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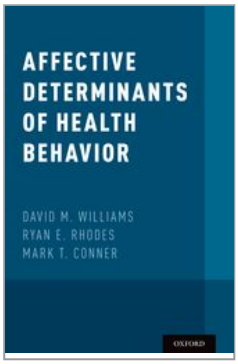

Affective Determinants of Health Behavior
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Affect, Dual-Processing, Developmental Psychopathology, and Health Behaviors

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Abstract and Keywords

This chapter discusses dual-process models of (health) behaviors, regarding both their recent criticisms and implications for health interventions. It agrees with critics that impulsive and reflective processes should not be equated with specific brain processes, but that psychological processes are emergent properties of the dynamic unfolding interplay between different neural systems. It maintains that at a psychological level of description, these models can still be useful to understand challenges to health behaviors and possible interventions. Affective processes can influence impulsive decision-making in health, but also reflective processes, when they concern affectively relevant goals. Cognitive training methods, including cognitive bias modification and training of executive control, have shown some success in changing health behaviors, but a critical variable for long-term success appears to be motivation to change.

Keywords: dual process model, affect, health, development, cognitive bias, modification

Introduction

In this chapter, we develop a broad theoretical framework to account for healthy and unhealthy behaviors and related psychopathology from a developmental perspective. We start with a discussion of dual process models, and argue that from a neurocognitive perspective, dual (or multiple) processes are an emergent property of unfolding and interacting brain processes. Although dual process models have been criticized, we argue that these models can still be useful at the psychological level of description. We then turn to broad developmental and personality inspired models including differences in temperament and socialization in relation to the development of individual differences in outcomes of health-relevant behaviors. The general heuristic model (Gladwin, Figner, Crone, & Wiers, 2011) is illustrated with a description of experiments, on **(p. 159)** the interplay between bottom-up and top-down processes in relation to health behaviors. In the second part of the chapter, we discuss interventions from this perspective.

Affect and Cognition, Dual-Process Models, and Beyond

Dual process models have been en vogue the past few decades in psychology (Evans, 2008; Smith & DeCoster, 2000; Strack & Deutsch, 2004). They have ancient roots, emphasizing the struggle between passion and reason, or the heart and the head (Hofmann, Friese, & Strack, 2009). Many different names have been given to the different processing modes (sometimes called systems), we here use the terms “impulsive” and “reflective” processes (Strack & Deutsch, 2004). Note that this does not equate to unconscious and conscious, some problem-solving occurs unconsciously (Kounios & Beeman, 2014), and some seemingly rash impulsive behaviors may be entirely goal-directed (see for intriguing examples, Kopetz & Orehek, 2015). As the historical background suggests, affective influences have primarily been associated with impulsive processes and nonaffective influences with reflective processes. However, as emotions get a stronger cognitive component (e.g., shame, guilt), they may also fuel reflective processes to inhibit an impulse to prevent (anticipated) shame, regret, or guilt. Some theorists have emphasized different evolutionary origins, with impulsive processes representing evolutionary old processes and reflective processes evolutionary later additions (Evans, 2008; K. B. MacDonald, 2008); some have emphasized different developmental origins, with impulsive processes emerging earlier in life than reflective (effortful control) processes (Nigg, 2006; Rothbart & Posner, 2011); some have distinguished between associative (impulsive) processes and symbolic (reflective) processes (Gawronski & Bodenhausen, 2006; Strack & Deutsch, 2004); and some have distinguished between model-free (impulsive) versus model-based (reflective) learning mechanisms (Ashby, **(p.160)** Alfonso-Reese, Turken, & Waldron, 1998; Daw, Niv, & Dayan, 2005). In addition to general dual-process models, more specific models have been developed to account for the development of common mental disorders, such as addictive behaviors (Bechara, 2005; Wiers & Stacy, 2006), anxiety (Ouimet, Gawronski, & Dozois, 2009), and depression (Beevers, 2005). Dual-process models have also been adapted to account for health behaviors (Hofmann, Friese, & Wiers, 2008; Sheeran, Gollwitzer, & Bargh, 2013). Before we return to dual process models and health, it is important to consider some of the recent criticisms of dual process models, and to consider what can be maintained regarding a general model on cognitive-motivational processes involved in health psychology and related psychopathology.

Neurocognitive Processes and Dual Process Models

In an influential criticism of dual process/systems models, it was argued that there is no evidence for separable neural systems for impulsive and reflective processes (Keren & Schul, 2009). We agree to some extent with the criticisms of those dual process models in which authors have equated specific brain systems with impulsive (or “reflexive”) processing (including “emotional” structures like the amygdala and striatum), and other areas, including parts of the prefrontal and parietal cortex as dealing exclusively with reflective processing (e.g., Heatherton & Wagner, 2011; Satpute & Lieberman, 2006), or in more broad, unspecified terms that different brain areas are correlated with impulsive and reflective processes (Evans & Stanovich, 2013). One problem is that this does not prove anything, many other models would be compatible with that observation (Keren, 2013; Hommel & Wiers, 2017).

But is this a fatal blow for dual process models? We argue it is not at the psychological level (Gladwin et al., 2011; Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013; Wiers & Gladwin, 2017). What the criticism rules out are dual process models that propose a one-to-one relationship between mental processes and the underlying neurocognitive **(p.161)** machinery, but alternatives are conceivable. For instance, the MIMIC (multiple indicators, multiple causes) model is based on the supervenience thesis (Kievit et al., 2011), according to which psychological constructs can be realized by underlying neural structures or processes in multiple ways. The neural indicators determine/constrain the psychological processes, without necessarily having a one-to-one relationship with them. This is in line with findings in cognitive neuroscience that the same neural structures are implicated in many psychological processes (see Kievit et al., 2011).

According to another perspective on the relationship between brain- and mental processes, the processes described in dual process models are emergent properties of the dynamic unfolding interplay between different neural systems (Cunningham & Zelazo, 2007; Gladwin et al., 2011; Hazy, Frank, & O'Reilly, 2007). This perspective suggests that behavior that can be described according to a dual process model might actually arise from interactions among several neural systems, each with their own computational objectives, and that any one of the "processes" reflects a dynamic interaction among these same systems (Frank, Cohen, & Sanfey, 2009; Hommel & Wiers, 2017). Importantly, recent computational models have demonstrated how symbolic processing, characteristic of reflective processing, can arise via dynamic interactions among multiple "loops" connecting the prefrontal cortex and basal ganglia (Collins & Frank, 2013; Kriete, Noelle, Cohen, & O'Reilly, 2013). According to these models, there can still be a first crude pass of information, which in extreme cases may already activate action-tendencies ("impulsive action"). However, typically more loops of information processing take place, which can be described as increasingly reflective *states* of processing (Gladwin et al., 2011). Clearly, this does not allow for specific neural structures (e.g., the dorsolateral prefrontal cortex) to only be involved in reflective processes and other structures (e.g., the amygdala) in impulsive processes (see, for a similar argument regarding emotion and cognition, Pessoa, 2008).

Where does this leave us at the psychological level? At that level of description (i.e., models describing the interactions between psychological **(p.162)** constructs, without equating them to underlying neural processes or systems), we would argue that dual process models could still be useful in generating testable predictions for understanding health-related processes. For example, in the case of health psychology, one paradoxical prediction of dual process models is that health prevention messages can backfire, especially when they are negatively phrased (e.g., "alcohol does not make you sexy"). The reason is that negation is a typical example of symbolic processing, and that the presentation with the two concepts (alcohol–sexy) can actually be strengthened by exposure, when over time the "not" part gets lost (Deutsch, Gawronski, & Strack, 2006; Krank, Ames, Grenard, Schoenfeld, & Stacy, 2010).

Development, Cognitive Processes, Psychopathology, and Health

While numerous terms have been used in the literature to describe self-regulatory capacity, these functions generally represent our ability to exert control, inhibit, or regulate attention, behavior, and cognition (Ahadi & Rothbart, 1994; Eisenberg et al., 2013; Nigg, 2000), and are commonly contrasted with dispositional approach tendencies, impulsivity, or disinhibition (Gray, 1994; Whiteside & Lynam, 2003), with both changing substantively across development (Anderson & Briggs, 2016). Before age 2, attentional control is the predominant means of coping with emotional distress with signs of more classical behavioral regulation developing by age 3 (Anderson & Briggs, 2016; Eisenberg, Smith, & Spinrad, 2010). Self-control capacity increases dramatically in the preschool years and continues to do so throughout childhood, with some regulatory functions achieving adult-like levels by adolescence (Luna, Paulsen, Padmanabhan, & Geier, 2013; Posner, Rothbart, Sheese, & Voelker, 2014; Rothbart & Posner, 2011). While adolescents can inhibit responding as well as adults in some contexts, self-regulation within certain rewarding environments, particularly involving peers, may be more challenging and require greater effort (Anderson & Briggs, 2016; Galvan, 2013; Van Duijvenvoorde & Crone, 2013).

(p.163) Individual differences in effortful and reactive self-control (impulsivity; inhibition to novelty) are evident as early as 2.5 years of age with evidence for differentiation between reactive under- and overcontrol by age 3.5 (Eisenberg et al., 2013). Temperament traits, particularly surrounding self-control, inhibition, and disinhibition, have been related to the development of psychopathology in childhood and beyond (Kagan, 2013; Nigg, 2000, 2006).

Partly based on these developmental findings, Carver and colleagues (Carver, Johnson, & Joormann, 2008, 2014) developed a model in which the relative dominance of impulsive versus reflective processes is modulated by serotonin, with low levels of serotonin relating to a relative dominance of impulsive processing. An elegant aspect of this model is that it can explain effects of both trait-differences (e.g., genetic factors modulating serotonin, for example genetic variability of the serotonin transporter gene, 5HTT), and state modulations of serotonin (e.g., depletion effect through experimental manipulations or natural factors such as sleep loss). Interestingly, a recent study demonstrated that participants with a genetic variant related to relatively low levels of serotonin performed better on a sorting task under conditions that favored model-free learning, while individuals with high levels of serotonin performed better under conditions that favored model-based learning in the same task (Maddox et al., 2015).

From this perspective (Carver et al., 2008, 2014; Ernst, Pine, & Hardin, 2006), individual differences in tendencies to develop certain mental and health problems are related to the interactions of *three* broad neural systems: an impulsive approach-oriented, an impulsive avoidance-oriented, and a reflective effortful control system. This model can explain why low levels of serotonin are related both to externalizing problems (e.g., aggression) and internalizing problems (e.g., anxiety and depression). For example, strong reactive approach coupled with weak control increases chances of reactive aggression, weak approach with weak control increases chances of depressive symptoms, and strong avoidance with weak control increases chances of developing anxiety problems. Important support for this idea comes from the at first sight counterintuitive finding **(p.164)** that individuals who have experienced a depressive episode are also more impulsive in response to positive stimuli (Carver, Johnson, & Joormann, 2013).

As another a point in case, the famous Dunedin study, following approximately 1,000 children since birth into adulthood, has demonstrated that indices of effortful control in childhood predicted later outcomes of mental and physical health (Moffitt et al., 2011), replicating and extending earlier findings by Walter Mischel and colleagues (Mischel, Shoda, & Rodriguez, 1989). Interestingly, a paper based on data of the Dunedin study argued that there could be a general factor in psychopathology (labeled the “p-factor”) in addition to the two broad classes of internalizing and externalizing behaviors (Caspi et al., 2014). One of the attractive aspects of this conceptualization is that it better fits with the developmental multiple process models described earlier, and indeed the p-factor was found to correlate with working memory capacity, often used as a general index of the capacity to control (Hofmann, Friese, & Wiers, 2011). In addition, the model may explain the counterintuitive positive correlation between internalizing and externalizing disorders, while in clinical practice children typically first develop either an internalizing or an externalizing problem, with occasional overlap often as a secondary diagnosis (e.g., becoming depressed as a consequence of negative social reactions to aggressive behavior). Hence, from this perspective, relatively weak effortful control and the associated tendency of reacting relatively impulsively are associated with the tendency to develop both internalizing and externalizing problems.

The next important developmental period is adolescence, the period in which most psychopathology originates (Paus, Keshavan, & Giedd, 2008), and the period in which many habits develop which impact later healthy and unhealthy lifestyles (smoking, drinking, physical exercise, etc.). With the onset of puberty, testosterone rises, which has been associated with an increase in dopamine in the midbrain and at a behavioral level with sensation seeking (Steinberg, 2010) and risk taking (Peper, Koolschijn, & Crone, 2013). From the present perspective, it would suggest a shift in balance between operating systems toward more impulsive reactions especially to emotional stimuli (Carver et al., 2014), as indeed has been **(p.165)** demonstrated both for reactions to both threat and romantic pictures (Quevedo, Benning, Gunnar, & Dahl, 2009). Adolescent risk-taking has been related to a relative immaturity of brain regions involved in control (frontal cortices), combined with a higher reward sensitivity (Steinberg, 2010). However, changes in social and affective brain processes have also been implicated (Crone & Dahl, 2012), indicating that some of adolescents' risk-taking behaviors may be due not to a lack of ability to moderate an impulse but rather to other goals being more important (e.g., making a good impression on peers or potential romantic partners). Similarly, in addictive behaviors in youth, it has often been assumed that they occur because of the relative immaturity of cognitive control systems (making impulsive reactions dominant), but often also these behaviors are goal-driven (Kopetz, Lejuez, Wiers, & Kruglanski, 2013; Kopetz & Orehek, 2015). This is another example of affective goals influencing behavior through reflective rather than impulsive processes. Hence, control of impulses with an impact on addictive and other health behaviors is not only about ability to control but also about motivation to control (Hofmann, Friese, et al., 2008; van Deursen et al., 2015; Wiers et al., 2007).

In a series of studies on the prediction of substance use in adolescents, it was found that in adolescents with relatively weak control capacity (assessed with measures of working memory or of interference control such as the classical Stroop test), substance use and problems were better predicted by relatively automatic or implicit measures (review: Wiers, Boelema, Nikolaou, & Gladwin, 2015). These findings were observed in adolescents both in regular education (Thush et al., 2008) and in special education, both in the Netherlands (Peeters et al., 2012, 2013) and in the United States (Grenard et al., 2008). However, there were also some negative findings (Janssen, Larsen, Vollebergh, & Wiers, 2015), perhaps related to Internet assessment. In some of the studies, the opposite pattern was found for explicit cognitive motivational measures such as alcohol-related expectancies and motives to drink, which were found to be stronger predictors in individuals with relatively strong executive control (EC) capacity (Thush et al., 2008), suggesting that some adolescents (with relatively weak control capacity) are more sensitive for environmental cues to drink or smoke, **(p.166)** while others (with stronger control capacity) make more rational decisions regarding substance use. Note that this interaction pattern was found not only for addictive behaviors but also for other health-related behaviors, including dietary behaviors (Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008) and aggression after alcohol (Wiers, Beckers, Houben, & Hofmann, 2009). Interestingly, from the present perspective, a similar pattern was also found in adolescents in the prediction of anxiety (Salemink & Wiers, 2012), and including the opposite pattern of stronger prediction of explicit processes in individuals with a strong control system was observed in anxiety (Salemink, Friese, Drake, Mackintosh, & Hoppitt, 2013).

Finally, it should be noted that dual process models in fact would predict a triple interaction, including not only ability to control impulses but also motivation to do so (Hofmann, Friese, et al., 2008; Wiers et al., 2007). Indeed, in a recent study this triple interaction was partly confirmed in a sample of problem drinkers who signed up for online training: implicit alcohol associations were especially predictive of levels of problematic drinking in those who scored low on control capacity and high on motivation to cut down (van Deursen et al., 2015). A similar pattern was also observed in a study that experimentally manipulated motivation to restrain drinking in students (who were told that greater consumption in a taste test would impair performance on a later task where they could win a reward), and found prediction of drinking by implicit associations, in those students in an ego-depletion condition (Ostafin, Marlatt, & Greenwald, 2008).[1] Hence, the overall pattern is consistent with the notion that the impact of impulsive processes on health behaviors depends on the combination of ability and motivation to control.

Implications for Interventions in Health: Training and Motivation

From the multiple processing account laid out already, health interventions can target different processes, either more impulsive or more reflective processes (Friese, Hofmann, & Wiers, 2011), provided that there is **(p.167)** some motivation to change the behavior. A number of training interventions have been developed that target either different relatively automatic cue-induced processes in addictive behaviors, such as an attentional bias and an approach-bias for substance-related cues, or cognitive processes related to control over impulses, such as working memory training (see for a review: Wiers et al., 2013). The first types of training are examples of cognitive bias modification (CBM), which targets domain-specific cognitive-motivational processes, such as an attentional bias, affective memory associations, or action tendencies related to disorder or health-domain-specific cues. Hence, CBM in alcohol use disorders or risky drinking will contain stimuli (words or pictures) referring to alcohol, and CBM for smoking will contain cigarette-cues. In order to assess (and modify) disorder-relevant biases, it is important that the stimuli are first validated (see for a protocol: Pronk, van Deursen, Beraha, Larsen, & Wiers, 2015). The second type of training targets domain-general EC processes, like working memory, which has indeed shown promise in relation to addictive behaviors (Bickel, Yi, Landes, Hill, & Baxter, 2011; Houben, Wiers, & Jansen, 2011) and risk for depression (Hoorelbeke, Koster, Vanderhasselt, Callewaert, & Demeyer, 2015). Another strategy concerning training of general control capacity concerns training of inhibition (Dovis, Van Der Oord, Wiers, & Prins, 2015).

One characteristic of domain-general training is that—compared to CBM—many more sessions are needed for this type of training (typically around 25, Klingberg, 2010; while around six sessions usually suffice in CBM, Eberl et al., 2014). This makes motivation to train very important in EC-training. One way to increase this is to embed the training in a game-like program (Dovis et al., 2015). However, it should be noted in the context of substance use, that while gamification may increase motivation to do training, it does not by itself increase motivation to change the addictive behavior (Boendermaker, Prins, & Wiers, 2015). Moreover, when a boring training is introduced as a game, youth will have high expectations, based on their experience with commercial videogames, and the gamified training may briefly be less boring than the original, but subsequently be liked even less, because of a violation of expectancy effect (Boendermaker, Boffo, & Wiers, 2015).

(p.168) One type of training that is sometimes misclassified from the present logic, concerns what we called selective inhibition training (Wiers et al., 2013), in which a Go/NoGo task is administered including cues of a health-related behavior (e.g., alcohol), which are systematically paired with an inhibitory (NoGo) response in the active condition, while there is no such relationship in the control condition. Because of the specific categories involved, this type of training should be regarded as a variety of CBM rather than as executive control training. Further, effects on behavior have been found after short training (a single session), and effects generalized to affective associations (Houben, Havermans, Nederkoorn, & Jansen, 2012; Houben, Nederkoorn, Wiers, & Jansen, 2011), but not to general inhibition as assessed with another standard task (Houben et al., 2012). Note that in these studies, participants (typically students) were not aware of the manipulation and did not need to have a motivation to change. Effects were short-lived (in a taste-test directly after the manipulation or in the week to follow) and weaker over time (see for a meta-analysis: Allom, Mullan, & Hagger, 2015). However, one study successfully used this paradigm to support overweight people to reduce weight (Veling, Koningsbruggen, Aarts, & Stroebe, 2014). In this study, volunteers in a study investigating different psychological interventions to facilitate dieting, were randomized to either active Go/NoGo training (combining food and drink pictures with a NoGo signal) or control Go/NoGo training (without food and drink pictures). In addition, participants also received an active or control implementation intention condition. In the active condition, participants were instructed to make detailed if-then plans concerning different meals and how to handle the situation in line with the diet goals. Hence, participants received Go/NoGo training (real/sham) and implementation intention training (real/sham). Both interventions had a positive effect on success in dietary restraint (on weight reduction), and only the effect of implementation intentions were moderated by the strength of the dietary goal, suggesting that this intervention strengthens the impact of reflective or goal-directed processes, while Go/NoGo training appears to be more independent of these processes. Note that in the domain of anxiety, there is also a “mixture” type of training. In **(p.169)** order to effectively improve cognitive control over emotional information processing, a working memory training in the context of emotional stimuli was developed and improved cognitive control over affective information and emotion regulation stimuli, while a working memory training with neutral stimuli did not (Schweizer, Grahn, Hampshire, Mobbs, & Dalgleish, 2013; Schweizer, Hampshire, & Dalgleish, 2011). A recent study with adolescents was unable to replicate these findings, but participants were unselected adolescents who thus were not selected on motivation for change (de Voogd, Wiers, Zwitser, & Salemink, 2016).

Clinical samples are typically at least somewhat motivated to change and receive therapy in which alternative goals are activated that are incompatible with continued excessive alcohol or drug use (Wiers et al., 2016; Wiers, Boffo, & Field, in press). In this context, varieties of CBM training have been found to generate positive effects. For example, retraining of an approach bias for alcohol was found to increase abstinence rates 1 year after treatment discharge by approximately 10% (Eberl et al., 2013; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011), with the clinical effect being mediated by the change in approach bias (Eberl et al., 2013). Retraining an attentional bias for alcohol in patients also had clinically relevant effects (Schoenmakers et al., 2010). These findings contrast with more modest or null findings in student populations, typically not motivated to change (Christiansen, