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Motivation and Self-Regulation in Addiction: A Call for Convergence

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Abstract

Addiction models have frequently invoked motivational mechanisms to explain the initiation and maintenance of addictive behaviors. However, in doing so, these models have emphasized the unique characteristics of addictive behaviors and overlooked the commonalities that they share with motivated behaviors in general. As a consequence, addiction research has failed to connect with and take advantage of promising and highly relevant advances in motivation and self-regulation research. The present article is a call for a convergence of the previous approaches to addictive behavior and the new advances in basic motivation and self-regulation. The authors emphasize the commonalities that addictive behaviors may share with motivated behavior in general. In addition, it is suggested that the same psychological principles underlying motivated action in general may apply to understand challenging aspects of the etiology and maintenance of addictive behaviors.

Keywords

addiction; brain disease; motivation; self-regulation

Substance abuse and drug addiction are typically characterized by intense and, at times, uncontrollable drug craving, along with compulsive drug seeking and use that take place at the expense of most other activities and persist even in the face of devastating consequences (National Institute on Drug Abuse, 2012a, 2012b). They represent a major public health concern that affects both individuals and society. Chronic diseases, such as cancer and HIV/AIDS, as well as drunk driving, child abuse, violence and crime, homelessness, and school- and work-related problems are all related to or impacted by substance abuse. Given the importance and the magnitude of substance-related problems, researchers across various disciplines have deployed a substantial amount of effort and resources to understand the

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causes and consequences of substance abuse and to develop effective prevention and treatment strategies.

Historically, the phenomena of substance abuse and drug addiction have been approached from different perspectives, emphasizing the importance of different factors in the etiology, development, and maintenance of addictive behavior. The prominence of socioeconomic factors (Chein, Gerard, Lee, & Rosenfeld, 1964), cultural factors related to the norms associated with drug use (Lindesmith & Gagnon, 1964), developmental factors (Jessor & Jessor, 1977; D. Kandel, 1975; D. B. Kandel & Jessor, 2002), biopsychological factors (e.g., Flay & Petraitis, 1994), and cognitive factors (e.g., M. H. Becker, Drachman, & Kirscht, 1974), just to name a few, waxed and waned in addiction models. These perspectives have proliferated and shifted with social, political, and cultural changes, partly depending on the drug in question and on the population under study (see N. D. Campbell, 2010, for an epistemological perspective).

Motivation and motivational constructs have been accorded a central place in many theoretical approaches to addiction. Across areas of investigation, substance use has been approached in terms of its instrumentality to fulfill different motivations or goals. The most common explanation of addiction typically takes the form of a two-sided hedonic hypothesis: Addictive drugs are taken to achieve a pleasant drug “high” (Everitt & Robbins, 2005; Hyman, Malenka, & Nestler, 2006; Robinson & Berridge, 1993, 2003; Stewart, de Wit, & Eikelboom, 1984; Stewart & Wise, 1992) and/or to escape an aversive withdrawal “low” or to cope with negative affect (Baker, Morse, & Sherman, 1987; Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Koob & Le Moal, 2008; O’Brien, 1976; Solomon, 1977; Solomon & Corbit, 1974; Wikler, 1948). In addition to these basic motivations, substance use behavior has been discussed in terms of its instrumentality to fulfilling heterogeneous motives, such as socializing or fitting in (with a drug using culture). Accordingly, initiation and maintenance of substance use are explained by individuals’ expectancies of positive outcomes as a result of substance use (see B. T. Jones, Corbin, & Fromme, 2001, for a review; Cooper, Frone, Russell, & Mudar, 1995; Cox & Klinger, 1988, 2004; Kuntsche, Knibbe, Gmel, & Engels, 2005; Palfai & Weafer, 2006). Similarly, in behavioral economics, substance use and addiction are approached as the result of a “rational” choice justified by instrumentality of drug use to maximization of a desired outcome (e.g., feeling good, not feeling bad, smooth social interaction) and the lack of alternative options or means to these particular outcomes (G. Becker & Murphy, 1988; Heyman, 2009; Rachlin, 1997).¹

Regardless of the perspective taken and the language used, there is little debate about the importance of motivation in understanding addiction. However, there is little agreement about the manner in which motivation and goals operate in driving addictive behavior (Bevins & Bardo, 2004). Addiction researchers have focused predominantly on identifying

¹Note that there are important theoretical and empirical approaches to addiction that may not receive extensive attention here. The scope of this article is to discuss motivational and self-regulation mechanisms and their relevance for addiction, rather than to provide a comprehensive theoretical analysis. Therefore, our discussion will be mainly focused on the theoretical perspectives that emphasize motivation. Other concepts and empirical research will be discussed throughout the article as they become relevant to the current analysis.

and classifying specific motivational contents and their corresponding processes and have neglected the general motivational process at the root of all behavior. It is unclear what relevant motivational principles may account for the changes in addictive phenomena that occur over time and across situations and for the alternations between episodes of bingeing and abstinence that constitute the defining aspect of addictive behavior. Whether drawing on sophisticated neural circuitry or economic principles and mathematical functions as explanatory mechanisms, motivational research on addiction has been mainly phenomenon- and data-driven rather than theory-driven, and hence it “rests on lists rather than principles,” as Wise (2004, p. 161) aptly put it.

This is surprising and unfortunate given the recent advances in basic motivation and self-regulation research, which emphasize the motivational process rather than specific motivational contents and uncover the principles that regulate motivated action in general. These developments remain relatively foreign to addiction researchers, with two important consequences. On the one hand, addiction is viewed as a “special,” unique phenomenon without sufficient attention to the continuities and commonalities that it shares with behaviors traditionally not considered addictive. On the other hand, motivation and self-regulation researchers have largely ceased addressing addiction and stopped short of extending their theories and empirical work to addictive phenomena.

This article is a call for convergence. We want to argue that addictive behavior is a special case of motivated behavior. As such, the same principles that apply to the regulation of motivated action in general should be relevant to the development and maintenance of addiction. In doing so, we will discuss previous approaches and recent empirical evidence across different areas. Although there has been a striking dissociation across different perspectives regarding the factors responsible for the etiology, development, and maintenance of addiction, we emphasize the commonalities and highlight the continuities that addiction shares with behaviors traditionally not considered addictive. We will then outline a theoretical framework that identifies the basic motivational principles that underlie the general dynamics of human action and that may therefore afford the treatment of seemingly disparate aspects of addiction and other motivated behaviors in an integrative manner. This perspective may converge with the current addiction approaches, thus contributing to a more complete understanding of addiction with important implications for prevention and treatment.

What Is So Special (and Nonspecial) About Addiction?

“Addiction” (from the Latin *addicere*) is a term that has been used since the 15th century to denominate a state of being surrendered (devoted) to something habitually or compulsively (“Addiction,” n.d.). As apparent in this definition, addiction is a term that has a broad general meaning and could be used in connection not only with eating, sexual behavior, gambling, and substance use but also with TV watching (Smith, 1986), religious confessions (Lewis, 1992), status (Scitovsky, 1992), and an increasing list of other behaviors (Ainslie, 1999; Orford, 2001; Wise, 2002) motivated by the possibility of positive or rewarding outcomes. As Peele (1985) summarized it, “addiction may occur with any potent experience” (p. 25). Accordingly, some scholars have argued that drug addiction is defined

by a pattern of behavior that can be simply identified as habitual responses to the rewarding properties of different substances and have emphasized the commonalities between drug abuse and other habits motivated by potent experience (eating, sex, etc.; Ainslie, 1992; G. Becker, 1992; Heyman, 2009; Holden, 2001; Orford, 2001; Shaffer et al., 2004; Weil & Rosen, 1993; Wise, 2004).

It is of interest that until recently, mainstream addiction research has greatly departed from this broad definition of addiction that can encompass any kind of behavior whatsoever. Instead, there has been a clear tendency to overidentify addiction with substance abuse (e.g., Holden, 2001) and to distinguish drug addiction in particular as a unique phenomenon, quantitatively and qualitatively distinct from behaviors and habits of everyday life. However, recent evidence in psychology, behavioral economics, and neuroscience seems to increasingly suggest that the qualitative dichotomy is unwarranted and that addiction to drugs shares essential commonalities with motivated or goal-directed behaviors in general. Our next section will review some of the traditional perspectives, as well as the recent evidence, and discuss the implications for a view of addiction as motivated behavior.

