Implicit Cognition and Addiction

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ABSTRACT—***Extensive recent research has begun to unravel the more implicit or automatic cognitive mechanisms in addiction. This effort has increased our understanding of some of the perplexing characteristics of addictive behaviors. The problem, often, is not that substance abusers do not understand that the disadvantages of continued use outweigh the advantages; rather, they have difficulty resisting their automatically triggered impulses to use their substance of abuse. Existing interventions may help to moderate these impulses. In addition, new techniques aimed at directly modifying implicit cognitive processes in substance abuse are being developed.***

KEYWORDS—*implicit cognition; addiction; attentional bias; associations*

Until recently, most cognitive research on addictive behaviors was grounded in theories of rational decision making. The logic behind this approach was that people generally do things expected to yield good outcomes and refrain from actions likely to harm them. Applied to addiction, this approach suggested a central role of expected benefits versus costs of continued drug use. However, the typical problem in addiction is not that drug abusers do not realize that the disadvantages of continued drug use outweigh the advantages. The central paradox in addictive behaviors is that people continue to use drugs even though they know the harm. Recent research on implicit or automatic processes provides clues to understanding this paradox. The essential idea is that behavior is partly governed through automatic processes that often exert their influence outside conscious control. The growing focus on these processes does not imply that explicit or deliberate processes are unimportant, but rather that implicit processes must be acknowledged if addictive behaviors are to be understood and treated.

The term *implicit cognition* is used in relation both to implicit processes and to their assessment. Fazio and Olson (2003) defined implicit measures as indirect measures, procedures in which constructs (e.g., attitudes) are indirectly inferred from behavior (e.g., reaction times). These measures are implicit in the sense that they capture the to-be-measured construct in a relatively uncontrolled or unintentional manner. As such, they may uniquely capture processes that are important in real-life behaviors including addictions (De Houwer, 2006). An example illustrates this. Upon arriving at a colleague's farewell reception, John, a heavy drinker, is shown a tray of alcoholic and non-alcoholic drinks. The beer catches his eye (attentional bias) and he feels inclined to reach for it (action tendency). This inclination may be suppressed (conscious control) when John is motivated to do so, perhaps because he must drive home later. When there is little room for conscious control at the moment of this drinking decision (for example because John is talking with a colleague), the automatic action tendency may drive the behavior without conscious deliberation or control (see Fig. 1). For each process in this example, researchers have developed assessment tools, described later in this article.

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DUAL-PROCESS MODELS

Acknowledgment and assessment of implicit processes have been accompanied by new dual-process models of addictive behaviors (for examples, see Wiers & Stacy, 2006). Although the models proposed differ in their levels of description (from neurobiology to social cognition) and the number of systems proposed, the general picture is that of at least two semi-independent systems: a fast associative "impulsive" system, which includes automatic appraisal of stimuli in terms of their emotional and motivational significance; and a slower "reflective" system, which includes controlled processes related to conscious deliberations, emotion regulation, and expected outcomes (Strack & Deutsch, 2004). Different neural structures underlie these processes (see Berridge, 2001; Bechara, Noel, & Crone, 2006; Yin & Knowlton, 2006).

Neurobiological research reveals that the brain changes as a result of continued substance use (e.g., Berridge, 2001). Importantly, some of these changes involve the neural substrates related to emotion and motivation. With repeated drug use, the impulsive system becomes sensitized to the drug and to cues that predict use (note that some neurobiologists suggest this

