) and participants were instructed to memorize the prime, which may have triggered controlled rather than automatic processes. However, implicit and explicit measures were not correlated, and implicit measures increased the prediction of (retrospective) alcohol use, above prediction of the explicit measures (which were stronger predictors of drinking).

In two conceptually related studies, Zack et al. (1999) and Stewart et al. (2002) tested implicit associations of two types of drinkers: those drinking for positive reinforcement (enhance positive affect) and those drinking for negative reinforcement (diminish negative affect, or “drinking to cope”, see also Cooper et al., 1995). Stewart et al. (2002) selected social drinkers scoring either high on coping motives (CM) or scoring high on enhancement motives (EM). The primed Stroop test used consisted of three types of primes: positive affect words, negative affect words, and neutral words (house-related nouns). Targets were alcoholic drinks or neutral words (clothes). As expected, CM-drinkers were slower to mention the color of an alcoholic target word than a neutral target word when it was preceded by a
negative mood word. This difference was not found for EM-drinkers. Also in accordance with
the hypotheses, EM-drinkers were slower to color-name alcoholic target words than neutral
target words when they were preceded by a positive affect word. Unexpectedly, CM-drinkers
showed the same priming effect for positive affect words. If proven valid, this finding could
indicate that all drinkers first learn to associate alcohol with positive mood states (typical of
the school-parties where many have their first drinks, Goldman et al., 1987), and that later on
a subgroup of drinkers learns to associate negative mood states with drinking alcohol and
develops coping-related motives, but future longitudinal research should critically test this
idea.

Zack et al. (1999) tested problem drinkers with high or low scores on psychiatric distress
(a high score on at least one of four anxiety-related subscales of the SCL-90), using a
semantic priming task involving a lexical decision task for the target-words (words vs. non-
words). They compared reaction times for negative affective words followed by alcohol-
related words (NEG > ALC), as well as the opposite combination (ALC > NEG) and both
were compared with control conditions (neutral words followed by alcohol-related words and
neutral words followed by negative words). Problem drinkers with high psychiatric distress
were faster on alcohol-related targets preceded by negative as compared with neutral primes,
and a trend in the opposite direction was found for low psychiatric distress problem drinkers
(inhibition of response by negative affect words). The opposite alcohol-negative affect
association was also found in problem drinkers with high psychiatric distress: they were
significantly faster on negative words when preceded by alcohol-related words as compared
with neutral words, and problem drinkers with low psychiatric distress were significantly
slower in this condition. The bidirectional associations between alcohol and negative affect
found in anxious problem drinkers correlated with the intensity of psychiatric distress, self-
reported bias to drink in negative affect states and confidence to avoid drinking in these
states. A recent study by Zack and colleagues (2003) found that negative mood primed
alcohol targets in university freshmen, both in participants scoring high and in participants
scoring low on anxiety sensitivity, which may suggest that it is to some extent a general
acculturated idea that drinking alcohol follows being in a bad mood. Interestingly, in women
but not in men, these primed responses predicted self-reported drinking in bad moods,
suggesting that in women this association is more related to their own behavior.

Taken together, these findings with different techniques underscore the relevance of the
arousal dimension in problem drinking (Kramer and Goldman, 2003), and the work of
Stewart et al. (2002) and Zack et al. (1999; 2002; 2003) indicates that it may be useful to
differentiate between different subtypes of problem drinkers, when assessing implicit
cognitions. It is an interesting question to what extent this also applies to smoking and other
drug-use, and how the implicit arousal associations relate to the implicit tension-reduction
associations: can people expect to become relaxed and aroused from using alcohol or other
substances at the same time? Or do different subgroups of problem drinkers have different
and opposing associations, that could be related to different phases of the blood-alcohol curve
(see Dunn and Earleywine, 2001)? One intriguing recent finding was that implicit arousal
associations correlated positively with explicit measures of tension reduction (Wiers et al.,
2005). In any case, these results underscore the importance of assessing affective dimension
in a unipolar rather than a bipolar fashion (participants may have both positive and negative
and arousal and sedation associations). The results of Zack et al. (1999) suggest that the
alcohol-negative affect association is bidirectional (in the IAT and related tests this cannot be
determined). For other implicit associations discussed earlier, this still needs to be examined. Finally, with respect to other drugs of abuse, Weinstein and colleagues (2000) tested semantic priming in opiate dependent patients and controls, and found that those patients who were expecting methadone after a weekend of abstinence were faster in recognizing drug-related words following sentences describing withdrawal, but not after sentences describing craving. These findings were interpreted in terms of personal concerns of the patients (cf. Cox et al., 2002). For an overview of other recent work on implicit cognition in other drugs, see Ames, Franken, and Coronges, 2006).

