To drink or not to drink: the role of automatic and controlled cognitive processes in the etiology of alcohol-related problems

CHAPTER 22

To Drink or Not to Drink: The Role of Automatic and Controlled Cognitive Processes in the Etiology of Alcohol-Related Problems

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Abstract: Explicit measures revealed three basic types of alcohol-related cognitions: positive reinforcement, negative reinforcement (relief), and negative expectancies. Using the same typology, we review studies assessing alcohol-related cognitions with implicit measures. Most research focused on automatic appetitive responses (positive reinforcement). The common model is that an automatic appetitive response tendency can be inhibited by more controlled inhibitory processes. In addition, there is scattered evidence indicating a role for automatic aversive responses to alcohol. Negative reinforcement appears to be more difficult to assess with tests involving single associations. It is argued that the reason is that for negative reinforcement two associations are needed (negative affect < > alcohol < > positive affect). Findings are integrated into a model from which suggestions for interventions are given.

Studies investigating alcohol-related cognitions with explicit measures have identified three basic types of alcohol-related cognitions: positive reinforcement (e.g., fun), negative reinforcement (relief from negative affect), and negative expectancies (negative outcomes of drinking). The first two variables have been documented as positive predictors of prospective drinking, and the last as a negative predictor of

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prospective drinking that could be related to motivation to cut down drinking (e.g., If I continue drinking like this, I'll lose my job). In this chapter, we will review the recent literature using implicit or indirect measures (see De Houwer, Chapter 2) to assess alcohol-related cognitions using this typology. Central questions are:

1. Are the same three types of cognitions found in research using implicit measures?
2. Do implicit and explicit cognitions predict unique variance in drinking behavior and/or unique aspects of drinking behavior?
3. Do implicit and explicit alcohol-related cognitions relate to different or to the same underlying processes?
4. How do individual differences in personality relate to the development of implicit and explicit alcohol-related cognitions?

A model is presented that integrates the findings, followed by implications for interventions. First, we discuss some issues that emerged from alcohol research using explicit measures, relevant for the discussion of the findings with more implicit measures.

EXPLICIT ALCOHOL-RELATED COGNITIONS

The explicit assessment of alcohol-related cognitions has been undertaken from a variety of different theoretical frameworks. Most dominant has been the expectancy framework, proposed by Goldman and colleagues (e.g., Brown et al., 1980; Goldman et al., 1999). Other influential frameworks have been social learning theory (Bandura, 1977), cognitive behavioral therapy (e.g., Beck et al., 1993; Marlatt & Gordon, 1985), the theories of reasoned action and planned behavior (Ajzen, 1988; Fishbein & Ajzen, 1975), and motivational theories (Cooper et al., 1995; Cox & Klinger, 1988). Despite differences in the exact definitions of alcohol-related cognitions in these frameworks, some general issues emerged.

The first general issue concerns whether assessment should be unipolar or bipolar. In the attitude literature, *bipolar* assessment is common. An example is:

(E1.) Drinking alcohol is:
good ———————————— bad.

(good and bad need to be on the same line.)

The underlying assumption of bipolar assessment is that the endpoints are opposites (correlated – 1), which, in case of attitudes, could reflect a natural tendency to classify something as either positive or as negative and not both at the same time (e.g., Russell & Carroll, 1999). This view has been challenged, because people have been found to be ambivalent about some attitude objects, with alcohol being a prime example (e.g., Conner & Sparks, 2002; note that ambivalence is at the heart of some addiction theories, e.g., Orford, 2001). In expectancy research, *unipolar* measures were found to better predict alcohol use than bipolar measures (Leigh, 1989). It has become standard practice to use *unipolar* response scales including both positive and negative expectancies (Fromme et al., 1993; Leigh & Stacy, 1993; Wiers et al., 1997). An example item:

(E2.) After a few drinks I feel good
disagree ———————————— agree.

It should be noted that a bipolar view on emotional valence and the finding that alcohol-related cognitions are best measured in a unipolar way are not necessarily incompatible: The time frame of negative and positive expectancies is different, with negative expectancies referring to more distal events (Dunn & Earleywine, 2001; Goldman et al.,

1999; Jones & McMahon, 1994), and higher dosages of alcohol (Fromme et al., 1993; Wiers et al., 1997). Hence, even though the uni- or bipolar nature of affect remains controversial (Cacioppo & Berntson, 1994; Russell & Carroll, 1999), it is clear that people hold both positive and negative alcohol-related cognitions, with the positive cognitions usually relating to immediate and negative cognitions to later outcomes.

The second issue concerns how many specific factors or dimensions are needed to represent alcohol-related cognitions. In the attitude literature, typically only positive and negative cognitions are assessed, whereas in the expectancy and motivation literature more specific factors have been proposed (e.g., Brown et al., 1980; Cooper, 1994). For positive expectancies, Leigh and Stacy (1993) and Goldman et al. (1997) showed that specific first-order expectancy factors (e.g., sexual and social enhancement) increased the prediction of alcohol use above the general higher-order factor(s). This suggests that it is useful to assess alcohol-related cognitions in more detail than general positive and negative factors only.

An important distinction in the expectancy and motivation literature concerns positive versus negative reinforcement, where the difference involves the emotional antecedent of drinking: positive or negative mood, respectively (e.g., Cooper, 1994). The literature on negative reinforcement motivations has indicated that negative reinforcement (or coping) motivations are strong positive predictors of alcohol problems (e.g., Cooper et al., 1995; Stewart et al., 2002). These findings may reflect the "clinical wisdom" that alcohol use often becomes problematic once individuals begin to drink to escape problems, which results in more negative affect in the long run (Sher, 1991).