Addiction: Dependence and negative reinforcement

In their attempts to understand the etiology and maintenance of drug addiction, late 20th-century researchers focused mainly on drugs' pharmacological properties. It has been argued that, because of their pharmacological properties, psychoactive drugs (unlike other activities) are physiologically, rather than merely psychologically, addictive (Leshner, 1997; Wise, 2002). That is, the use of psychoactive drugs initiated by the desire to obtain a "drug high" may develop into drug dependence, as revealed by withdrawal symptoms when drug administration is interrupted. The classical physical dependence symptoms, such as cramps, sweating, nausea, convulsions, and so on, are quite dramatic and can be objectively measured. Thus, the notion of physiological dependence offered a potential explanation of addiction as the result of the addict's attempts to eliminate the negative experience of withdrawal (Koob & Le Moal, 1997, 2001, 2008; Solomon, 1977; Solomon & Corbit, 1973; Wikler, 1948).

However, as research progressed, it soon became apparent that dependence is neither a necessary nor a sufficient condition for addiction and therefore not a key element in motivating drug seeking and use (Koob & Volkow, 2010; Robinson & Berridge, 2003; Stewart & Wise, 1992; but see Shaham, Erb, & Stewart, 2000, and Shalev, Grimm, & Shaham, 2002, for reviews; Wise, 1987). First, dependence models did not offer an explanation for why drug self-administration habits get established. Even in the case of opiates, which served as the model or prototype for the dependence theory, compulsive self-administration is rapidly established in the absence of classic dependence signs (Deneau, Yanagita, & Seevers, 1969; D. P. Devine & Wise, 1994; Woods & Schuster, 1971). Furthermore, the dependence models did not explain why relapse rates are so high in the absence of any withdrawal symptom for days, months, and even years after the addict has been adequately detoxified and drug free (Mello & Mendelson, 1965; Woods, Ikomi, & Winger, 1971; Wise & Bozarth, 1987). Such evidence led many to question the usefulness of dependence in explaining addiction. If dependence theory fails in the prototypical case of

opiate self-administration, then the notion of dependence is even less useful to explain addiction to substances that produce weak or atypical dependence signs (Heyman, 2009; R. T. Jones, 1980; Shiffman, 1979).

Addiction: Appetitive processes

As the dependence approach became unsatisfactory in accounting for important addiction phenomena, a significant number of researchers turned to the paradigms and principles of operant psychology as an alternative source of understanding addictive behavior. According to these principles, the ability of various agents (i.e., drugs) to establish compulsive self-administration lies in their reinforcing properties or their capacity to elicit approach or forward locomotion (D. P. Devine, Leone, Pocock, & Wise, 1993; Glickman & Schiff, 1967; Robinson & Berridge, 2003; Wise & Bozarth, 1987). From this perspective, drugs meet the Skinnerian definition of operant reinforcement (Skinner, 1953), and the development of drug self-administration follows the laws of reinforcement, as revealed by the plethora of studies on other habit-forming agents, such as food, water, or sex. According to this way of thinking, the individual learns an association between drug self-administration and a desirable end state. It is this association, initially anticipated or expected and subsequently strengthened through sustained drug administration, that “pushes” the organism forward toward drug use, hence motivating self-administration. The reinforcing effects of drugs, and thus their addiction liability, are assumed to result from their capacity to elicit approach behavior; this is seen to account for both initial development of drug-seeking habits and the rapid reinstatement of drug use after long periods of drug abstinence (for detailed discussions, see Everitt & Robbins, 2005; Robinson & Berridge, 2003; Wise, 2002).

From the behavioral perspective, then, it is the motivational process whereby an initially neutral behavior or action (i.e., drug administration) acquires incentive value that prompts approach behavior. That, in contrast to tolerance and dependence, represents the common denominator in the addictive properties of all drug classes. Note, however, that the motivational principle is much broader than the domain of addiction, however defined, and it constitutes a general mechanism responsible for all human action (Carver & Scheier, 1981; Custers & Aarts, 2005; Heckhausen, 1977; Heckhausen & Kuhl, 1985; Klinger, 1975, 1977; Pervin, 1989; Young, 1961). According to this principle, human life is organized by self-regulation toward desirable end states and away from undesirable end states. An action or a specific behavior (i.e., drug self-administration) is enacted as a function of its perceived instrumentality in the attainment of such states.

Addiction: Neuroadaptations

The motivational commonalities between addictive behavior and other behavior types are further supported by recent neuroscience developments. Accumulating evidence suggests that alterations in the neural circuitry normally involved in pleasure, reward processing, and incentive motivation typically associated with addictive drug use are rather common to other behaviors motivated by potent reinforcers, such as food, sex, thrill and novelty, internet and video-game use, money, beauty, chocolate, and exercising (Bardo & Dwoskin, 2004; Ettenberg & Camp, 1986; Holden, 2001; Shaffer et al., 2004; Volkow & Wise, 2005; Wise,

1982, 2002, 2004). Indeed, it is now accepted that all positive reinforcers (drugs included) activate a common biological mechanism: the reward pathway. Most motivated behavior—even the seeking of food or water when thirsty—is learned (Changizi, McGehee, & Hall, 2002). Both animals and humans learn directly or indirectly that certain (initially random) actions are rewarding or associated with positive consequences, whereas others are not. Whenever an action that satisfies a need or fulfills a motivation is performed, the brain, through the dopamine system, records the experience and its antecedents, and the individual is likely to do it again (Berridge & Robinson, 2003; Cardinal, Parkinson, Hall, & Everitt, 2002; Hyman, 1994; Hyman et al., 2006; Robinson & Berridge, 2003; Volkow & Wise, 2005; Wise, 2004; Wise & Bozarth, 1987). Dopamine is important through its role in the selective reinforcement of associations between a reward and otherwise neutral stimuli. It is implicated in the “stamping in” of memory that attaches motivational importance to all otherwise neutral environmental stimuli (Flagel et al., 2011; Wise, 2004). But as Holden (2001) put it, “as far as the brain is concerned, a reward is a reward, regardless of whether it comes from a chemical or an experience” (p. 980). Addictive drugs clearly activate such neural circuits, often more strongly than do other such stimuli. However, as Wise (2002) noted, this suggests a quantitative rather than a qualitative difference and emphasizes the commonalities between addiction and other motivated behaviors rather than their differences.

Other motivated behaviors

Evidence now exists that the pattern of behavior typically associated with addiction may characterize other motivated behaviors, including seeking self-esteem, love, money, and sex (see Vohs & Baumeister, 2008, for an extensive discussion on these commonalities), and even such “pedestrian” pursuits as golf, jogging, cooking, or playing an instrument (Vallerand et al., 2003).

For instance, the need for esteem and admiration from others and the behaviors associated with fulfilling such needs may lead to an addiction-like pattern (Baumeister & Vohs, 2001). Specifically, among people with a strong motivation for admiration and high regard, favorable outcomes and positive social feedback result in increased desire (i.e., craving) for even more esteem and admiration. Such individuals will constantly seek new opportunities to accrue social rewards (W. Campbell, 1999; W. Campbell, Rudich, & Sedikides, 2002; Morf & Rhodewalt, 2001; Rhodewalt, Madrian, & Cheney, 1998; Wilson, Centerbar, Kermer, & Gilbert, 2005) and are generally unwilling to adjust their high self-esteem, even when it is not supported by the social environment, in which case they respond with hostility and aggression (Bushman & Baumeister, 1998).

Motivation for love with a specific person has been long associated with patterns of behavior that bear striking similarities to addictive behaviors (Peele & Brodsky, 1975). Being with the person one loves elicits euphoric highs that conjure up a permanent craving of togetherness, elicits time- and energy-consuming behaviors to be with the loved one, and even produces withdrawal-like symptoms (cf. lovesickness) upon separation from the target of one’s affection.