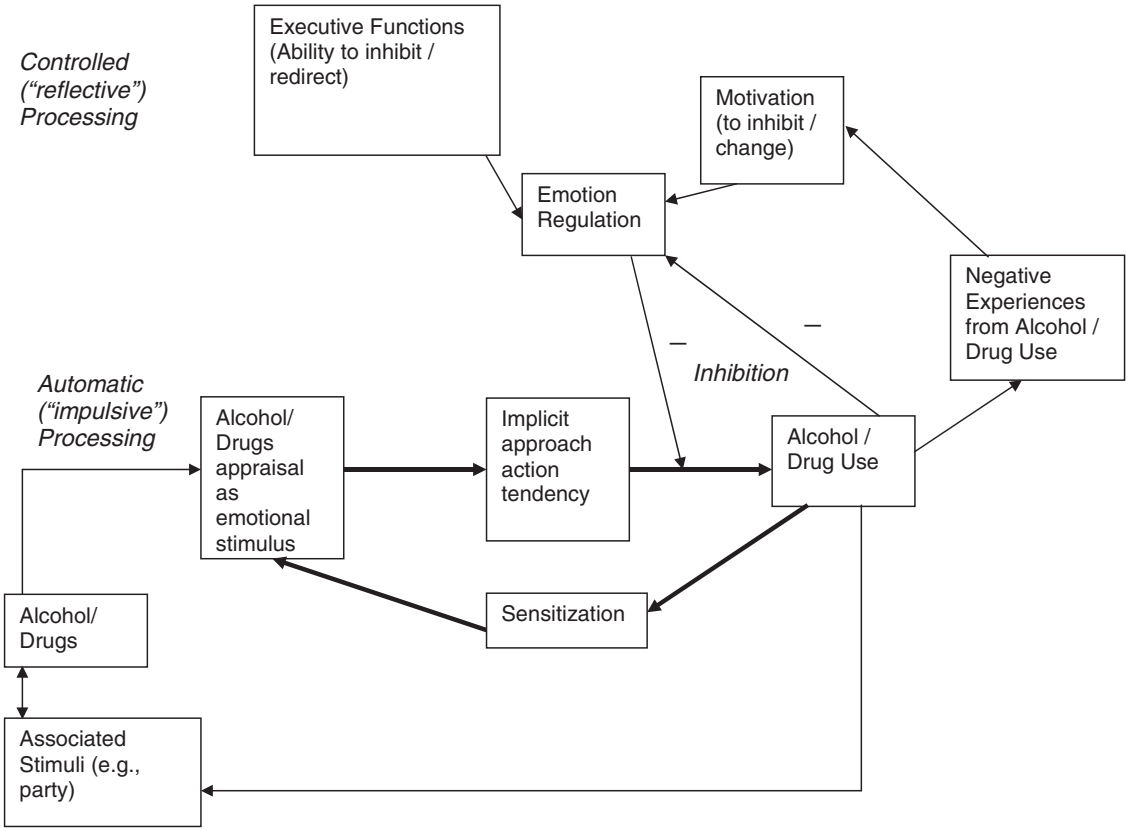

Fig. 1. A schematic overview of different processes involved in the development of addictive behaviors. As an addictive behavior develops, automatic affective (or ''impulsive''; Strack & Deutsch, 2004) processing of alcohol- or drug-related stimuli increases in strength, through adaptations at the neural level called sensitization (i.e., a stronger neural response after repeated exposure to a stimulus). The automatically triggered impulse to engage in an addictive behavior can be moderated or inhibited (emotion regulation), provided that there are sufficient motivation and cognitive resources available to do so (controlled or ''reflective'' processes). As the addictive behavior develops, the modulation of these impulses becomes more difficult through two processes: stronger automatic approach tendencies and weaker abilities to moderate (both as a direct effect of acute intoxication and as the long-term result of heavy alcohol or drug use).

neuro-adaptation is characteristic only of early stages of addiction). As a result, drug-related cues automatically capture attention (e.g., the sight of a bottle of beer). This may foster automatic onset of approach action tendencies toward the drug. This action tendency can still be inhibited if the person has enough ability and motivation to do so (see Fig. 1; cf., Fazio & Olson, 2003). Importantly, long-term effects of many drugs are impairments of the ability to inhibit and regulate impulsive action tendencies (Bechara et al., 2006). Moreover, impulsive individuals are at enhanced risk to develop addictive behaviors (Bechara et al., 2006; Strack & Deutsch, 2004). To make things worse, an acute effect of alcohol and many other drugs of abuse is to affect controlled cognitive processes while leaving the automatic associative processes intact (Fillmore & Vogel-Sprott, 2006). Taken together, the changes in the balance between these systems make the addictive behavior more "stimulus driven" and outside conscious control as an addiction develops.