With respect to the third type of alcohol cognitions, negative expectancies are usually found to be negatively correlated with current drinking in cross-sectional research in social drinkers (e.g., Goldman et al., 1999; Wiers et al., 1997). Jones and McMahon (1994) have found that negative expectancies predict success of abstinence of alcoholics in treatment. From this perspective, negative expectancies develop with negative experiences and should be *positively* correlated with (negative) prior drinking experience. Still, they should negatively predict (future) drinking and should be related to motivation to change behavior (Jones & McMahon, 1998). Recently, it has been shown that it is useful to assess motivations for refraining from drinking next to motivations to use alcohol (like negative expectancies, McEvoy et al., 2004). Finally, it may be useful to assess motivation for alternative behaviors from drinking (see Cox et al., Chapter 17).

In expectancy research, Goldman and colleagues have investigated the underlying memory structure of expectancies using multidimensional scaling (MDS; Goldman et al., 1999; Rather et al., 1992). A two-dimensional structure was selected reflecting two orthogonal dimensions: valence (positive vs. negative) and arousal (arousal vs. sedation). Goldman et al. (1999) observed that these dimensions also underlie affective processing, and that many expectancies can be regarded as anticipated changes in affect. Mapping of subgroups of drinkers into the two-dimensional, valence-arousal space, showed that all drinkers were on the positive side, and that the more people drink, the higher they score on the arousal dimension (Goldman et al., 1999). In a recent paper, Goldman and Darkes (2004) argued that specific expectancy factors can all be conceptualized as unique positions in the two-dimensional, valence-arousal space. A problem with this notion is the location of negative reinforcement as positive sedation, which is associated with *light* rather than with *heavy* drinking, whereas negative reinforcement motives are predictors of problem drinking. In

conclusion, more factors or dimensions are needed than valence alone to represent alcohol-related cognitions, but the exact number of factors needed is an issue of debate.

Third, a general concern about the explicit assessment of alcohol-related cognitions and the prediction of drinking concerns criterion contamination (Stewart & Devine, 2000; cf. Darkes et al., 1998). When people drink a lot, they are likely to respond positively to general items like "I drink because it's fun" (Cooper, 1994). This may assess self-justifications rather than specific alcohol cognitions. In line with this concern, the predictive power of explicit alcohol cognitions decreases markedly after controlling for previous use (e.g., Jones et al., 2001; Sher et al., 1996).

In summary, there is broad agreement that there are three types of explicit alcohol-related cognitions: positive and negative reinforcement and negative cognitions, and they have been related to the two-dimensional structure of emotions (valence and arousal). This typology is used to review the literature on implicit alcohol-related cognitions.

IMPLICIT ALCOHOL-RELATED COGNITIONS

Implicit Cognition, Positive Reinforcement, and Incentive Salience

Most research using implicit measures to study alcohol-related cognitions also focused on positive reinforcement: attentional bias for alcohol-related cues (e.g., Bruce & Jones, Chapter 10; Jones et al., 2002), memory associations of alcohol with positive outcomes (e.g., Stacy, 1997; Stacy et al., Chapter 6), with positive reinforcement (e.g., Kramer & Goldman, 2003), with positive arousal (e.g., Wiers, Van Woerden, et al., 2002), and with approach action tendencies (e.g., Palfai & Ostafin, 2003a). Findings have generally been linked to neurobiological models emphasizing incentive motivation or positive reinforcement accounts of the development and maintenance of addictive behaviors (e.g., Robinson & Berridge, 1993, 2003; Stewart et al., 1984; Wise & Bozarth, 1987). Findings regarding an attentional bias for alcohol are reviewed in other chapters (Bruce & Jones, Chapter 10; Field et al., Chapter 11); here we focus on findings regarding implicit alcohol associations.

Stacy and colleagues propose that alcohol-related associations represented in memory (e.g., positive affective outcomes related to alcohol use) can elicit a relatively automatic influence over alcohol and drug use. In a series of studies, using a variety of tests (see Stacy et al., Chapter 6), they found that the number of alcohol-related responses was predictive of higher levels of alcohol use, and this finding replicated across different measures, different populations, and different drugs of abuse (e.g., Ames & Stacy, 1998; Stacy, 1995). Importantly, Stacy (1997) demonstrated that memory associations were the strongest predictor of prospective drinking, which remained the case after controlling for earlier use, explicit measures, and personality and background variables. Hence, this line of research has demonstrated that first associations represent unique information not captured by explicit measures. In view of the research on explicit cognitions, it is noteworthy that almost all studies in this line of research have focused on *global* positive associations without differentiating more specific outcomes (e.g., positive vs. negative reinforcement). A reason may be statistical power: Many participants are already needed for global positive outcomes and many more might be needed to discern specific positive outcomes.

Recently, a variety of reaction-time paradigms have been used to assess alcohol-related cognitions, and this has been done in

more dimensions than global positive only. In our own research, we have used adapted versions of the Implicit Association Test (IAT; Greenwald et al., 1998; also see Houben et al., Chapter 7) to assess alcohol associations in the two affective dimensions that were found in MDS alcohol and emotion research: valence and arousal. In a series of studies, we found that heavy drinkers associated alcoholic drinks more strongly with arousal than with sedation (as compared with sodas, Wiers, Ganushchack, et al., 2003; Wiers, Van de Luitgaarden, et al., 2005; Wiers, Van Woerden, et al., 2002). Alcohol-arousal associations were also found in alcoholics (De Houwer et al., 2004), and light drinkers were not found to hold implicit alcohol-arousal associations (Wiers, Van Woerden, et al., 2002). On the valence dimension, all of these studies found stronger negative than positive associations for alcohol as compared with soda both for light and for heavy drinkers (in contrast with explicit positive expectancies in earlier and in the same studies). To the extent that these negative associations are "real" and not an artifact of the IAT procedure (see Houben et al., Chapter 7), we argued that this pattern of results resembles the dissociation between "wanting" and "liking" proposed by Robinson and Berridge (1993, 2003). On the basis of animal research, they distinguish between two neural processes underlying natural rewards and drug responses: "wanting" and "liking," with "liking" being an important factor in early use, and "wanting" taking over once sensitization has developed. Sensitization refers to increased psychomotor activation directly and increased incentive motivation after repeated use. Importantly, "wanting" (the activation of incentive-salience) can occur in the absence of "liking." This dissociation may reflect an important feature of addiction; that compulsive use may continue in the presence of negative effects for the individual and in the absence of pleasure (Berridge & Robinson, Chapter 31; Robinson & Berridge, 1993, 2003).