In the realm of motivation for money, economists speak of the *hedonic treadmill* to explain people's increasing greed with accumulating wealth (Kasser & Ryan, 1993). Adaptation processes echoing drug tolerance effects have been invoked to explain why acquired wealth often results in increased (and unsatiated) motivation to amass more money, even when doing so brings little happiness or satisfaction (Diener, Suh, Lucas, & Smith, 1999; Kasser & Ryan, 1993; Sirgy, 1998).

Numerous other activities could be pursued in an addictionlike pattern, whereby an initially neutral activity becomes a consuming passion whose pursuit is experienced as a “necessity” despite potentially negative consequences. Vallerand and colleagues (2003) called this way of pursuing an activity “obsessive passion” and investigated it in different domains. For instance, obsessively passionate cyclists continued to bike outdoors during the cold, snowy winter season in Québec. They reported that they could not live without biking, could not control their desire to do it, could not imagine their life without it, and experienced seriously negative emotions when the activity was blocked. Similarly, obsessively passionate dancers reported a loss of control in their involvement in dancing, expressed in a strong need to dance, and experienced difficulty in missing a performance even when injured and in pain (Rip, Fortin, & Vallerand, 2006).

The above discussion reveals that the patterns of behavioral, psychological, and neurophysiological phenomena that characterize addiction to drugs are hardly unique to drug use but rather are common to many motivated human behaviors. Evidence across domains seems to converge on the conclusion that addiction is, after all, a motivated behavior where drug administration is initiated and maintained due to its rewarding capacity—that is, its ability to fulfill a motivation. Yet jogging, drinking a cup of coffee, or eating a piece of cake elicit a similar effect. All reflect individuals' attempts to attain a desirable end state.

Although the research discussed earlier supports the commonalities between substance use and addiction and motivated behavior in general, such commonalities are typically approached at a phenotypical level by describing how addiction and other motivated behaviors “look” similarly either at the neurophysiological level or at the behavioral level. Most models discuss how drug use, similarly to other motivated behavior (e.g., jogging), acquires motivational value and tends to perpetuate itself and emphasize a common neuropsychological basis of such processes. However, there are surprisingly few attempts to explore the broader implications of such commonalities and to explain how the general motivational and self-regulatory processes may account for other aspects of addictive behaviors. For instance, Vohs and Baumeister's (2008) model emphasizes the similarity between addiction and other behaviors motivated by self-esteem, love, money, and so on and suggests that such similarities are the result of a common motivational process, whereby “getting begets wanting” (p. 376). In other words, regardless of the motivational content, when a motivation leads to satisfaction or some other form of reward, that motivational state will be strengthened and reemerge. Conversely, when the motivation is unfulfilled, it results in reduction or extinction. Although this model is one of the few attempts to identify a general motivational process underlying addiction and other motivated behaviors, it remains limited to only one aspect of addiction. Specifically, it attempts to explain how the motivational value of substance use (similarly to other motivated behaviors) is acquired and

strengthened. However, according to the model, long periods of abstinence should result in the reduction and even the abstinence of substance use behavior, which is inconsistent with the patterns of relapse that often characterize addiction. We believe that approaching addiction from a motivational and self-regulatory perspective has broader theoretical implications. That is, the same principles that apply to the regulation of motivated action in general should also apply to the development and maintenance of addiction, despite the negative consequences often associated with addictive behaviors.

Our next section attempts to explore these principles and their relevance to addiction in greater depth, from a conceptual perspective based on the recent advancements into motivated behavior and self-regulation. Such an analysis may offer new insights into the self-regulatory mechanisms underlying drug addiction specifically and may address some of the challenging questions regarding the etiology, development, and maintenance of addictive behaviors more generally.

Addiction as a Motivated Behavior

Motivation concepts have been invoked to explain why people behave as they do and what makes individuals shift from one state to another (Allport, 1937; Atkinson & Birch, 1970; Kruglanski & Köpetz, 2009a, 2009b). The processes that translate motivation into action have been referred to as ones of self-regulation (Carver & Scheier, 2011; Shah, 2008). They include setting a goal (as a desirable and attainable end state), finding appropriate means, warding off distractions, and negotiating conflicts. As such, they underlie most of our behaviors, whether stopping for a cup of coffee, choosing a vacation spot, or, indeed, using drugs.

A new look in motivation: The basic principles of motivated behavior

The past 20 years of research on motivated behavior have been characterized by a social-cognitive perspective that approaches motivation and goals in terms of cognitive representations of desired end points interconnected with other goals and means of attainment (Bargh, 1990; Bargh & Huang, 2009; Carver & Scheier, 1998; Fishbach & Ferguson, 2007; Gollwitzer & Moskowitz, 1996; Kruglanski, 1996; Kruglanski & Köpetz, 2009a, 2009b; Kruglanski et al., 2002). This definition implies that motivational concepts abide by the general principles that govern all cognition (e.g., categories, concepts, judgments, or opinions). Such principles include the notions of construct accessibility (Higgins, 1996) and interconnectedness between motivational constructs and their dependence on limited cognitive resources (for reviews, see Fishbach & Ferguson, 2007; Kruglanski & Köpetz, 2009a, 2009b). From this perspective, motivational phenomena such as goal setting and goal activation, choice of means, and management of goal conflict are seen as the products of cognitive, motivational, and emotional principles. In what follows, we outline some of these principles.

Cognitive principles of motivated behavior—As a type of cognition, motivational constructs are inferred from relevant evidence. For instance, people may adopt a specific goal (e.g., using cocaine) because they inferred from relevant evidence (e.g., their own experience, cultural beliefs) that it is a worthy goal to have. Motivational constructs are

stored, and, according to the *accessibility principle*, they are capable of being activated from memory (Higgins, 1996). Whereas some goals are consciously activated from memory and pursued (e.g., selecting the next vacation spot), others may become spontaneously accessible through environmental or internal cues cognitively associated with the goal (e.g., the smell of freshly brewed coffee may automatically activate the goal of having a cup thereof).

As people pursue their goals, they may consider a multitude of action plans, objects, and even people that represent the means to attaining their goals. Specifically, then, according to the *interconnectedness principle*, goals are cognitively associated with other relevant constructs, such as their means of attainment (Kruglanski et al., 2002). For instance, the goal of being physically fit may be connected to different means, such as running, walking, and weight lifting. Once a goal becomes activated, the activation spreads to its corresponding behavioral plans (Aarts & Dijksterhuis, 2000; Aarts, Dijksterhuis, & De Vries, 2001; Bargh, 1990; Bargh & Huang, 2009; Ferguson & Bargh, 2004; Kruglanski et al., 2002) and stirs individuals to action.

Effective self-regulation requires the individual to select and implement the appropriate means to his or her goals. The course of action that the individual may take and the phenomenological experience associated with his or her choice depends on a variety of cognitive and motivational factors. Some of these factors refer to the number of goals and means currently active, the strength of the associations among them, and the value or importance of each goal, which may vary from one moment to the next, lending dynamism to individuals' behavior. For instance, if running is the means most strongly associated (thus most instrumental) to the goal of being fit, upon goal activation, running will likely be the course of action that the individual takes. However, if in addition to the goal of being fit, the goal of talking to a friend happens to be active, the individual may forego running and go for a walk with the friend. Such course of action may allow him or her to fulfill both active goals simultaneously. Conversely, if being fit is relatively more important than talking to a friend, the individual may be more likely to choose running rather than walking with a friend as the means perceived to be most instrumental to attain the important goal.

Finally, as with other cognitive constructs, goals too are constrained by limited cognitive resources, such that the activation of a given goal may pull resources away from alternative goals (for reviews, see Fishbach & Ferguson, 2007; Kruglanski & Köpetz, 2009a, 2009b). For instance, if one's cognitive resources were committed to the goal of eating (e.g., in a high state of hunger) one might "forget" (i.e., momentarily suppress or inhibit) one's determination to diet and easily succumb to tasty but high-calorie culinary temptations.

Motivational principles of motivated behavior—Beyond their cognitive properties, goals have distinct "motivational" properties. Unlike other cognitive concepts, such as "tables," "doctors," or "butterflies," goals have a unique motivational meaning: They represent desirable end states presumed to be attainable through action (Kruglanski, 1996; Kruglanski et al., 2002). In turn, the desirability or the value of the goal determines goal commitment, or the degree to which the individual is determined to pursue the goal (which may express itself in persistence of goal-directed strivings despite obstacles and barriers). An important consequence of such determination is that activation of a high-importance goal

may result (according to the *goal shielding principle*) in the inhibition of alternative goals in order to maximize the likelihood of focal goal attainment (Shah, Friedman, & Kruglanski, 2002).