EVIDENCE THROUGH NEW ASSESSMENT METHODS

Although some earlier theorizing addressed automatic processes in addiction (e.g., Tiffany, 1990), systematic research gained substantial momentum only recently. New assessment strategies that measure automatic or implicit processes involved in addiction are applied. There are two general classes of implicit-cognition tests used: tests of attentional bias and tests of memory associations. The best-known test of attentional bias is the drug-Stroop task. The participants' task is to name the color of words (i.e., name the color of the ink, irrespective of the meaning of the word). Substance abusers do this more slowly for words related to their addiction (e.g., alcohol abusers are slower to say "red" to the word *beer* printed in red letters than to the word *barn*). This drug-Stroop interference effect is a robust phenomenon that has been demonstrated for many addictions. A recent meta-analysis including dozens of drug-Stroop studies (primarily on smoking and drinking) found that as participants have a stronger urge to

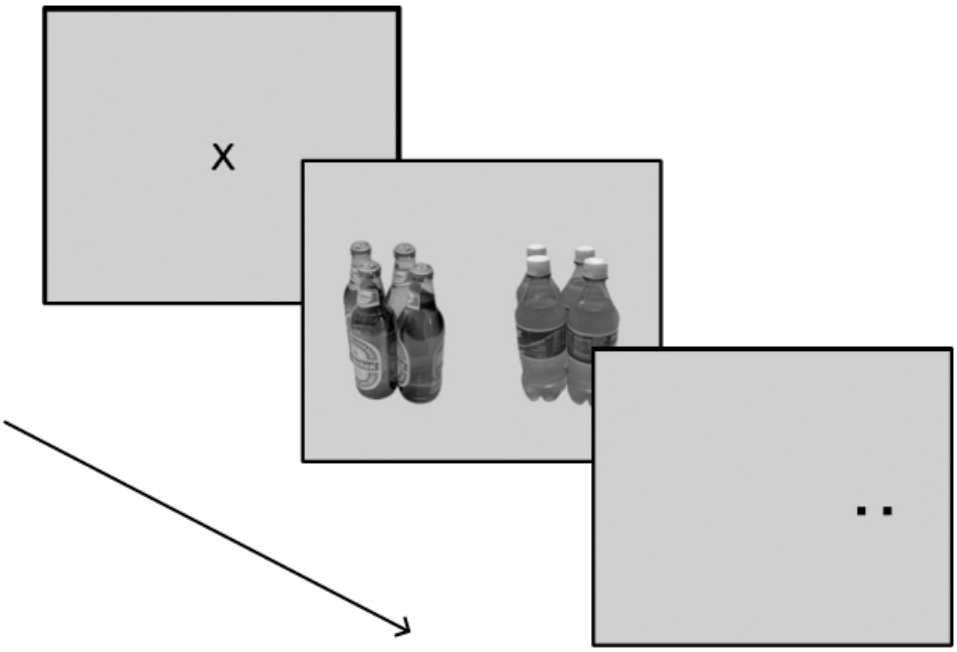

Fig. 2. Schematic overview of a visual probe test, here used to assess an attentional bias for alcohol. Participants ignore the primes (two pictures, one alcohol, one soft drink) and respond to the target (one or two dots, here two dots). Normally, the target replaces alcoholic drinks 50% of the time and soft drinks 50% of the time. In a retraining version, the target replaces soft drinks 90% of the time. The result is that heavy drinkers implicitly learn to direct their attention to the soft drink rather than to the alcoholic drink.

use a drug, their drug-Stroop-interference effect is larger (i.e., slower color naming of drug words; Cox, Fadardi, & Pothos, 2006). A second often-used test of attentional bias is the visual-probe test. In this test, two pictures are shown simultaneously on a computer screen, one drug related, the other not. After a brief interval, these pictures disappear and the target cue appears in place of either the drug-related picture or the neutral one (Fig. 2). Drug abusers more rapidly detect a target stimulus when it replaces a drug-related picture than when it replaces a neutral picture (see Field, Mogg, & Bradley, 2006). This test is thought to reflect an early component of attention (orienting), while the drug-Stroop test is thought to assess problems in disengaging attention from drug-related cues. Recently, researchers have begun to use eye movements to further investigate these attentional subprocesses (Field et al., 2006).