We argued that the implicit arousal associations could be related either to the motivation to approach alcohol (an appetitive response, triggered by alcohol-related stimuli), or could represent a sensitized psychomotor stimulant reaction after drinking alcohol. In two recent studies, we tested these hypotheses. In the first, we found support for the first hypothesis: Implicit arousal associations (assessed with two different tests) predicted individual differences in subjective cue-induced craving assessed 6 weeks later, after controlling for background variables, habitual drinking, and memory associations assessed at the time of the cue-induced craving manipulation (Wiers, Granzier, et al., 2005). In the second study (Van den Wildenberg et al., 2004), we tested whether implicit arousal associations in heavy drinkers were correlated with heart-rate increase following rapid consumption of approximately five alcoholic drinks (a measure of sensitivity to the stimulant properties of alcohol; Conrod et al., 2001), but this was not confirmed. A caveat was the low proportion of participants with a positive family history of alcoholism, for whom the heart-rate increase is strongest (Conrod et al., 2001).

Palfai and Ostafin (2003a; Ostafin et al., 2003) assessed the automatic activation of approach versus avoidance tendencies for alcohol in hazardous drinkers. This is a somewhat different approach, because it does not focus on the appraisal side of the emotion process, but on action tendencies (e.g., Frijda, 1986). Emotionally relevant cues can automatically trigger an action tendency, either toward the cue (approach) or away from the cue (avoidance). In one study, an adapted version of the IAT was used (Palfai & Ostafin, 2003a). Categories used were alcohol versus electricity (irrelevant contrast) combined with approach versus

avoidance. Alcohol-approach associations correlated with the frequency of binge drinking and with the number of drinks per occasion. After the assessment of the IAT and questionnaire, participants were subjected to a cue-exposure procedure. IAT approach associations were correlated with urge to drink after exposure to alcohol, but not to urge to drink at baseline. Further, after controlling for baseline responses, it was found that those who scored higher on the approach IAT, exhibited stronger urge and arousal reactivity (no reactivity for valence). These findings suggest that the approach associations in this study are closely related to the arousal associations in our own work. In a recent study (Wiers, Both, et al., 2005), we assessed both valence and arousal associations and approach-avoidance associations and found that approach avoidance associations were positively correlated with positive valence and with arousal (in the absence of a correlation between valence and arousal). This suggests that approach associations are related to positive arousal associations.

The research on implicit alcohol associations presented so far has used bipolar attribute dimensions, which is at odds with the findings in the explicit literature that suggest that unipolar assessment is superior in the assessment of alcohol-related explicit cognitions (Leigh, 1989), but consistent with a bipolar view on instantaneous affect (e.g., Russell & Carroll, 1999). Given biological research that has indicated the presence of separate neural systems for approach and avoidance (e.g., Gray, 1990; Lang, 1995), it may be useful to assess implicit alcohol associations in a unipolar manner too. This has been done in a number of recent studies. Jajodia and Earleywine (2003) separately assessed positive and negative associations (against different neutral categories) using an adapted IAT and found both positive and negative associations for alcohol. Positive but not negative associations predicted unique variance in alcohol use, but this finding has to be qualified for two reasons: Positive associations were always assessed first (and IAT effects get smaller with practice; see Wiers, Van de Luitgaarden, et al., 2005) and in the regression analysis positive associations were entered first. Houben and Wiers (2004) assessed positive, negative, arousal, and sedation associations in a series of (counterbalanced) unipolar IATs. We found the strongest effects for negative associations (effect size, $d > 1$), large effects for both positive and arousal associations (d around .8), and smaller but significant sedation associations (d around .5). Note that these findings are in line with the findings with the bipolar IATs (negative stronger than positive and arousal stronger than sedation). Interestingly, only arousal associations were significantly correlated with alcohol use and problems. These first results using unipolar IATs are promising, but it should be noted that choice of the opposing contrast category is difficult and may influence results (see De Houwer, 2002; Houben et al., Chapter 7). Using a (unipolar) primed Stroop task, Kramer and Goldman (2003) found significant positive-arousal associations in heavy drinkers and significant sedation associations in light drinkers. Ostafin et al. (2003) used a priming task to assess (unipolar) approach and avoidance tendencies. Hazardous drinkers classified target words with respect to approach or avoidance, and the targets were preceded by briefly-shown alcohol-related or neutral primes. The results on both dimensions (difference between neutral and alcohol primed approach and avoidance words) ranged from very positive to very negative (– 340 ms to 480 ms), which may indicate stronger approach tendencies in some individuals and stronger avoidance tendencies in others. Weak avoidance and not strong approach motivations predicted binge drinking and alcohol-related problems. The authors note, however, that the negative finding for

approach motivations is qualified by the low reliability of the priming procedure. Hence, unipolar implicit assessment of alcohol-related cognitions shows promise. Different associations, including emotional dimensions (valence, arousal), outcomes of drinking, and action tendencies (approach vs. avoidance) can be assessed. The latter could be assessed more directly (actual movement toward or away from the stimulus; cf. Mogg et al., 2003).

Some studies investigated the effects of a priming dose of alcohol on implicit alcohol cognitions. Palfai and Ostafin (2003b) assessed primed positive and negative associations for alcohol as compared with neutral targets. Participants performed the task twice, before and after a priming dose of alcohol or placebo. It was found that the consumption of alcohol as compared with placebo made the positive associations with alcohol particularly salient. Similarly, consumption of a moderate dose of alcohol has been found to increase the activation of an alcohol-memory bias, assessed as the number of alcohol-related associations to ambiguous words (Glautier & Spencer, 1999; Havermans et al., 2004). Further, after an alcoholic sip-prime, alcohol-related words of positive affect were found to be more accessible in social drinkers (e.g., Jones & Schulze, 2000). Hence, drinking a low dose of alcohol enhances the accessibility in memory of positive reinforcement associations and approach tendencies (see Fillmore & Vogel-Sprott, Chapter 20; de Jong et al., Chapter 27).

In summary, researchers using a variety of techniques have found that in heavy drinkers, alcohol-related cues automatically grab and hold attention (Bruce & Jones, Chapter 10; Field et al., Chapter 11), and that they are automatically associated with (positive) arousal and approach action tendencies. These findings have been related to biological theories that focus on positive reinforcement and incentive motivation. In line with this, it has been found that alcohol-related cues and priming dosages make the implicit alcohol-related cognitions more salient, and that implicit alcohol associations predict cue-induced craving.

Implicit Negative Associations?

As reviewed above, there is accumulating evidence that with increasing alcohol use, people develop stronger appetitive reactions to alcohol including automatic approach tendencies. It is also evident that most people reduce alcohol consumption in their twenties, often without professional help even after high levels of consumption (e.g., Sher & Gotham, 1999). The question is what restrains their drinking. One factor concerns reduced opportunities to drink and increased responsibilities, but there is also evidence that alcohol-related cognitions play a role. When a person increasingly experiences problems related to drinking, this will be a motivator to change behavior (Jones & McMahon, 1998; Orford, 2001). From this perspective, the problem drinker is torn between two forces: an automatic approach reaction triggered by alcohol-related cues and a more controlled inhibitory response that is motivated by more distal negative outcomes (Stacy et al., 2004; Tiffany, 1990; Wiers, de Jong, et al., 2004; Wiers, Van Woerden, et al., 2002).

An additional possibility is that at least in some individuals, with repeated negative experiences, *automatic negative associations* develop that give rise to an automatic avoidance response. Note that an attentional bias for alcohol-related stimuli has generally been interpreted as a marker of an appetitive response, but could also be related to an automatic avoidance reaction, similar to findings in anxiety research (e.g., Stormark et al., 1997; see also de Jong et al., Chapter 27 and Field et al., Chapter 11).

Two studies examined associative memory responses to negative next to positive

alcohol-related outcomes (Gadon et al., 2004; Leigh & Stacy, 1998). Leigh and Stacy found that previous alcohol use predicted undergraduates' associative memory responses to both positive and negative outcomes of drinking. In a series of studies, Gadon et al. (2004) developed an association instrument including frequent and infrequent positive and negative alcohol-related outcomes as well as nonalcohol-related outcomes. They found that undergraduate students' alcohol responses to highly frequent positive and negative outcomes correlated with their alcohol use. A subsequent study using the same methodology in older adults replicated this finding. In the latter sample, negative low-frequency, alcohol-related outcomes and even negative outcomes unrelated to alcohol generated more alcohol responses. This finding suggests that maturing out of heavy use might be related to increased accessibility of negative alcohol associations with age.

Some of the findings with reaction-time measures discussed in the previous section can also be interpreted as suggestive evidence for the existence of automatic negative or avoidance associations. The first concerns the replicated finding of strong negative associations in heavy drinkers in valence IATs (De Houwer et al., 2004; Houben & Wiers, 2004; Wiers, Ganushchack, et al., 2003; Wiers, Granzier, et al., 2003; Wiers, Van de Luitgaarden, et al., 2005; Wiers, Van Woerden, et al., 2002). Even though the finding is reliable, it should be noted that heavy drinkers do not hold stronger negative associations than light drinkers (if anything they tend to be somewhat less negative; cf. Waters & Sayette, Chapter 21). Further, we found that negative associations did not correlate with alcohol-related problems, while arousal associations did (Houben & Wiers, 2004; Wiers, Van de Luitgaarden, et al., 2005). Findings with a different reaction-time test to assess associations (the Extrinsic Affective Simon Task, or EAST; De Houwer, 2003) showed that alcohol was associated as strongly with negative as with positive valence in heavy drinkers (no significant difference; De Houwer et al., 2004; Wiers, Ganushchack, et al., 2003). Because the EASTs used were bipolar, however, it remains possible that heavy drinkers hold both positive and negative associations. The findings regarding the large variance in automatic approach versus avoidance associations (Palfai & Ostafin, 2003a; Ostafin et al., 2003) also leave the possibility open that automatic avoidance associations may develop, either in some individuals or within one individual next to automatic approach associations (which would lead to "implicit ambivalence").

Is there other evidence in favor of automatic avoidance reactions? Before the current interest in implicit cognition and addiction, there was a research tradition on *aversion conditioning*, with the first experiments dating back to the 1920s (Nathan, 1985). The clinical literature can be summarized as "success and failure" (Nathan, 1985): success primarily for chemical aversion therapy (which is a biologically more related to negative response than shocks; Garcia, 1989), with higher one-year abstinence levels than usual in alcohol treatment. Failure concerns the lack of controlled studies, and the fact that most studies were performed in private clinics with high-SES (social economic status) alcoholics with good motivation for change (Nathan, 1985; Wilson, 1987, 1991). Some findings in this line of research are interesting for the present topic (automatic aversive reactions to alcohol).

A series of studies by Baker and Cannon (Baker & Cannon, 1979; Cannon et al., 1986) demonstrated that aversion therapy resulted in specific changes in subjective, behavioral, and physiological responses specific to alcohol (compared with sodas) that were consistent with acquired aversion (e.g., more negative flavor rating, overt signs of

disgust, and accelerated cardiac response). The latter variable predicted the latency to the first drink (Cannon et al., 1986). Elkins (1991), following Garcia (1989), notes that taste aversion conditioning should be seen as different from classical conditioning, which subserves the learning of cognitive expectancies, and that "neither conscious mediation nor intentionality are necessary for CA [consummatory aversion] formation" (Elkins, 1991, p. 393). In his reply, Wilson (1991) agrees with Elkins (1991) that taste aversion is a form of *Evaluative Conditioning* (EC) that should be seen as an automatic process different from classical conditioning. A recent review concluded that EC is indeed a different process than classical conditioning (De Houwer et al., 2001): EC is resistant to extinction, less influenced by statistical contingency, does not require conscious awareness of the co-occurrence of neutral and emotional events, and is not modulated by occasion setting (context effects).

A final line of research relevant for the discussion of automatic approach versus aversion tendencies is research on cue reactivity, in which a variety of physiological measures have been assessed. A meta-analysis by Carter and Tiffany (1999) concluded that physiological responses were generally more in line with incentive models (approach tendencies). It may be questioned, however, to what extent the physiological data unequivocally support incentive models: One interpretation of the results (Glautier, 1999) is that emotionally relevant cues give rise to autonomic arousal (increased heart rate and skin conductance) and that this can lead either to an appetitive or to an aversive response (or perhaps both, in case of "implicit ambivalence"). This might be an explanation for the diversity of the findings. Further, a number of methodological issues need to be addressed in this area of research including a standardization of procedures (Stritzke et al., 2004), because subtle variations may dramatically change the effects (e.g., holding vs. sipping alcohol generates opposite response patterns; Glautier et al., 1992). Grüsser and colleagues (2002) used the affective modulation of the startle response as a measure of affective valence (Lang, 1995) in response to aversive, neutral, appetitive, and alcohol-related pictures. These responses were compared with subjective measures of arousal, valence, and craving in detoxified alcoholics, social drinkers, and rarely-consuming controls (Grüsser et al., 2002). Abstinent alcoholics subjectively perceived the alcohol stimuli as more aversive than the social drinkers and the controls, and alcoholics and social drinkers experienced more arousal than the controls when alcohol-related stimuli were presented. Interestingly, in alcoholics, the startle data in response to alcohol stimuli were similar to the response to appetitive stimuli. Hence, the alcoholics *subjectively* report an *aversive* reaction to alcohol, but showed an *automatic appetitive* reaction to alcohol-related stimuli, reminiscent of the wanting versus liking dissociation proposed by Robinson and Berridge (2003). In a recent study, the mean affective startle response in a new sample of detoxified alcoholics again showed a mean positive value (Smolka et al., 2004). Interestingly, the individual startle responses showed a wide range of responses, indicating that for some the alcohol-related pictures were very aversive, whereas for others they were "better than sex" (strong appetitive response even compared with natural incentives). In summary, there is scattered evidence that indicates that at least in some people, alcohol cues can elicit an automatic aversive reaction, which is something else than an inhibition of an appetitive action tendency.

Different Underlying Processes?

In several studies and reviews of implicit cognition in substance use and misuse, it has been suggested that implicit measures may

better tap into neurobiological processes involved in the etiology and maintenance of the addiction than explicit measures (e.g., Stacy, 1997; Stacy et al., 2004; Wiers et al., 2004; Wiers, Stacy, et al., 2002; Wiers, Van Woerden, et al., 2002). There are three lines of indirect evidence to support this notion.

First, several studies have shown that implicit associations predict unique variance in alcohol use after co-varying explicit measures (Jajodia & Earleywine, 2003; Kramer & Goldman, 2003; Stacy, 1997; Wiers, Van Woerden, et al., 2002). The fact that a different assessment method predicts unique variance, however, does not necessarily indicate that different processes are involved (method variance is a likely alternative). In social cognition research, it has been found that implicit measures predict different aspects of behavior than explicit measures (more spontaneous behavior; see Dovidio et al., 2001); and the same has recently been found in other areas of research, such as personality (Asendorpf et al., 2002) and psychopathology research (Huijding & De Jong, in press; Teachman & Woody, 2003). For example, Huijding and De Jong (in press) found that spider-related affective associations (assessed with the EAST), best predicted automatic fear responses, whereas explicit fear ratings best predicted strategic avoidance behavior. In alcohol research, there are some first indications that implicit measures predict spontaneous reactions to alcohol such as cue-induced craving (Palfai & Ostafin, 2003a; Wiers, Granzier, et al., 2005), but more research is needed on the associations between implicit and explicit cognitions and different aspects of drinking behavior.

Second, neurobiological research demonstrated that subcortical circuits involved in emotion and motivation that are important in addiction are not directly accessible for introspection (Bechara et al., 2003; Berridge, 2001; Robinson & Berridge, 2003; White, 1996). Implicit measures have been shown to correlate highly with activation of these structures in fMRI studies (e.g., Phelps et al., 2000). Subliminally presented pictures activate these structures in the absence of awareness (Cunningham et al., 2004). Recent research by Berridge and colleagues and by Dickinson and colleagues has demonstrated that conditioned incentive salience (underlying "wanting") can be dissociated from expected outcomes (for a review, see Berridge, 2001). Several independent studies have shown that one system can be manipulated, without affecting the other. For example, blocking the mesolimbic dopamine system blocks the incentive salience attribution but leaves the cognitive expectations unchanged, whereas prefrontal and insular lesions affect the cognitive expectations but not incentive salience (see Berridge, 2001). Again, this second line of evidence is indirect, because no direct dissociations between brain mechanisms underlying implicit versus explicit assessment of alcohol-related cognitions have been demonstrated in humans.

Third, dual-process models have been proposed in (social) cognition research (e.g., Deutsch & Strack, Chapter 4; Evans & Coventry, Chapter 3; Strack & Deutsch, 2004). Common to these models is the presence of two different learning mechanisms, one fast and associative and one slower mechanism with limited capacity. Strack and Deutsch (2004) review evidence that associations are bidirectional in the fast system, whereas they are unidirectional in the slow system (e.g., expected outcomes). As noted above, different processes are likely to underlie EC and expectancy learning (De Houwer et al., 2001).

Taken together, there is indirect evidence from different lines of research that suggests that implicit measures at least partly tap into more automatic processes than explicit measures, but this should not be seen as an absolute difference (due to "leakages" between underlying processes, Berridge, 2001; Strack

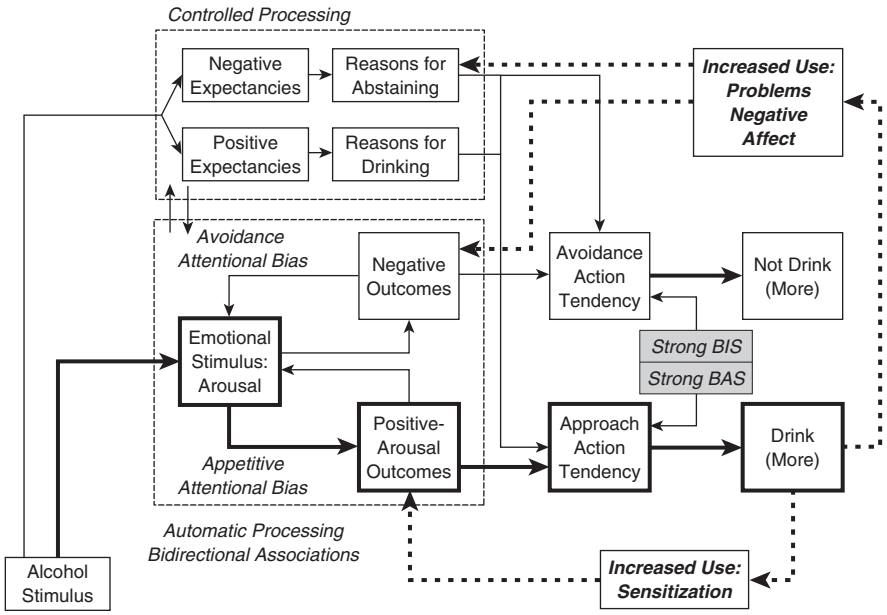

Figure 22.1 A model is depicted that attempts to integrate the findings on automatic and controlled processing in alcohol use and abuse. Thick lines develop with the development of alcohol abuse. Dashed lines are feedback loops. The upper part of the figure refers to controlled processing, with unidirectional representations. As a result of a variety of learning mechanisms (social learning, Pavlovian conditioning, expectancy learning), positive and negative expectancies develop that motivate drinking and abstaining, respectively. Meanwhile, memory associations can be formed through the mechanism of evaluative conditioning. These associations are bidirectional. As the double arrows between the two systems indicate, expectancies and associations can mutually influence each other (see Deutsch & Strack, Chapter 4). Once an individual begins to drink regularly, neural sensitization develops which will promote automatic reactions to alcohol, such as an appetitive attentional bias for alcohol, positive arousal associations and automatically triggered approach action tendencies (bold arrows). With increased use, an individual will also experience negative effects as a result of alcohol. These experiences could lead to automatic negative associations that trigger automatic avoidance action tendencies (conditioned aversion) and in negative expectancies and reasons for abstaining. These motivations could be used to abstain from drinking or to inhibit urges to drink. (approach action tendencies). Negative reinforcement exists as a positive expectancy and reason to drink. At the automatic level a negative mood may be associated with alcohol, which in turn could activate arousal associations and approach tendencies. Finally, note that an "alcohol stimulus" can be multifaceted, with sensory elements cueing appetitive responses while other elements (e.g., health warnings) may cue avoidance responses (cf. Sherman et al., 2003).

& Deutsch, 2004; and because measurement procedures are not entirely implicit or explicit, see De Houwer, Chapter 2). The three processes discussed so far are represented in Figure 22.1.

Implicit Negative Reinforcement?

The final issue in this section concerns the implicit assessment of negative reinforcement cognitions. The reason why this topic is

discussed here, and not earlier, is that we propose an interpretation of the results, based on the model in Figure 22.1. It is clear that at least a subgroup of problem drinkers explicitly report to drink for reasons of negative reinforcement (stress reduction, relief from *Negative Affect,* NA). It is less clear to what extent these beliefs reflect actual affective changes (Greeley & Oei, 1999). Further, several variables moderate the perceived anxiolytic effects of alcohol, such as the timing of drinking (Sayette, 1999) and a family history of alcoholism (Sher, 1987).

One important difference between the positive reinforcement and negative alcohol-related cognitions on the one hand and the negative reinforcement cognitions on the other hand, is that an extra premise has to be added:

(I: Positive Reinforcement): Alcohol > Feel good (Positive Arousal, Appetitive Response)

(II: Negative Expectancies): Alcohol > Feel bad (Negative, Sedation, Aversive Response)

(IIIa: Negative Reinforcement): Stress / NA > Alcohol > Feel good (better).

Further, as explained in the previous section, there is evidence for a fast, automatic processing mode for affective stimuli, based on relatively simple associations, in contrast to the more cognitive resources demanding explicit expectancies (Berridge, 2001; De Houwer et al., 2001). An important difference between associations and beliefs or expectancies is that expectancies and beliefs are unidirectional, whereas associations are typically bidirectional (De Houwer, 2002; Strack & Deutsch, 2004; note, however, that the strength of the associations can be asymmetric; see McEvoy & Nelson, Chapter 5, Stacy et al., Chapter 6). When one translates negative reinforcement expectancies into bidirectional associations, one gets:

(IIIb): Feel bad (Stress / NA) < > Alcohol use < > Feel good

This comes down to two associations: The first is equivalent to negative alcohol associations, the second to positive reinforcement associations. The suggestion is then that implicit (association) measures of negative reinforcement assess *associations from alcohol with negative affect and with positive affect*. Is this idea supported by research?

Two research groups have studied implicit negative reinforcement. These studies are discussed in more detail in Birch et al. (Chapter 18). Zack and colleagues used semantic priming tasks in which participants make a lexical decision (word/nonword) for a target (Zack et al., 1999). It was investigated to what extent a prime facilitates this process. They tested problem drinkers that were either high or low on psychiatric distress. In high but not in low psychiatric distress drinkers, they found that NA words facilitated alcohol words (NA > alcohol), and they also found the opposite facilitation (alcohol > NA), in line with the interpretation presented above.

Stewart and colleagues selected students as scoring either high on explicit negative reinforcement motives ("coping drinkers") or on positive reinforcement motives ("enhancement drinkers"). In a first study (Stewart et al., 2002), a primed Stroop task was used to investigate the effects of mood primes on the response time to alcohol or neutral words. As expected, in enhancement drinkers, positive mood cues primed alcohol words and negative mood words primed alcohol in coping drinkers. Interestingly, in coping drinkers, positive mood words also primed alcohol words. One interpretation of this finding is in line with the double bidirectional association of implicit negative reinforcement represented above (see Figure 22.1): A negative mood could activate the concept alcohol, and alcohol in turn could activate positive reinforcement associations.

Taken together, these studies generally found that in a subgroup of "coping drinkers" (selected with explicit measures)

negative affect words automatically trigger alcohol-related concepts, which is related to their explicit reports of drinking to reduce stress or NA. The full negative reinforcement expectancies, however, cannot be "translated" into a single association, because the antecedent is a crucial part. Since associations are bidirectional, one would expect not only a NA > alcohol association, but also the reverse association (alcohol > NA). Results in this area appear to be generally in line with the notion. This does not mean that implicit negative reinforcement does not exist (see also Baker et al., 2004; Curtin et al., Chapter 16), but rather that they may be difficult to assess with explicit or implicit measures using single adjectives (cf. the discussion of MDS expectancy research above). More research is needed in this area, also in relation to the actual biological effects in "coping drinkers": Do coping drinkers really medicate their negative mood and reduce their stress or not, and how is this related to physiological and implicit arousal responses? From the current perspective, the second of the two bidirectional associations involved in negative reinforcement (NA < > alcohol < > positive mood) could be equal to the positive reinforcement association, with the difference being the cue (NA or not). In line with this idea, we recently found a significant positive correlation between implicit alcohol arousal associations and explicit negative reinforcement expectancies in heavy drinkers (Wiers, Van de Luitgaarden, et al., 2005). Further, there is some evidence that stress and alcohol both trigger the mesolimbic dopaminergic system; perhaps stress can trigger a sensitized alcohol response (Saal et al., 2003).

INDIVIDUAL DIFFERENCES AND THE ETIOLOGY OF ALCOHOL USE AND PROBLEMS

As noted above, a common view concerning the etiology and maintenance of alcohol use and abuse (and other addictive behaviors) is that there are two important cognitive processes at work: automatic appetitive action tendencies and controlled inhibitory processes. From this perspective, individual differences can be related to either one of these processes: People may differ in their appetitive action tendencies (and there is evidence for genetic differences in sensitization, Robinson & Berridge, 2003) and individuals may differ in the ability to inhibit these action tendencies (Bechara et al., Chapter 15; Finn et al., 1994; Ostafin et al., 2003; Stacy et al., 2004). From the present perspective, there may also be individual differences in the third process involved: the development of automatic aversion with alcohol (and a genetic factor in the development of alcohol aversion has been reported; Elkins, 1986).

Recent genetic research suggests that individual differences in the susceptibility to addictive behaviors are partly substance specific and partly general (Goldman & Bergen, 1998). With respect to the general risk factor, personality factors are a likely candidate and indeed both internalizing and externalizing behavior at age three prospectively predicted later alcoholism in boys (e.g., Caspi et al., 1996). The predictive power of externalizing behavior is relatively straightforward: This trait has been linked to a strong Behavioral Activation System (BAS), reward sensitivity, sensation seeking, behavioral undercontrol and to a weak Behavioral Inhibition System (BIS; e.g., Finn et al., 1994; Gray, 1990). Externalizing children are likely to start experimenting with alcohol early, to experience the reinforcing effects of alcohol strongly, and to lack strong inhibitory control on the urge to use. Moreover, acute and chronic alcohol and drug use significantly interfere with inhibitory control (e.g., Fillmore & Vogel-Sprott, Chapter 20; Peterson et al., 1992).

The predictive power of internalizing personality characteristics is less straightforward

and might involve different mechanisms. (Note that in Gray's [1990] theory BAS and BIS represent two dimensions, hence an individual may be high on BIS and on BAS, in line with the ambivalence model on alcohol motivation where an individual can differ both on approach *and* on avoidance tendencies; Breiner et al., 1999; see also Figure 22.1.) Once internalizing individuals initiate drinking (usually late), perceived negative reinforcement may promote an escalation of use (Conrod et al., 1998). Indeed, individual differences in anxiety sensitivity (fear of anxiety-related sensations) are associated with sensitivity to the negatively reinforcing effect of alcohol on stress responses (not expectancy mediated; see MacDonald et al., 2001).

In the development of alcohol-related cognitions, there is a crucial step: the initiation of drinking. Before this, alcohol-related cognitions are socially learned, whereas after this, genetic influences related to individual differences in the reaction to alcohol influence their further development (Wiers et al., 1998). Research using questionnaires (e.g., Fossey, 1994; Wiers et al., 1998, 2000) and first associates (Dunn & Goldman, 2000) has shown that children report predominantly negative expectancies before they begin drinking alcohol themselves. These negative expectancies may inhibit the onset of drinking (cf. Caffray & Schneider, 2000). Cross-sectional studies suggest that positive expectancies develop with age, which does not imply that negative expectancies diminish but rather that positive expectancies "catch up" (Cameron et al., 2003). Once drinking begins, children score higher on positive and arousal expectancies (Dunn & Goldman, 1998, 2000), and this is more strongly the case for children of alcoholics (Wiers et al., 1998). In a recent study, Thush & Wiers (2005) tested 100 adolescents using the Single Target variety of the IAT (ST-IAT; see Houben et al., Chapter 7) and found that arousal associations and negative explicit expectancies predicted alcohol use at a one-year follow-up. This finding suggests a causal role for (implicit) arousal associations in the early development of drinking.

Finally, personality characteristics have been related to individual differences in risk for addiction (Cloninger, 1987; Cox, 1987; Finn et al., 1994; Sher, 1991) and there is emerging evidence that personality risk factors are related to individual differences in the development of explicit alcohol-related cognitions, such as expectancies (Darkes et al., 2004) and motives (e.g., Stewart & Devine, 2000). Explicit cognitions have been shown to partially mediate the association between personality and alcohol use (Darkes et al., 2004; Finn et al., 2000; Sher et al., 1991). Obviously, the caveat noted above (criterion contamination) is also relevant here (cf. Darkes et al., 1998). As yet, few studies have investigated the association between personality and implicit alcohol-related cognitions. Notable exceptions are the studies on implicit cognition and negative reinforcement by Stewart and colleagues and by Zack and colleagues (see section entitled "Implicit Negative Reinforcement?" and Birch et al., Chapter 18). Further, Palfai and Ostafin (2003a) found that BAS scores correlated with implicit approach associations on the IAT, and Ostafin et al. (2003) found that more impulsive individuals had weaker primed associations between alcohol cues and avoidance words. Ames et al. (2005) found that the relationship between sensation-seeking and alcohol use and problems was mediated by implicit alcohol associations in high-risk adolescents.

In summary, individual differences in personality predict individual differences in alcohol use and abuse. There is preliminary evidence that part of this relationship is mediated by alcohol-related cognitions, but this conclusion is primarily based on research using explicit assessment strategies and on

cross-sectional data. There clearly is a need for longitudinal studies on the development of implicit and explicit alcohol-related cognitions in relation to personality and the development of alcohol use.

CONCLUSION AND IMPLICATIONS FOR INTERVENTIONS

Individuals may differ in automatic and more controlled cognitive processes that can both influence drinking behavior. In heavy drinkers, automatic appetitive reactions triggered by alcohol cues (or by negative affect in "coping drinkers") play an important role in their drinking behavior. From the present perspective, restraint can come from two different mechanisms: an automatic mechanism that is triggered by aversion, and a more controlled effortful mechanism that inhibits an approach tendency. Interventions may target these different mechanisms. In addition, the automatization of alternative behaviors is important (Gollwitzer, 1999; see also Cox et al., Chapter 17; Prestwich et al., Chapter 29).

In *treatment*, it appears useful to try to decrease the automatic appetitive response (e.g., medication such as Naltrexone or cue-exposure; see Wiers et al., 2004). An alternative, which has a long history but has largely gone out of favor today, is to try to stimulate an automatic avoidance reaction (aversive conditioning), but therapeutic usefulness is unclear (Wilson, 1987, 1991). Perhaps an alternative could be to use less aversive methods involving reconditioning (see De Houwer et al., 2001; Hermans & Van Gucht, Chapter 32). Some of the implicit assessment techniques could be transformed to change automatic affective and cognitive processes in alcohol abuse (see de Jong et al., Chapter 27; Wiers et al., 2004). In addition, the more controlled inhibition mechanism may be enhanced, by making negative (long-term) expectancies more salient, by increasing motivation to change, and perhaps by automatizing restraint (see Palfai, Chapter 26). In prevention, it seems useful to try to prevent the automatic processes from taking over (see Krank & Goldstein, Chapter 28). This could be done by stimulating the more controlled inhibitory processes, and in heavier drinkers by debunking explicit positive expectancies (e.g., through an expectancy challenge; Darkes & Goldman, 1993; Wiers, Van de Luitgaarden, et al., 2005; Wiers, Wood, et al., 2003) and by motivational techniques (e.g., Cox et al., Chapter 17; Marlatt et al., 1998). Cognitive behavioral strategies also target implicit and explicit beliefs by explicitly challenging problematic alcohol-related beliefs, and by implicitly challenging such beliefs by building up self-efficacy around alternative coping behaviors. Whether interventions are actually achieving the cognitive effects that they are targeting is a topic of debate (see Stewart & Conrod, in press), but will be greatly facilitated by the refinement of methods to assess alcohol cognitions. We hope this review and tentative model will stimulate further research on automatic and controlled processes in (alcohol) addiction and their applications to interventions.

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