**Evaluative Priming**

In an evaluative priming task, participants have to make an evaluative judgment (usually decide whether the target word is positive or negative, see Fazio, 2001, for an overview). It is investigated whether this judgment is made faster after primes of interest (e.g. alcoholic drinks or smoking-related words) as compared with neutral words. Hence, the crucial manipulation concerns different combinations of the valence of primes and targets (in this approach only valence is tested as emotional dimension). Palfai and Ostafin (2003) compared reaction times to positive and negative words of hazardous drinkers after exposure to alcohol-related or neutral prime-words. The test was done in four conditions: before and after consumption of alcohol (beer) or placebo. In the alcohol but not in the placebo condition, the gain in reaction times was larger for positive words than for negative words, suggesting that drinking alcohol facilitates the activation of positive outcomes more than negative outcomes, at least shortly after drinking alcohol (10 minutes). When these results are combined with those discussed earlier, it appears that substance users most likely hold both positive and negative substance-related associations and that the psychopharmacological effects of the drug may serve as an internal memory context that further increases the accessibility of the positive relative to the negative associations. Payne and colleagues (2005) developed a more reliable variety of the evaluative priming procedure, the affect misattribution procedure (AMP). With a version adapted for assessing alcohol associations, Payne and colleagues (submitted) found that automatic positive reactions to alcohol predicted alcohol use.

**Timed Memory Accessibility Measures**

These measures are relatively closely related to questionnaire measures of expectancies, with the main difference being that the expected outcomes are assessed in a reaction time test, where the reaction time of response represents the measure of accessibility. Participants first see one of two prompts, e.g. “Alcohol makes me” or “I am generally”, followed by either a positive alcohol-expectancy word or another personality trait (Palfai, Monti, Colby and Rohsenow, 1997). In case of smoking an example is “smoking makes me” vs. “TV makes me”, followed by positive smoking expectancy words or filler words (Palfai, 2002). Participants have to answer the question (e.g. “Smoking makes me” ---- “less anxious”) as quickly as possible by pressing a yes or a no-button. This procedure is based on the attitude accessibility paradigm developed by Fazio and Williams (1986).

With respect to alcohol expectancies, Palfai et al. (1997) found that the instruction to suppress the urge to drink alcohol, made alcohol expectancies more accessible, in line with Wegner’s (1994) theory of rebound effects from suppression (no differentiation was made between types of expectancies). In a study using the same measure, nicotine deprived hazardous drinkers responded faster to alcohol-expectancy items than non-nicotine deprived
hazardous drinkers, which correlated with urge to drink during a smoking cue-exposure procedure and with alcohol consumption in a taste test after this procedure (Palfai, Monti, Ostatin, and Hutchison, 2000). This interesting study suggests that a manipulation that increases the incentive salience of one drug also increases the incentive salience of a second drug, that is associated in memory. This is in line with incentive salience and incentive sensitization theories of addiction (e.g. Baker et al., 1987; Robinson and Berridge, 1993; 2003). We return to this issue in the next section. Finally, with respect to smoking, Palfai (2002) found that performance on the smoking-memory accessibility measure correlated significantly with smoking, after controlling for explicit measures.

Other Implicit Memory Tests

Stacy and colleagues developed a whole range of implicit memory tests in the form of paper and pencil tests asking for first associations. An advantage of this type of test is that it can be used more easily in classroom settings, with large numbers of participants. In addition to this, an advantage may be that personal associations are used, rather than the same associations for everybody. However, it may be easier for participants to censor their associations (for a further discussion of these issues, see Stacy, Ames and Grenard, 2006). Further, this approach has been used to test implicit associations for a wide variety of drugs other than alcohol and cigarettes (e.g. Stacy, Gajaif, Sussman and Dent, 1996). In a seminal study, Stacy (1997) assessed word, outcome, and object associations. In all of the tests, participants were asked to write down the first associations that came to their mind. The word association test consisted of first associations to homographs, that could be related to alcohol (e.g. draft), to marihuana (e.g. pot), or to neither (fillers). In the outcome association task, describes a number of potential outcomes from various behaviors that could be related to alcohol-or drug-use (e.g. “relaxation”) or that were filler-outcomes. The object association task presented participants with 24 ambiguous pictures, related to alcohol, marihuana or filler-scenes. In all implicit memory tests, alcohol- or marihuana-related first associations are scored. Prospective use of alcohol was best predicted by implicit memory measures, and remained a significant predictor after controlling for previous use, explicit alcohol-expectancies, and sensation seeking. For marihuana, implicit memory activation was the only variable that predicted prospective use, after controlling for previous use.

These findings, as well as later work in this tradition (e.g. Ames and Stacy, 1998; for recent reviews see Stacy and Ames, 2001; Stacy, Ames, and Knowlton, 2004; Stacy et al., 2006), may best be seen as a strong case for the existence of an implicit memory bias, that has predictive value above explicit measures of expectancies and other measures. The approach has not yet focused much on specific memory associations, such as the alcohol-arousal, alcohol-approach or the negative mood-alcohol associations described earlier, but there seems to be no principled reason why this could not be done. When used as a general measure of an implicit memory-bias, the construct comes close to studies of a drug-related attentional bias. In those studies, it is investigated whether substance abusers have an attentional bias for stimuli related to their preferred drug. This can be measured with an (unprimed) “emotional” Stroop test (e.g. Cox et al., 2002), with a dot-probe task (e.g. Bradley, Mogg, Wright, and Field, 2003), or with other tasks such as an adapted change-blindness paradigm (e.g. Jones, Jones, Blundell, and Bruce, 2002). Findings regarding drug-related attentional biases are beyond the scope of this chapter, because they do not measure implicit associations with alcohol, smoking or other drugs. However, it remains an interesting question how these
phomena are related (see Wiers, De Jong, Havermans and Jelicic, 2004), which awaits further empirical investigation.

Another set of studies that should be briefly mentioned, are studies that prime alcohol expectancies, and investigate effects on subsequent drinking behaviour (e.g. Roehrich and Goldman, 1995; Stein, Goldman and DelBoca, 2000). In these studies alcohol-expectancies are primed in memory (e.g. by an emotional Stroop-test in which either various positive alcohol-expectancy words or neutral words are used), and this procedure is followed by a seemingly unrelated taste-session, in which participants who were previously primed with alcohol-expectancy words, were found to drink more than those who were primed with neutral words. Although these studies are interesting in the broader picture of memory models related to alcohol-use, no specific associations are measured (or primed).

How Implicit are these Measures?

Importantly, the word “implicit” can refer to different things (see for an excellent discussion of this issue De Houwer, 2006). First, “implicit” refers to the measurement method, which is indirect: one does not ask participants to introspect upon reasons for behaviors or attitudes, but infers them from task performance. Second, the word implicit refers to the outcome of the measurement process, where the idea is that the implicit (indirect) measure assess something more automatic and more outside awareness of the participant that explicit measures. The latter claims await further empirical support (see De Houwer, 2006).

When one considers the different measures discussed to assess implicit associations with alcohol, smoking or drugs, they can be represented as falling on a continuum, between more implicit and more explicit measures (cf. Jacoby, 1991). For example, the timed memory accessibility measures are not very implicit in the sense of measuring something outside awareness of the participants (participants basically answer the same question as in a questionnaire, but now on a computer in a speeded fashion). For these measures one could expect higher correlations with the related explicit measures (however, the more typical low correlations have been reported). Further, the implicit measures predicted incremental variance in substance use above questionnaire measures, suggesting they at least partly assess something else. Similarly, one might think that the timed memory accessibility as well as the other implicit memory tests described could perhaps be more easily controlled (or faked) by the participants than some of the more indirect tests such as the IAT (see Greenwald and Nosek, 2001), which could make them less suitable for behaviours that are disliked by society (e.g. illegal drug use). However, the opposite was found: for marihuana use implicit memory measures were the only variables with incremental predictive value after controlling for earlier use, whereas for alcohol explicit measures had additional predictive value (Stacy, 1997). On the other side of the implicit-explicit measurement spectrum, it is noteworthy that studies of implicit cognition in this field have not often used subliminal techniques to test drug-related associations, as have been used in the field of social cognition (e.g. Dijksterhuis, Dijksterhuis, Aarts, and Smith, 2005; Stapel, Koomen, and Ruys, 2002). This could be an interesting road to proceed, although it should be noted that the few studies that assessed an attentional bias using subliminal drug-related stimuli are inconclusive (Franken, Kroon, Wiers and Jansen, 2000; Ingjaldsson, Thayer, and Laberg, 2003).
CONCEPTUAL ISSUES

Implicit Measures or Implicit Processes?
As indicated in the introduction, there are different views on the question what the implicit-explicit distinction refers to: different measures or different processes (De Houwer, 2006; Fazio and Olson, 2003; Rudman, 2004; Wilson et al., 2000). A similar discussion has divided basic memory researchers (see Reingold and Toth, 1996), and it is clear that there is no simple empirical solution. For example, a dissociation between implicit and explicit measures may be explained by a single process model, therefore a dissociation of implicit and explicit measures can not in itself be interpreted as proof of different underlying processes (Reingold and Toth, 1996, p. 170). We will briefly discuss two popular accounts of implicit and explicit cognitions that are relevant for the field of addictive behaviors.

Dual Process, Single Underlying Attitude
Fazio (1990; see also Fazio and Olson, 2003) proposed the MODE model [Motivation and Opportunity as Determinants], in which attitudes can exert their influence on behavior through relatively spontaneous or more deliberative processes, and the circumstances determine whether the more spontaneous or more deliberate route prevails. For example, the model predicts that when participants do not have the opportunity to control the expression of their attitudes, a “more pure” glimpse of the underlying attitude (or other cognitions) can be obtained, free from self-presentation strategies, etc. The MODE model predicts that when either motivation or opportunity is low at the time the explicit response is considered, the explicit measure should correlate with the implicit measure. Note that, according to this view, there is a single underlying cognitive construct (belief, association, attitude, expectancy), that can be assessed in different more or less implicit (or better indirect) ways. A similar view has been proposed in the alcohol-field by Goldman and colleagues (Goldman et al., 1999; cf. Kramer et al., 2003). In the latter study, indeed the overall effects on explicit and implicit measures were in the same direction for positive arousal: heavy drinkers expected positive arousal on explicit measures of alcohol expectancies and showed the priming effect on positive arousal items. However, the implicit priming effect for light drinkers was not found on the explicit measures, and in line with other studies the implicit and explicit measures did not correlate and predicted unique variance in drinking. Similarly, the study by Stewart et al. (2002) did show that when participants were selected on their explicit motives (enhancement or coping), they could be differentiated with respect to their equivalent implicit associations (although there was no perfect correspondence and positive and negative coping motives typically correlate significantly). Further, Zack and colleagues also reported corresponding implicit and explicit coping motives in several studies (Zack et al., 1999; 2002; 2003). These findings contrast with those reported for the IAT and related measures, where dissociations in contents of implicit and explicit attitudes have been reported (e.g. positive on explicit measures, negative on implicit measures), although as noted above, at least part of this dissociation seems attributable to the nature of the IAT. In summary, future research has to shed light on the question whether implicit and explicit associations “really” dissociate or not, while there is growing evidence for prediction of unique portions of the variance in behavior. But dissociation and unique prediction alone cannot be taken as proof for the existence of different underlying processes, both could be explained by a common underlying mechanism.
which is assessed with different types of measures that have different measurement error. What could?

**Different Underlying Processes**

A different account of the implicit-explicit distinction, states that there are different underlying cognitive motivational processes. Irrespective of the question to what extent a specific measure may be more or less implicit (in the sense of indirect) this view states that there is evidence that implicit measures tap into different underlying cognitive motivational processes (e.g. Rudman, 2003; Stacy, 1997; Stacy et al., 2003; Wilson et al., 2000). What lines of evidence support this position?

The first concerns development. Rudman and Heppen (2003; see Rudman, 2004), found that negative implicit smoking attitudes (but not explicit attitudes) were related to retrospectively reported early negative experiences with smoking, while their positive explicit attitudes (and not the implicit attitudes) were related to recent more positive experiences with smoking. In an earlier study, only assessing explicit alcohol expectancies, we found that young children of alcoholics were even more negative about alcohol than their peers (who were negative too), while those of adolescent children of alcoholics (who had begun drinking) were more positive than those of their peers (Wiers, Sergeant and Gunning, 1998). One tentative interpretation is that the negative implicit attitudes that are related to early experience are not replaced by the more positive attitudes reflecting later personal positive experiences, but that they remain there at the implicit level (cf. Wilson et al., 2000). However, this suggestion is highly speculative at this moment, because the evidence rests on one study using retrospective measures and one other study that assessed implicit smoking attitudes in young adolescents (using an IAT with a neutral contrast category, Chassin, Presson, Rose, Sherman and Prost, 2002) found that all adolescents showed negative implicit associations with smoking (with no significant difference for smokers and non-smokers, Chassin, 2003, personal communication). Further, Chassin et al. found no evidence for a significant influence of parents’ implicit smoking attitudes on those of their adolescents.

The second line of evidence suggests that implicit attitudes represent affective experiences, while explicit attitudes represent more cognitive experiences (Rudman, 2004). Rudman and Heppen (2003; see Rudman, 2004) found that implicit but not explicit smoking attitudes were influenced by reading a guilt-inducing story about the effects of smoking on loved ones. Further, Rudman, Ashmore and Gary (2001) found that a diversity education training changed implicit and explicit racial attitudes, and that the predictors for the two changes differed: changes in implicit racial attitudes were correlated with reported emotional experiences, while changes in explicit racial attitudes were correlated with cognitive effort. In relation to addiction, the correlations between implicit associations and craving (which can be seen as an emotional experience, Baker et al., 1987; Franken, 2003), found in several studies of Palfai and colleagues, could be a case in point.

The third line of evidence concentrates on different brain mechanisms underlying implicit and explicit cognition. For example, Phelps et al. (2000) found high correlations between amygdala activation and scores on a racial IAT. Since the amygdala is thought to be involved in affective processes that lie largely outside conscious awareness (e.g. LeDoux, 1996), this could be interpreted as support for the affective experience account, and for the dual process account. However, a recent study by Phelps and colleagues (2003) showed intact performance on the race-IAT in a patient with bilateral damage to the amygdala, indicating that the
amygdale is not critical for IAT performance. In relation to drug use, Stacy and colleagues report a number of studies suggesting different underlying neural structures for implicit and explicit memory systems (Stacy, 1997; Stacy, et al., 2004). Further, brain research in the area of addiction also speculate on different mechanisms underlying implicit and explicit drug-related cognitions, and it is clear that subcortical areas are involved in addiction that are unlikely to be open to conscious cognitive processes (e.g. Berridge, 2001; Robinson and Berridge, 1993; 2003, White, 1996), but it still has to be demonstrated beyond doubt that these areas are indeed critically involved in performance on implicit tasks.

Fourth, there is evidence that implicit measures predict other aspects of behavior than explicit measures (e.g. Dovidio et al., 2001). However, note that this is also predicted by the MODE model. The only studies we know in the field of addictive behaviors are the studies of Palfai and colleagues who report associations between implicit associations and craving, and actual consumption in a tasting session (Palfai et al., 2000). More detailed analyses of substance use behaviors could be undertaken to investigate to what extent implicit and explicit substance-related cognitions predict different aspects of behavior.

Fifth, the processes can be computationally modeled and the fit of different models to the data can be compared (e.g. Conrey et al., 2005). Recent studies using this approach indicated that the IAT and other implicit measures partly tap into automatic processes (Conrey et al., 2005; Payne, 2005). From studies applying the process dissociation approach to assess drug-effects, it has become evident that drugs specifically effect controlled processes, in the absence of effects on automatic processes (Fillmore and Vogel-Sprott, 2006).

In summary, there is some suggestive evidence from different lines of research that can be interpreted as support for a dual process accounts (see also Wiers and Stacy, 2006), but this issue clearly needs further investigation.

Semantic Associations or Emotional Processes and a Developmental Speculation

The final question, tightly related to the previous issue, is what these implicit substance-related cognitions stand for. What are they, what do they represent? Are they “merely” semantic associations that people pick up in their environment (for example from advertisements), or do they represent emotional processes related to substance use? Stated differently, would the implicit associations of an (imaginary) moderately drinking alcohol researcher who learned about the emotional responses to alcohol be the same as those of a problem drinker or would they be different (Winkielman, 2003)?

What are implicit cognitions?

Implicit cognitions are associations stored in memory (e.g. Greenwald et al., 1998, see also Goldman, 1999). In our view, implicit substance-related cognitions represent previous substance related-experiences, which are often emotional in nature. We do not see implicit cognitions as either identical to or as completely independent of emotional drug-related experiences: part of the representation could involve the (re)activation of the same brain-structures that are involved in the actual emotional experience (see Jeannerod, 1997, for a similar account of action representation), as the study by Phelps and colleagues (2000) suggests. What emotional drug-related processes could be represented in implicit substance-
related cognitions? We present a developmental speculation, backed by some preliminary
evidence. Nonetheless, developmental studies are much needed in this area.

First, there may be the representation of negative experiences, either related to early
negative experiences (e.g. a smoking parent in the car), or to later aversive substance-related
experiences. Early negative attitudes can result from general cultural connotations (e.g.
repeatedly hearing that smoking is bad for you), or from personal experience that can be more
emotional (e.g. death of a loved one due to smoking). It could well be that early experiences
are important, because they might provide a “working model”, from which later experiences
are interpreted (Bowlby, 1973, Epstein, 1994; Koole, Dijksterhuis and van Knippenberg,
2001). Further, there is evidence that associations generated through evaluative conditioning,
are resistant to change (Baeyens, Eelen, and Crombez, 1995; De Houwer, Thomas and
Baeyens, 2001). Hence, there is reason to speculate that the initial negative implicit
substance-related associations may “last forever” at the implicit level (cf. Wilson et al., 2000).

As the child grows older, some peers will start drinking and smoking, which could result
in the development of more positive attitudes (Dunn and Goldman, 1998; Wiers et al., 1998).
At a certain moment, the child (or hopefully the adolescent) begins to use alcohol and/or
cigarettes. This is a strong emotional experience: he or she will feel dizzy, light-headed, etc.
In fact, there is some evidence that the retrospective accounts of the first physiological
reaction to alcohol is correlated with the later risk to develop alcoholism (Schuckit, 1997).
With repeated use, the negative effects will become less salient, while the psychomotor
stimulant reaction directly following substance use sensitizes (Robinson and Berridge, 1993;
2003). We believe that this sensitized emotional response will become represented in implicit
arousal associations, which will develop next to the implicit negative associations that were
already there. A related account states that they are represented as implicit approach action
tendencies (Palfai and Ostafin, 2003).

In addition to this, positive social experiences related to substance use, may also become
represented at the implicit level. This may result in ambivalent attitudes at the implicit level
(positive and negative; for preliminary evidence in favor of the potential existence of implicit
ambivalence, see Petty, Brinol, Tormala and Jarvis, 2003). With repeated use, some substance
users will repeatedly use substances when in a negative mood and experience tension
reduction or relief from the negative mood, which may result in implicit relaxation
associations (which are not necessarily equal to negative reinforcement associations, see
Wiers et al., 2006), which could develop next to the implicit arousal associations (relaxation,
Stewart et al., 2002; Zack et al., 1999). Note that when all these processes occur in a person,
one could end up with implicit ambivalence in two dimensions! Further, individual
differences in personality and reaction to the substance are likely to influence whether an
individual develops stronger alcohol-arousal associations or stronger relief from negative
mood associations (e.g. Pihl and Peterson, 1995; Zack et al., 2002).

One interesting issue is how the drug-related emotional experiences are best represented,
in bipolar or as unipolar dimensions (positive-negative or positive and negative; and the
same for arousal-sedation). This is a debate in the emotion-literature (e.g. Cacioppo and
Berntson, 1994; Russell and Caroll, 1999). The preliminary results on implicit drug-related
cognitions indicate that a unipolar view might be most suitable: problem drinkers could very
well have both negative and positive and arousal and sedation alcohol associations, although
it is not clear to what extent these occur at the same time and within one individual. Also, the
unipolar assessment may bring in extra measurement problems (e.g. the composition of the neutral contrast categories).

If it is true that a number of more specific substance-related implicit associations develop over time with repeated use (or abuse), the next question becomes how they relate to explicit associations, and to (aspects of) substance use behavior. We endorse a dual process view. In this view, implicit cognitions represent affective experiences (negative, positive-social, arousal, tension reduction, etc.), and explicit cognitions represent more deliberate thought about reasons why we use substances of abuse. The extent to which the implicit and explicit substance-related cognitions overlap may differ from person to person: some people better understand their own feelings than others (the alexithymia dimension, see Wilson, 2002). Further, people tend to make coherent stories or naive theories at the explicit level that need not be related to the factors that actually predict behavior (e.g. Nisbett and Wilson, 1977; Wilson, 2002; for a developmental account see Samarapungavan and Wiers, 1997). In this view, a person who regularly uses a substance of abuse will develop implicit arousal associations, related to the sensitized psychomotor stimulant reaction to the drug, which may be stronger for individuals at high risk (for which we found preliminary evidence, Wiers, in press). To some extent this affective experience will also be represented at the explicit level, as is evident from expectancy research in relation to alcohol (e.g. Goldman et al., 1999), cigarettes (e.g. Brandon, Juliano and Copeland, 1999) and other drugs (e.g. Aarons, Brown, Stice and Coe, 2001). The arousal-expectancy words typically reported are both related to physiological arousal (e.g. “energized”, “active”) and to social experiences in this mood (e.g. “funny”), as well as to other appetitive responses that may be triggered by substance use (e.g. “horny”). However, if one simply asks a substance abuser why he or she drinks, typical answers may primarily reflect global positive reasons (e.g. “it tastes good”, “it makes me feel good”, “to have fun”). The reason why participants come with these responses could well be that they share the rational decision model discussed in the introduction with many of the traditional health and social psychologists: if I use the substance, it must be because I benefit from it, and I know that there are negative sides to it, so there must be positive sides to it too.

We predict that there are emotional processes involved that in some cases may exert their influence outside awareness of the substance user (cf. Bechara, Damasio and Damasio, 2000; Berridge and Winkielman, 2003). In these cases, substance users will create a coherent story, when asked the open question why they use, and this story may have little to do with the underlying processes at work (cf. Wegner, 2002).

Finally, how do implicit and explicit associations relate to (aspects of) substance use and abuse? In line with incentive sensitization theories, we believe that substance-related cues may trigger an appetitive response, which can be regarded as a “go” response, or a goal directed action-tendency, that comes with arousal (Baker et al., 1987; Franken, 2003; Gray, 1987; Lang, 1995). In non-problematic substance use, the appetitive response is most likely a general state that can lead either to substance use (either the substance that triggered the response or another substance, common for smoking and drinking, see Palfai et al., 2000), or to other appetitive responses (desire for food, sex, etc.). From this view, implicit arousal (or approach) associations should be related to cue-induced craving responses (as found by Palfai and Ostafin, 2003, and by us, see Krank et al., 2005) and to an attentional bias for the substance of abuse (Franken, 2003; Wiers et al., 2004). Once substance use develops into substance abuse, there will be a conflict between implicit cognitions, triggering an appetitive response and explicit cognitions that will tell the person to stop, because continued abuse may
do more harm than good (Jones and McMahon, 1994; 1998). Successful treatment should result in either making the explicit negative cognitions more salient, more easily accessible (e.g. by relating them to personal emotional experiences, as is done in a motivational interview, see Miller and Rollnick, 2001) or by making the implicit arousal associations less salient or accessible (e.g. through cue-exposure or through a retraining, see Wiers et al., in press) or better controllable by explicit cognitions. At this moment we know very little about ways to change implicit substance-related cognitions, although there are some initial findings that hold promise (see further Wiers et al., 2004; in press).

**GENERAL CONCLUSION AND SUGGESTIONS FOR FURTHER RESEARCH**

In the introduction, we argued that the recent interest in implicit assessment of substance-related cognitions holds promise for addiction research and health psychology. This suggestion holds true, irrespective of the underlying theoretical position one holds: one may see them as different, more indirect routes to the underlying “real” substance-related cognitions (but see Mitchell et al., 2003: there may be no “real” underlying cognition), that are useful because they add some variance in the prediction of behavior above explicit measures, or one may see them as at least partly representing different underlying cognitive-motivational processes than explicit measures. When considered together, we believe the “dual process” account may be a viable theoretical perspective in this field (see for many recent examples Wiers and Stacy, 2006). Further, different aspects of substance use behavior may be predicted by implicit and explicit substance-related cognitions. However, it should be noted that at present, both positions can be defended. Some interesting issues for further research may include the following topics:

**Measurement and Conceptual Issues**

- Are substance-related implicit cognitions best regarded as representing emotional responses to substances on bipolar dimensions or on unipolar dimensions?
- When assessing implicit valence associations (either in a unipolar or in a bipolar fashion), does it make a difference whether general positive and negative words are used (as is usual in social cognition research) or whether substance-specific associations are used (as has been done from an addiction perspective, e.g. Kramer and Goldman, 2003; Houben and Wiers, in press a,b; Wiers et al., 2002b)
- Does it make a difference whether personalized stimuli are used vs. the same stimuli for all participants? (cf. Cox et al., 2002; Fazio and Olson, 2003).
- Similarly, when one makes participants select the personally most relevant attributes (e.g. Van Harreveld, Van der Pligt, and De Vries, 1999), how does this influence prediction of behavior, and differences between implicit and explicit cognitions?
- How do different RT-measures for implicit substance-related cognitions correlate?
- And how do they correlate with other association measures, from a memory tradition?
- And how do they correlate with measures of a drug-related attentional bias?
- And how are these constructs related to cue-induced craving?
- And how are they related to cue-induced physiological and brain-responses?
• Do implicit arousal associations correlate with peripheral indices of autonomic arousal (e.g. heart rate increase, see Conrod, Peterson and Pihl, 2001), and/or to subcortical responses as measured with f-MRI?
• Are implicit substance-related cognitions a psychological index of high-risk individuals?
• Are the same implicit cognitions relevant for other drugs of abuse and gambling? (see Wiers and Stacy, 2006 for recent overviews of initial findings).

**Applied Issues**

• How do implicit and explicit substance-related cognitions develop over time and by which factors are they best predicted?
• How do interventions (preventive or therapeutic) influence implicit and explicit cognitions? (see Wiers et al., 2005)
• How can one influence implicit and explicit substance-related cognitions, and to what extent does this result in changes in substance use (see Wiers et al., 2004, press)?

**General Issues relating to Social Psychology and Social Cognition Research**

Since this is a chapter in a social psychology book, we will try to make some general remarks for researchers and students in this area. Recent developments in social cognition research have strongly influenced recent developments in the area of experimental psychological addiction research, along with influences from experimental memory and learning psychology, and research in experimental psychopathology (see Wiers et al., 2004). In short: the addictions field has learned a lot from social cognition research. Do we have something to offer to social psychology and social cognition research too? Perhaps we do.

First, the findings in this area suggest that it may be beneficial to assess implicit associations in a unipolar fashion, and that it might be useful to consider other affective dimensions than valence alone. We do not know to what extent this will prove useful for other topics in social cognition research, but one reason why it could be important is that implicit cognitions are thought to be stored representations of affective experiences and that emotion research suggests that there is more than valence alone. Second, in attitude research, often general models are tested for a number of “attitude-objects”, often including smoking and drinking alcohol, as well as very different attitude-objects, like eating meat or organ donation (e.g. Van Harreveld et al., 1999). If we are right that with regular substance use, implicit arousal associations develop, this could imply that combining attitude-objects for which this occurs (substances of abuse) with attitude objects for which this does not occur (other objects) may be suboptimal for testing a general model.

In conclusion, the rapidly growing research area investigating implicit substance-related cognitions is an exciting area of research, with many unanswered questions waiting to be addressed that are both theoretically interesting and that may ultimately provide new insights into the etiology and maintenance of substance abuse, and suggest new ways to prevent or treat substance use disorders.

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