The second class of implicit measures assesses memory associations. Stacy and colleagues have developed a variety of memory-association tasks, modeled after tests used in basic memory research. Importantly, in these tests, the target behavior (alcohol or drug use) is not mentioned. Participants give their first association to a cue, which is either drug related or not (e.g., "Friday night" vs. "Thursday morning"). Another associative-memory test presents participants with affective phrases that can be alcohol or drug related (e.g., "having fun"). In these tests, the dependent variable is the number of substance-related associations. Stacy (1997) demonstrated that this variable was the best cognitive predictor of alcohol and marijuana use in the month following the assessment, after controlling for previous use, background variables, and sensation seeking. Changes in alcohol use were predicted both by memory associations and by explicit outcome expectancies, while for marijuana use only memory associations predicted prospective use after controlling for previous use. This finding illustrates that spontaneous associations, which we believe reflect impulsive, automatic processes in addictive behaviors, assess unique information beyond more explicit expected outcomes.

Wiers and colleagues assessed memory associations through various reaction-time measures, mostly using adapted versions of the Implicit Association Test (IAT). The IAT is a timed classification test in which participants use two response keys to sort two times two opposing categories (hence two categories per response key). Two opposite concepts are the target categories (in our case usually alcoholic drinks vs. soft drinks) and the other two opposite concepts are the attributes (e.g., positive vs. negative valence). These target and attribute categories are combined in two different ways (i.e., the combination alcohol or positive press left, negative or soft drink press right, is compared with the combination soft drink or positive press left, negative or alcoholic drink press right). The IAT effect is the difference in reaction times between these two sorting conditions, based on the idea that when two concepts are associated, sorting is easier (faster and fewer errors). For many examples of the IAT, see www.implicit.harvard.edu.

Wiers et al. combined alcoholic drinks and soft drinks with two different emotional dimensions: positive–negative (valence) and arousal–sedation (Wiers, Van Woerden, Smulders, & De Jong, 2002). Perhaps surprisingly, faster reaction times were found for the combination alcohol–negative than for alcohol–positive, suggesting that both heavy and light drinkers have negative associations with alcohol. This reliable finding contrasted with the explicit positive attitudes of the same participants. Recent research suggests that heavy drinkers hold both positive and negative associations and that the strong negative associations found in the IAT are partly but not fully due to the fact that both alcoholic drinks and negative words are salient (Houben & Wiers, 2006). Does this mean that heavy and light drinkers do not differ in their implicit associations? No, it does not. On the arousal dimension, it was found that heavy but not light drinkers associated alcohol with arousal, and this was related to their alcohol use and problems (Houben & Wiers, 2006; Wiers et al., 2002). We hypothesized that this reflects sensitization, an important concept in current animal models of addiction (Berridge, 2001). The same has been hypothesized for other implicit measures of appetitive motivation, such as automatic alcohol–approach associations (Palfai & Ostafin, 2003) and attentional bias. Overall, the rapidly growing literature on new assessments reveals the potential importance of implicit processes and suggests many applications to addiction research (see Wiers & Stacy, 2006).

IMPLICATIONS FOR INTERVENTIONS

The work reviewed reveals that we are beginning to develop a better understanding of implicit processes that play a role in addictive behaviors. The next important question is whether these findings are helpful for interventions. First, implicit cognition may help by increasing our understanding of current interventions. Wiers, Van de Luitgaarden, Van den Wildenberg, and Smulders (2005) tested the effects of a cognitive-behavioral intervention in problem drinkers. They found a significant decrease in explicit arousal expectancies as a result of the intervention (not found in the control group), whereas the implicit arousal associations were hardly affected. Interestingly, changes in implicit and explicit cognitions were entirely uncorrelated. The change in explicit cognitions predicted a short-lived reduction in problem drinking in men. This finding suggests that this cognitive intervention is better suited to change explicit cognitive processes than to change implicit ones. Another application in interventions is a study showing that the increase of alcohol abusers' attentional bias during treatment predicted their later dropout (Cox, Hogan, Kristian, & Race, 2002). This suggests that implicit processes play an important role in relapse.

Second, researchers are beginning to develop new interventions, aimed at directly influencing implicit cognitive processes. One approach uses "attentional retraining." In this approach, tests used to assess an attentional bias (e.g., drug-Stroop or visual-probe task) are modified so that attention is trained away from the drug-related stimulus. For example, in a normal visual-probe task, the target replaces the alcohol and neutral pictures equally often. In a retraining version, the target replaces the neutral picture 90% of the time. This way, the alcohol abuser implicitly learns to turn attention away from alcohol, toward the neutral stimulus (see Fig. 2). Initial findings from three different labs are quite promising: Heavy drinkers implicitly learn to direct their attention away from alcohol. A study by Field and Eastwood found significant effects on subsequent craving and alcohol consumption (see Wiers et al., 2006). An initial finding by Cox and colleagues suggests that repeated retraining may help heavy drinkers to learn to control their drinking (see Wiers et al., 2006).

Another approach aimed at changing automatic processes in addiction takes a different perspective: Rather than trying to unlearn maladaptive associations, one tries to automatize action plans that lead to alternative behaviors. When stated in simple "if-then" formulations (implementation intentions), these action plans can lead to action without the need for controlled processes. An example could be: "If I drive, then I drink soft drinks." Given the negative effects of many drugs on controlled processes, automatic action plans may be particularly beneficial in curtailing or reducing use of alcohol and other drugs (for examples, see chapters by Palfai and by Prestwich and colleagues in Wiers & Stacy, 2006).

How do these interventions relate to existing treatments? We see the newly developed interventions as potentially helpful supplements to existing treatments rather than as replacements. It has been well documented that motivation to change addictive behavior plays an important role in the change process. One way to increase motivation to change is through motivational interviewing. Moreover, sufficient motivation to change is a prerequisite for participation in any intervention, and often severe negative drug-related consequences need to be experienced before this point is reached (Fig. 1). Existing interventions may help to moderate the influence of appetitive processes on behavior. This can be done by increasing motivation to change or by training control over the impulse to use drugs. Perhaps newly developed tools such as attentional retraining can add to current treatments. However, we stress that this work is currently in an early, developmental phase; the first clinical trials are now being conducted.

FUTURE DIRECTIONS

The first future challenge in research on implicit cognition and addiction concerns theory and assessment. The newly developed assessment tools are not yet optimal and much effort is currently being devoted to improving them and to developing new ones. A related issue concerns the relationship between different measures of implicit cognition and the processes they assess. A second issue concerns the relationship between implicit mea-

sures and neurobiological processes. Many authors (see Wiers & Stacy, 2006) have expressed the idea that implicit measures may better reflect "deeper" affective mechanisms that operate outside awareness than may explicit measures, and thus may provide a unique window on these processes in the development of human addiction. However, this idea largely awaits empirical confirmation. If validated, it would imply that the current gap between neurobiological models of addiction (largely based on animal research) and psychological addiction research might be bridged. Additionally, few studies have addressed the development of implicit versus explicit cognitive processes in relation to the development of addictive behaviors. Recent evidence indicates that long-term effects of alcohol and drugs on systems of emotion and motivation are particularly pronounced during adolescence, probably because these systems are still developing then. Unfortunately, this is also the period in which alcohol and drug use peak, making this an important issue for further study. Finally, the research on new ways to change implicit cognitive processes and on helping substance abusers regain executive control over implicit processes is an exciting avenue for future research. These efforts may eventually lead to better prevention and treatment of this widespread problem.

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