Affective principles of motivated behavior—By sheer association, in addition to the cognitive properties of the goal (i.e., its activation), its motivational properties (e.g., desirability or value) and the emotional aftermath of goal attainment are transferred to the means, that is, behavioral plans perceived as instrumental to goal attainment. This refers to the *principle of emotional transfer* (Fishbach, Shah, & Kruglanski, 2004). It is akin to the “anticipatory goal responses” discussed by neobehavioral learning theorists, who described organisms as having emotional reactions during goal pursuit that were analogous to those elicited upon goal attainment (Spence, 1956). The amount of emotional transfer from goals to means and, consequently, the emotional experience of engaging in that particular behavior, depend on (a) the importance of the goal that they serve and (b) the strength of the association between the behavior and the goal (Fishbach et al., 2004). The strength of a given goal–means association may be reduced by the simultaneous presence of alternative means (Kruglanski et al., 2002). This is reminiscent of the classic “fan effect” discussed by Anderson (1974, 1983), wherein the greater the number of specific facts linked to a general mental construct, the less likely it is that any particular fact will be recalled upon the presentation of the construct. The strength of the association between the goal and its means affects the transfer of cognitive (e.g., activation) and affective properties between the two. Specifically, the higher the number of means associated with a goal, the lower the strength of the association between any particular goal and means (Kruglanski et al., 2002) and the lower the level of activation and emotional transfer. As a consequence, when multiple means are present, the likelihood that any particular one of them is deemed instrumental and enacted toward goal achievement is reduced.

By identifying the general principles of goal-directed actions, the *new look* approach affords a broad view of human motivated behavior and captures its dynamic nature. It portrays the process of carrying out motivated action across specific goal contents that are applicable across persons and situations. In the following, we explore the implications of this approach in answering critical questions regarding drug use and addiction. Specifically, we will discuss the self-regulatory principles that may address (a) the transition from casual use to addiction, (b) individuals’ vulnerability to such transition, (c) what perpetuates drug abuse, and (d) how drugs take over one’s behavior despite serious negative consequences and what are some potential, albeit preliminary, “solutions” to this problem.

The new look approach to motivation in addiction

What underlies the transition from casual drug use to addiction?—A

fundamental question in the domain of addictive behavior is how substance use can result in addiction. People have always used substances, in different forms and for different reasons, whether for medicine, pleasure, religion, or curiosity (see Gahlinger, 2004, for a historical overview). Although over 90% of individuals experiment with alcohol and/or illicit substances, only a small proportion of these individuals become addicts (Robinson & Berridge, 2003). In fact, the latest report of the National Survey on Drug Use and Health,

reports that in 2010, 8.7% of the population ages 12 or older were classified with substance dependence or abuse in the past year (Substance Abuse and Mental Health Services Administration, 2011). The challenge for the addiction researcher, then, is to understand the factors that determine the transition from experimental, casual drug use to addiction and to identify the most vulnerable individuals.

A major difference between casual drug use and addiction is the evolving function of the behavior as the individual phases out of the former mode and moves into the latter. Whereas in the beginning drug use is merely a means to different motivations or goals that individuals may have (e.g., to satisfy curiosity, to feel good, or to socialize), for the addict, the behavior of drug use acquires a motivational pull or becomes an end in itself that is compulsively² pursued despite negative consequences. The question is how does this transition happen and via what specific processes?

Addiction models have typically attempted to answer this question through an interaction of Pavlovian and instrumental learning processes and their associated neuroadaptations that occur with repeated drug use (Everitt & Robbins, 2005; Redish, 2004; Robinson & Berridge, 2003). Specifically, through Pavlovian learning, previously neutral stimuli that predict rewards acquire motivational properties, becoming attractive and desirable incentive stimuli. Drug use is progressively reinforced because of the rewarding properties of the drugs, resulting in drug self-administration. During this process, the neural circuits involved in reward or incentive processing become sensitized or enduringly hypersensitive such that environmental stimuli closely associated with drug use gain incentive salience, permanently reminding (explicitly or implicitly) drug users about the rewarding properties of the drug. This sensitization, also known as a *conditioned motivational response*, is assumed to be responsible for drug users' pathologic "wanting" and insatiable use of the drug (e.g., Robinson & Berridge, 2004). Furthermore, such transition may reflect important changes in the frontocortical regions mediating the executive control over behavior typically associated with drug use (Everitt & Robbins, 2005; Jentsch & Taylor, 1999; Robbins & Everitt, 1999; Robinson & Berridge, 2003; Volkow, Fowler, Wolf, & Hitzemann, 1991; Volkow, Hitzemann, Wang, & Fowler, 1992). Such increased hypersensitivity to drug-related cues coupled with a weakened executive control has been invoked to explain substance use transition from a voluntary action governed by its consequences to a more habitual behavior triggered automatically by environmental cues.

Although these models provided important insights into the potential processes mediating the transition from casual drug use to addiction, it remains unclear how precisely drug-related stimuli acquire motivational value and what is the nature of such motivational value. Furthermore, most evidence supporting previous approaches comes from animal research

²The term "compulsive" carries considerable meaning, and it may refer to different aspects of addictive behavior, including constant drug seeking and use, loss of voluntary control, and irresistible strong urges. However, the literature is not clear on whether all these characteristics need to be present to characterize drug use as compulsive, nor is it clear whether compulsiveness is a necessary condition of addictive behavior. We use the term here to refer to constant drug use determined by a strong urge that the addict finds hard to resist despite his or her effort to control it. We believe that this conflictual aspect (which is also captured by the diagnostic criteria) is crucial. In this regard, we believe that compulsive use (which often but not always accompanies addictive behaviors) reflects a motivational conflict whereby the individual often succumbs to an immediate and strong urge despite other concerns (e.g., safety, health).

where accidental drug self-administration in highly controlled environments becomes systematic as the animals learn to associate a behavior (e.g., lever press, nose poke) with the rewarding effects of the drugs administered directly (to their brain, heart, etc.) following that behavior. However, in humans the story is more complicated. The first drug self-administration is usually accompanied by negative experience. In alcohol and smoking research, people describe their first drinking or smoking experiences as awkward, uncomfortable, and physically unpleasant (DiFranza et al., 2002; Fallon & Rozin, 1983; Moore & Weiss, 1995). In addition to overcoming such initial negative experiences with substances, humans also need to overcome potentially negative health and legal consequences that are usually absent in animals. The puzzling question, then, is what makes them do that? How do drug-seeking and drug-taking behaviors acquire motivational value despite the initial and long-term adverse consequences of substance use? We believe that the regulatory processes having to do with the relationship between goals and their means of attainment may provide valuable insights into these issues.

Emotional transfer from goals to means: One important aspect of human drug use is that the first experiences with drugs are rarely accidental, as they are in animals. People start using drugs for social rewards, affect enhancement, and/or to reduce boredom (Bogen, 1929; Brandt, 2007; Cooper, 1994; Cox & Klinger, 1988, 1990, 2004; De Micheli & Formigoni, 2002; Knee & Neighbors, 2002; Kuntsche et al., 2005; Palamar, Mukherjee, & Halkitis, 2008; Perry & Mandell, 1995; Riley, James, Gregory, Dingle, & Cadger, 2001; Sheeran et al., 2005; Spijkerman, van den Eijnden, & Engels, 2005; Waldrop, Back, Verduin, & Brady, 2007). In other words, people use drugs because they expect drugs to be instrumental to the achievement of important goals and therefore to the experience of positive consequences associated with goal attainment.

The use of drugs as means to different goals has important implications for the transition from casual drug use to problematic use and in some cases to addiction. The activity, which initially served only as a means to a goal, becomes a desirable state in itself, that is, goal capable of driving behavior automatically in the absence of the original motivation (Allport, 1937; Skinner, 1937; Tolman, 1935; Woodworth, 1918). The idea that positive affect associated with a behavioral state has motivating properties is the hallmark of incentive theory. In general, incentive theory (Bindra, 1974; Bolles, 1972; Toates, 1986) proposes that stimuli or states associated with positive affect form an incentive for which the organism will work.

Until recently, the processes underlying this phenomenon remained unknown. However, recent advances in the study of motivation and self-regulation have begun to uncover these processes. Specifically, behaviors that are routinely selected and performed to fulfill a certain motivation or to achieve a particular goal acquire instrumentality and become strongly associated with the goal (Aarts, Verplanken, & van Knippenberg, 1998; Bargh, 1990; Ouellette & Wood, 1998; Vohs & Baumeister, 2007; Zhang, Fishbach, & Kruglanski, 2007). This process is reminiscent of Pavlovian conditioning and instrumental learning (see Rescorla & Holland, 1982, for a review), but it specifies the mechanism. In other words, the cognitive association between the representation of the goal and the representation of the behavior enacted repeatedly to achieve the goal is strengthened over time. Such

strengthening of the association between a goal and a means facilitates a process of emotional transfer. More specifically, the motivational value (desirability) of the goal is transferred to the objects or activities that are strongly associated with the goal and are deemed instrumental to goal attainment. This process of emotional transfer from goals to means is known as *means valuation* and has been widely supported by recent self-regulation research (Brendl & Higgins, 1996; Brendl, Markman, & Messner, 2003; Ferguson & Bargh, 2004; Fishbach & Ferguson, 2007; Fishbach et al., 2004; Lewin, 1935; Markman, Brendl, & Kim, 2007). For instance, in one study, thirsty participants evaluated items more positively that could satisfy thirst directly (e.g., water and juice) but not items that were only moderately instrumental to the thirst-quenching goal (e.g., coffee and beer; Ferguson & Bargh, 2004).

It is thus possible that, just like the jogger who starts jogging to lose weight but becomes a regular runner who continues to run long after the weight loss goal was achieved because jogging became desirable in itself, the drinker who started drinking to socialize may continue to drink even outside the socializing contexts because drinking became valuable. In addition to its capacity to fulfill other important goals, substance use may be particularly effective in acquiring positive affect because of the initial pharmacological effects of drugs.

The idea that, through extensive drug use, drugs and drug-related stimuli may acquire positive valence and may spontaneously result in drug seeking and use has received support from numerous studies exploring measures of implicit attitudes (e.g., traditional and modified versions of the Implicit Associations Test [IAT], the Extrinsic Affective Simon Task, or IAT and sequential priming techniques). Results revealed that across different substance-use categories including drinking, smoking, and cannabis use, substance users associate their drug of choice with positive affect more strongly than do non-substance users (see Houben, Wiers, & Roefs, 2006, for an extensive review). Furthermore, such associations often predict increased levels of substance use (e.g., Houben & Wiers, 2008). For instance, using a Go/No-Go Association Task, Dabbs et al. (2003) showed that smokers had more positive implicit attitudes toward smoking than nonsmokers did. Furthermore, smokers exhibit more positive attitudes toward cigarettes and are more willing to purchase raffle tickets for the opportunity to win three cartons of cigarettes when they have been deprived of smoking than when they have just had a cigarette (Brendl et al., 2003; Sherman, Rose, Koch, Presson, & Chassin, 2003). In the domain of alcohol use, Wiers and his colleagues found that heavy drinkers demonstrated stronger alcohol-arousal associations compared with light drinkers (Wiers, van de Luitgaarden, van den Wildenberg, & Smulders, 2005; Wiers, Van Woerden, Smulders, & De Jong, 2002). Other studies using modified versions of the IAT showed that alcohol was associated with approach action tendencies in heavy drinkers and that such action tendencies were significantly correlated with the urge to drink as well as arousal reactivity in anticipation of alcohol consumption (Ostafin & Palfai, 2006; Palfai & Ostafin, 2003).

The principle of emotional transfer in the transition from casual drug use to addiction has important theoretical implications. First, it is consonant with the previous approaches, which emphasize the alterations of brain circuitry involved in incentive or reward processing as a critical process in this transition, and it explains the psychological principle that may

accompany such alterations. These approaches distinguish between “wanting” and “liking” and suggest that “liking” of drug use is not the driving force perpetuating drug-use behavior. Our approach, conversely, suggests that it is the value that the behavior acquires progressively (through emotional transfer) that may be a critical process underlying the transition from casual drug use as a means to different goals to addiction, where drug use becomes a desirable end state or a goal capable of driving behavior in itself. However, we do not propose a hedonic approach. The value associated with drug use does not imply a hedonic phenomenological experience associated with the behavior. Rather, it refers to the potential positive consequences of the behavior or its incentive value. The individual does not need to consciously “like” the drug. In fact, there is substantial recent evidence suggesting that individuals may adopt and persist at an originally neutral behavior (e.g., solving anagrams) following a mere association (through unconscious affective conditioning) of that behavior with positive affect. Furthermore, this happens without any change in individuals’ conscious evaluation (or affective experience) of that behavior (Custers & Aarts, 2005, 2010).

Second, the emotional transfer principle offers some explanations regarding the specificity of the drugs and drug administration behaviors that were left unexplained by previous approaches. Specifically, by explaining how a specific behavior related to a specific drug (e.g., injecting heroin) transitions from a means to an end in itself by accruing affective value, this approach offers some insights into how individuals became addicted to one particular drug rather than a class of rewards and why the majority of them stick with one particular substance and mode of administration rather than others.

Who is more vulnerable to addiction and why?—Given that only a small proportion of individuals transition from casual to problematic substance use, there is substantial effort to understand the biological, personality, and contextual variables that may enhance individuals’ vulnerability to addiction (see Redish, Jensen, & Johnson, 2008, for an extensive analysis, but also Flagel et al., 2011; Robinson & Berridge, 2003). The principle of emotional transfer may also offer some insights into this issue and may explain previous observations and findings.

As mentioned above, the emotional transfer principle suggests that behaviors (or means) acquire affect or value in direct proportion to (a) the importance of the goal that they serve and (b) the strength of the association between the behavior and the goal. Specifically, when multiple (versus a single) means are available for goal attainment, the affective properties of the goal (goal value) will spread to all means connected to the goal, resulting in a lower amount of affect being transferred to each particular means. This suggests that individuals who uniquely use drugs to fulfill some important goals (anxiety reduction, mood elevation, performance enhancement, etc.) are more prone to become addicts than are individuals who have at their disposal alternative ways of pursuing these goals and do not need to rely exclusively on drugs for that purpose. In other words, the teenager for whom socializing and being accepted by peers is a top priority and for whom alcohol and drugs are the only way he could achieve this goal may be more vulnerable to develop pathologic substance use than a counterpart for whom socializing may be equally important but for whom drinking is only one way (means) of socializing in addition to playing sports or going to the movies with

friends. This is so simply because in the former case individuals have a stronger association between using drugs and the motivation that this behavior fulfills, which facilitates the transfer of affect and may increase the likelihood of the drug use becoming a motivational force in itself. Conversely, when several means are perceived to be instrumental to the same goal, the likelihood of one means becoming predominantly used and therefore highly valued may decrease (Kruglanski, Pierro, & Sheveland, 2011). Indeed, previous research has documented that social support and social relationships may be substitutable for smoking and other addictive activities (DeGrandpre & Bickel, 1996; Fisher, 1996). Similarly, decision making and behavioral economics models suggest that substance use is a function of the availability of reinforcing alternatives (Green & Kagel, 1996; Rachlin, 1997; Redish, 2004). Our analysis takes a step forward and explains, based on the basic principles of self-regulation, why this may be the case.

From a prevention point of view, then, the likelihood of casual substance use transitioning into addiction could be reduced by diminishing the strength of the association between substance use and the goal that it serves. One way of doing so could be by adding more (substitutable) means to the goal. When the individual knows that he could hang out with friends and family or go to the gym to release stress and to feel good, the likelihood of alcohol becoming uniquely used as an emotional coping strategy and therefore becoming a desirable end state in itself decreases. Again, several lines of research provide indirect support for this notion. Across several studies, individuals who identify important life pursuits (e.g., friends and family, love and intimacy), are optimistic about such pursuits, and expect to draw satisfaction from them experience fewer drinking problems and are more likely to recover from alcohol abuse than individuals who do not identify such alternative pursuits (Cox & Klinger, 2002; Palfai & Weafer, 2006).

What perpetuates drug use? Automatic goal activation and pursuit

Accessibility of goals and goal-related information: Once goals have been adopted, they are likely to become active spontaneously without the individual's voluntary intention, awareness, or conscious control. This is because, as cognitive constructs, goals obey the principle of knowledge accessibility (P. G. Devine, 1989; Higgins & King, 1981; Higgins, Rholes, & Jones, 1977; Taylor & Fiske, 1978). Just like other cognitive constructs, goals too can be activated by aspects of the external environment or by people's internal associations (Aarts, Gollwitzer, & Hassin, 2004; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Fitzsimons & Bargh, 2003; Shah, 2003; Shah & Kruglanski, 2003; but see Fishbach & Ferguson, 2007; Kruglanski & Köpetz, 2009a, 2009b, for reviews).

The active goal operates on relevant stimuli and events to produce goal-appropriate outcomes (Ach, 1935; Bargh, 1997; Bruner, 1957; Gollwitzer, 1996; E. E. Jones & Thibaut, 1958; Kruglanski, 1996; Kuhl, 1986; McClelland & Atkinson, 1948). This notion has received rigorous empirical support in various studies (Aarts et al., 2001; Balcetis & Dunning, 2006; Ferguson & Bargh, 2004; Förster, Liberman, & Higgins, 2005; Moskowitz, 2002). Goals operate on any and all such relevant information: driving selective attention to it when it is present (Chartrand & Bargh, 1996), causing differential evaluation of it as to whether it facilitates or interferes with goal progress (Ferguson & Bargh, 2004),

transforming and manipulating the information in service of the goal (McCulloch, Ferguson, Kawada, & Bargh, 2008), and guiding behavior toward the goal (Bargh et al., 2001) through means selection and implementation. As Bargh and Huang (2009) put it, “the world is filtered through the goal’s eyes” (p. 139). This was presumed to be possible because goal constructs, as mental representations, contain information related not only to the desirability of the end state but also to the behaviors, objects, and plans needed to attain it. Thus, following goal activation, goal-related knowledge becomes more accessible and usable for performance of actions felt to afford goal attainment. Such accessibility helps people to recognize opportunities for goal satisfaction.

Consistent with these notions, addiction research has long documented the capacity of contextual cues to evoke what is known as drug craving, that is, a strong desire or intense longing for a drug (Bernheim & Rangel, 2004; Laibson, 2001; Marlatt & Gordon, 1985; Stewart et al., 1984; Tiffany, 1990). As discussed in the previous section, it has been suggested that anything processed during repeated drug-use episodes (e.g., perceived affective outcomes, drug stimuli, and environmental cues) could establish and strengthen such specific memory associations. These are often spontaneously activated and may govern drug-consistent cognitive, affective, and behavioral responses (Baker et al., 2004; Robinson & Berridge, 2004; Rooke, Hine, & Thorsteinsson, 2008; Stacy, 1997; Stacy, Ames, & Grenard, 2006; Tiffany & Conklin, 2000).

Indeed, recent research using different paradigms has supported the idea that drug users have heightened accessibility to drug-related cues, which constitutes a good predictor for subsequent substance use. For instance, memory associations whereby participants are instructed to respond to critical cue words, phrases, or pictures with the first response that comes to mind were found to be better predictors of subsequent alcohol and marijuana use than explicit outcome expectancies, sensation seeking, acculturation, and gender (Ames, Sussman, Dent, & Stacy, 2005; Stacy, 1997). In the same vein, contextual priming, which represents a more ecological activation of memory associations, has been found to have a significant effect on the processing of drug-related information. For instance, opiate-dependent participants were faster to respond to drug-related versus neutral words that followed withdrawal-related sentences (Weinstein, Feldtkeller, Law, Myles, & Nutt, 2000). Likewise, marijuana users reported stronger motivation to use marijuana and spent less time reading drug prevention information after being subliminally primed with social cues (i.e., the name of individuals who use marijuana), especially when such cues represented close social relationships (Leander, Shah, & Chartrand, 2009).

Similarly, research using a drug-specific Stroop task, a dot probe, and/or a visual probe or flicker task has repeatedly shown that drug users are more cognitively distracted by drug-related stimuli than by neutral stimuli and that such *attentional bias* plays an important role in guiding subsequent substance use (Cox, Fadardi, & Pothos, 2006). For instance, smokers have been found to exhibit greater smoking Stroop effects than never smokers or past smokers (Munafò, Mogg, Roberts, Bradley, & Murphy, 2003). Moreover, smoking Stroop effects have been found to correlate significantly with the number of cigarettes smoked per day (Mogg & Bradley, 2002; Zack, Belsito, Scher, Eissenberg, & Corrigan, 2001) and short-term cessation outcomes (Waters et al., 2003). Similar results have been reported for alcohol

abuse (see Bruce & Jones, 2006, for an extensive review). Other studies using the visual focus localization paradigms have also reported that attentional bias for drug-related stimuli correlates with self-reported drug use (Mogg, Bradley, Field, & De Houwer, 2003; Townshend & Duka, 2001; Yaxley & Zwaan, 2005).

Consistent with the notion that active goals increase the accessibility of goal-relevant information and prepare the organism for action, attentional bias toward drug-related stimuli is assumed to exert important preconscious influences on behavior by increasing drug craving and the tendency to direct approach behaviors toward drug-related cues (Field, Mogg, & Bradley, 2006; Franken, 2003; Palfai & Ostafin, 2003).

Goals–means association: Once goals have been activated and adopted, a series of regulatory processes is set in motion to initiate and maintain progress toward goal attainment. That happens because goal representations include a variety of behaviors, plans, and objects (means) that in the actor’s mind promise advancement toward one’s respective goal. According to the interconnectedness principle, when the goal becomes salient, it will automatically activate behavior representations and resultant action tendencies. For instance, Aarts et al. (2001) manipulated participants’ thirst and showed a subsequent increase in the accessibility of drinking-related objects. In this manner, a certain circumstance may become capable of activating a representation of an outcome (goal), which will in turn activate the behavior known to produce it. Such unique associations promote stable and repetitive choices and behavior, as in the case where driving to work each morning (instead of taking the bus or biking) may represent one’s attempt to maximize goal attainment by choosing the means that has proven effective in the past.

Such processes may explain some of the most intriguing behaviors associated with drug use, such as sex exchange for crack cocaine, which occurs frequently among female crack cocaine users (Logan, Cole, & Leukefeld, 2003; Logan & Leukefeld, 2000), despite its potential legal and health-compromising consequences. The problem, recognized by many, is not that these women do not know or understand the risk but that they have difficulty resisting such behavior when a crack cocaine craving is induced by contextual factors. This may happen because females who engage in sex trade to satisfy their drug craving may form cognitive representations where the goal of alleviating a drug craving is strongly associated with sex trade as a means toward their goal. Hence, the experience of drug craving may increase the accessibility of sex exchange as a means of drug obtainment and may result in initiating this behavior without conscious intention and voluntary control.

In line with this reasoning, Köpetz, Pickover, Collado, Calvin, and Lejuez (2012) investigated the automatic behavioral tendencies toward sex exchange as a means to obtain crack cocaine among female crack cocaine users. Specifically, the researchers used a joystick task paradigm to assess cocaine users’ automatic behavioral tendencies toward sex trade words as a function of goal activation (i.e., cocaine primes), gender, and history of sex exchange. In this paradigm, participants were subliminally presented with the word “cocaine” (vs. neutral words). This procedure was intended to manipulate the accessibility of the goal of drug obtainment by inducing a drug craving. The primes were immediately followed by sex trade words (and other words irrelevant to sex exchange). Using a joystick,

participants were asked to “move” away from rather than toward the sex trade words. The researchers reasoned that when the drug goal was active (after cocaine priming), women with a history of sex exchange (who therefore may have developed a strong association between the goal of obtaining crack cocaine and sex exchange as a means) should be faster to initiate movement toward the sex trade targets than away from them. That is precisely what happened. As additional support for the goals–means association, this effect was found only following cocaine primes, not neutral primes, suggesting that approach tendencies toward sex exchange are relevant only when the goal is active and not otherwise. Furthermore, the effect was not obtained among women with no sex exchange history or among men, presumably because for these participants, sex exchange did not represent an instrumental means to drug obtainment.

The principles underlying goal activation and operation may explain many addicts’ difficulty in resisting the urge of drug use and their paradoxical willingness to engage in self-destructive, even life-threatening behavior to obtain their drugs. This may well exemplify that goals are “selfish”; they mobilize organisms to pursue their “agenda autonomously even when doing so is not in the overall best interest of the individual” (Bargh & Huang, 2009, p. 130). However, one may wonder how a single goal (e.g., obtaining and using drugs) out of the multitude of other goals that the individual undoubtedly holds could take over and dominate the individual’s behavior to such an extent. One possible answer is offered by the self-regulatory principles governing the relationship between multiple goals given limited mental resources available for goal pursuit. This topic is the focus of our next and last section.

How do drugs “take over” one’s behavior despite negative consequences and individuals’ attempts to control their drug use?—One of the most daunting problems related to substance abuse is that for some individuals it becomes the main preoccupation, “taking over” other concerns vital for individual and social well-being. A common explanation for this problem has been in terms of incentive sensitization coupled with a deficit in the functioning of executive control (Everitt & Robbins, 2005; Robinson & Berridge, 1993, 2003). Accordingly, addicts find it harder and harder to control their drug-use behavior as it is automatically triggered by drug-related cues. It is unclear, however, what exactly is the nature of these processes and how they operate to result in an overdominance of substance use over other concerns. Is this a problem of lack of resources, whereby addicts cannot exercise control over their substance use? Or does it reflect a motivational weakness whereby the addict does not have a strong motivation or, in other words, does not want to control his or her substance use? The principles that underlie intergoal associations and govern the management of goal conflict may offer some insights into such questions.

It has been long established that goal pursuit is resource dependent and that self-regulatory resources may get momentarily depleted through acts of self-regulation. It follows that the greater the investment in pursuing a given goal, the less resources should be available for alternative goals or means (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Gailliot et al., 2007; Muraven, Tice, & Baumeister, 1998; Vohs & Heatherton, 2000). To deal with the limited resource pool, individuals learn to mobilize and allocate resources strategically, in

proportion to goal saliency and importance (see Kruglanski et al., 2012, for a review). Although multiple goals may become simultaneously active, individuals shield currently important goals from interference from rival alternatives through automatic inhibitory connections (Köpetz, Faber, Fishbach, & Kruglanski, 2011; Shah, Friedman, & Kruglanski, 2002). For instance, due to intergoal inhibition, the more important the goal of eating becomes (e.g., because of hunger), the less active and powerful a dieting concern is. As a consequence, although the individual may be normally concerned with dieting, in the moment, when eating becomes relatively more important, the individual “forgets” about dieting and may be willing to consider “whatever” foods regardless of their caloric content (Köpetz, Faber, et al., 2011). We believe that a similar dynamic may underlie addicts’ apparent “loss of control.”

In the context of an induced drug craving (through environmental and/or internal cues), although the person may have other concerns related to safety, abstinence, and so on, the momentarily heightened accessibility of the drug-use goal may draw attention to its subjective value and may mobilize the resources necessary for goal pursuit, resulting in the automatic inhibition of alternative concerns (Loewenstein, 1996, 2007). The psychological salience of the proximal goal (drug seeking and use) in comparison with the distal and hence pallid (albeit more significant) objective renders drug use so hard to resist.

Overriding the action tendencies triggered by the accessibility of the drug-use goal and abstaining from drug use would require a considerable amount of resources. When the resources are scarce (either chronically at the trait level or momentarily at the state level), behavior becomes susceptible to the automatic tendencies triggered by environmental and internal cues (Grenard et al., 2008; Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008; Mann & Ward, 2004, 2007; Ward & Mann, 2000). However, in the presence of sufficient processing resources or salient alternative motivations, the individual may be able to assess the relative value of drug use compared with its alternatives and might well refrain from pursuit of the immediate goal despite the initial impulse.

It is noteworthy that the amount of resources available for goal pursuit (e.g., abstinence) may fluctuate on a moment-to-moment basis as these resources get constantly depleted and replenished (Gailliot et al., 2007). This dynamic nature of self-regulatory resources may explain the fluctuations and inconsistencies often observed in addicts’ patterns of use. When self-regulatory resources are plentiful, the individual may be able to quit smoking or using drugs and may have extended periods of abstinence, despite environmental and internal cues that may remind him or her of drug use and that may induce drug craving. However, when self-regulatory resources get depleted (because of fatigue, stress, or other self-regulatory attempts), the individual’s ability to maintain abstinence is substantially weakened. During these “moments of weakness” (Baumeister & Heatherton, 1996; Leander et al., 2009), druguse behavior may be automatically triggered by drug-related cues, resulting in lapses and even relapse.

Potential solutions

Reducing substance use by increasing processing resources: Recent evidence supports the above notions and shows that increasing processing resources through working memory

training may increase heavy drug users' capacity to resist the automatic "goal pull" exercised by substance-related cues and may decrease substance use. This is particularly relevant, as chronic drug users (compared with nonusers or casual users) often show executive function deficits (e.g., Bolla et al., 2003; Fillmore, Vogel-Sprott, Wiers, & Stacy, 2006; Hester & Garavan, 2004; Kamarajan et al., 2005; Noël, Bechara, Dan, Hanak, & Verbanck, 2007; Rogers & Robbins, 2001). In one study (Houben, Wiers, & Jansen, 2011), heavy drinkers were randomly assigned to take part in a working memory training program over 25 sessions. The training did result in improved working memory capacity, which in turn appeared to have decreased alcohol consumption by approximately 10 glasses per week from pretest to posttest. Furthermore, this reduction was still evident 1 month later at follow-up. What is more interesting for the current analysis is that such effects were stronger among participants with strong automatic preferences for alcohol (as measured by the IAT). This suggests that improving working memory (through training) may "replenish" substance users' self-regulatory resources (presumably affected by chronic use), which are necessary to control automatic substance-use urges and tendencies.

The above analysis and empirical findings are consonant with previous approaches, according to which maintenance of addictive behavior despite negative consequences may be partly due to the executive functioning deficits often associated with chronic drug use (e.g., Everitt & Robbins, 2005; Robinson & Berridge, 2003). However, these approaches portrayed a rather rigid drug user engaged in persistent, out-of-control drug bingeing. They do not account for the dynamic aspect of addictive behavior, which often consists of episodes of bingeing and abstinence and involves inner conflicts arising from voluntary, often unsuccessful attempts to control one's behavior. The principle of limited regulatory resources and its implications for intergoal associations (i.e., inhibition) may shed light into such a dynamic and may explain when and why drug users are most vulnerable to relapse but also what are the regulatory factors that may promote abstinence.

Reducing substance use by reducing the saliency of the drug-use goal: In addition to increasing the resource pool, the overriding effect of the substance-use goal over other concerns and consequently over one's behavior may be reduced by decreasing the saliency and value of the consumption goal. Indeed, issues of relative saliency and value of goals involved in self-control circumstances similar to that of drug use have been emphasized in researchers' discussions of strategies of resisting immediate impulses. Several studies have shown that individuals could resist the temptation of food, cigarettes, and alcohol when the saliency and value of the consumption goal was reduced directly or through the introduction of alternative goals.

For instance, people are better able to resist the temptation of fattening food or cigarettes and to experience less craving when instructed to think abstractly about the tempting stimuli (e.g., Fujita, Trope, Liberman, & Levin-Sagi, 2006; Kober, Kross, Mischel, Hart, & Ochsner, 2010; Metcalfe & Mischel, 1999). Such a strategy may presumably decrease the emotional, "hot" aspect of the tempting stimuli, reducing the importance of the consuming goal and increasing individuals' capacity to abstain.

In a recent study, Wiers and colleagues (Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011) incorporated a motivational retraining in the regular treatment administered to alcoholic inpatients. Specifically, they used a joystick task and trained participants to make an avoidance movement (by pushing the joystick away) from alcoholic beverage stimuli in the experimental condition. In the control condition, participants were administered a sham training where they both pushed and pulled alcohol-related pictures or received no training at all (with no differences between these control conditions). The training is based on the fundamental motivational assumption that individuals avoid (represented by pushing away from oneself) undesirable outcomes and approach (representing by pulling toward oneself) desirable outcomes (Chen & Bargh, 1999; Duckworth, Bargh, Garcia, & Chaiken, 2002; Markman & Brendl, 2005; Solarz, 1960). The training was successful in reversing the typical approach bias toward drug-related stimuli found in heavy drug users. Specifically, following this short retraining treatment (compared with control conditions), individuals showed a strong avoidance bias toward alcohol-related stimuli. Furthermore, participants in the motivational retraining condition had significantly lower rates of relapse to alcohol use a year posttreatment than their counterparts who received only the regular treatment. It is possible that such motivational training might have reduced the subjective value of alcohol and therefore restrained its motivational power, facilitating abstinence.

Indeed, in a similar study, Houben and colleagues (Houben, Nederkoorn, Wiers, & Jansen, 2011) obtained direct evidence in support of this notion. They showed that pairing drinking cues (e.g., pictures of glasses of beer) with a *no-go* versus a *go* signal in a modified Go/No-go paradigm resulted in a significant increase in heavy drinkers' negative implicit attitudes toward alcohol, coupled with a significant reduction in weekly alcohol intake.

Such studies are consistent with extensive empirical support suggesting that individuals who are successful in regulating their immediate impulses and resisting temptations (e.g., food) are ones who might have learned to automatically avoid the stimuli that represent such temptations (Fishbach & Shah, 2006; Veling, Aarts, & Papies, 2011) while automatically activating and approaching alternative goals (e.g., dieting; Fishbach, Friedman, & Kruglanski, 2003).

Indeed, saying “no” to temptations, including substance use, may be easier if alternative goals are brought to the forefront. Several studies have shown that alternative goals pull resources away from each other and constrain behavior (Köpetz et al., 2011; Shah & Kruglanski, 2002). In this vein, Papies, Stroebe, and Aarts (2007) found that for restrained eaters, the biased attention to tasty food items prompted by food preexposure tended to disappear after participants were reminded or primed with diet-related stimuli. Similarly, reminding hungry participants of their dieting goal reduced the number of foods hungry participants considered for lunch and resulted in a healthier choice of nonfattening, low-caloric foods (Köpetz et al., 2011). In the realm of risk behavior relevant to drug use, recent results from our lab showed that increasing the saliency and importance of the goal of being “prudent” (though an affective conditioning procedure) resulted in less risk behavior compared with decreasing the value of the goal of being “risky” (Lee, Köpetz, Calvin, & Lejuez, 2010).

The above discussion suggests that the cognitive control deficits that may accompany chronic drug use may be overcome either by enhancing the regulatory resources or by training automatic tendencies incompatible with drug use. In both cases, substance use appears to be substantially reduced. These behavioral findings are well in line with recent neuroscience findings suggesting that goal pursuit (e.g., abstaining from drug use) is maintained through a dynamic interplay between prefrontal cortex functions responsible for maintaining the activation of relevant goal information while inhibiting irrelevant or distracting information (Munakata et al., 2011).

The findings reviewed above suggest that drug-use behavior can be understood and modified by the application of principles underlying goal-driven behavior in general. Indeed, treatments that incorporate some of these principles have recently provided very encouraging results in reducing drug treatment dropout and increasing the rates of abstinence among drug users. For instance, behavioral activation approaches that aim to activate individuals' important goals and to increase their value by increasing individuals' engagement in rewarding activities that support such goals (Jacobson et al., 1996; Lejuez, Hopko, Acierno, Daughters, & Pagoto, 2011; Lejuez, Hopko, & Hopko, 2001; Lewinsohn, 1974) have been successful in increasing substance-use treatment retention (Magidson et al., 2011), decreasing alcohol use among college students (Reynolds, MacPherson, Tull, Baruch, & Lejuez, 2011), and increasing smoking abstinence over 6 months (MacPherson et al., 2010). Furthermore, treatments designed to promote the use of healthier, nonsubstance-related strategies (in other words, alternative means) to fulfill chronic motivations related to substance use (e.g., sensation seeking) may lead to reductions in motivation to drink alcohol or use illicit drugs (Conrod, Castellanos-Ryan, & Mackie, 2011).

So What Is So Special About Drugs? Conclusions and Prospects

Our previous sections emphasized the commonalities between drug use and motivated behavior in general. Our article attempted to sketch a framework that would afford an integrative treatment of previous perspectives in addiction and basic self-regulation research. On the basis of both neuroscience and behavioral evidence, we proposed that substance abuse and addictive behaviors are motivated behaviors. We argued that approaching drug use as a special instance of motivated behavior governed by the general principles of dynamic human action may offer important insights into addictive behavior and may answer some questions refractory to elucidation from alternative perspectives. We discussed some of these principles suggested by our conceptual framework along with the empirical evidence that supports them and outlined their relevance for addiction. Specifically, we discussed how the principles of emotional transfer, accessibility, interconnectedness, and limited resources that govern general goal adoption, activation, and pursuit may offer additional insights into transitioning from casual drug use to addiction, vulnerability to and maintenance of addictive behavior despite negative consequences, and individuals' voluntary attempts to control their substance use.

Admittedly, underplaying the unique aspects of substance use and arguing that there is actually nothing special about addiction would be as naive as saying that addiction is a thoroughly unique phenomenon. After all, it does seem to be the case that people “prefer

opium to broccoli” (Hyman, 1994). Compared with the majority of motivated behaviors, substance use does represent a significant public health problem, and one may wonder why that would be. Alcohol, nicotine, and other drugs have direct pharmacological effects that are powerful and unique. The subjective experience associated with drug use is one of euphoria, of “feeling good.” Such experience undoubtedly accompanies other motivated behaviors. However, the strength and immediacy of drug effects are unparalleled by the affective experiences associated with more pedestrian goal pursuit. Whereas the positive affective experience of jogging (or eating broccoli for that matter), for instance, emerges slowly, with time and effort, the effects of drugs are immediate and strong. This may have at least two important consequences. On the one hand, the immediate positive aftermath of drug use (due to its pharmacological effects) may indicate the instrumentality of the behavior to the goal that it serves, and it may strengthen the association between them. Consequently, drug use may become positively valued (through transfer of affect) and may gain motivational properties (to drive drug seeking and use behavior) more quickly and effectively than other behaviors. On the other hand, perceived instrumentality of drug use may facilitate its automatic enactment upon the activation of the goal at the expense of alternative behaviors or means that may not be perceived as instrumental.

Although development and maintenance of drug addiction may indeed follow the principles of motivated behavior discussed above, the pharmacological properties of the drugs contribute to facilitate these processes to a great extent. Furthermore, the pharmacological properties of drugs may also explain different patterns of drug taking depending on the drug and its effects, as well as individuals’ vulnerability to addiction to certain drugs depending on genetic and personality predispositions (Lejuez, Bornovalova, Daughters, & Curtin, 2005).

So drugs do have unique effects, at least in terms of immediacy and intensity. Are these effects qualitatively different than the subjective experience associated with other motivated behaviors? We do not know yet. But what we do know is that aside from these unique pharmacological effects, addiction is in many ways psychologically similar to motivated behavior in general, whereas in some rare and extreme cases it appears more like a “brain disease.” This suggests a continuum from normal to pathological, with more research required to determine what delineates one from the other.

The focus of this article was not to provide a definitive answer to the challenges that we face in understanding, preventing, and treating addiction. Rather, it attempted to identify convergence points between traditional and basic self-regulation perspectives on addiction and to advocate for an approach that emphasizes commonalities between addiction and motivated behavior while recognizing the uniqueness of drug use. We believe that it is this coexistence, which acknowledges the value of the conceptual and methodological advancements in each relevant field and attempts to integrate them, that will promote scientific understanding and more effective prevention and treatment of addiction.

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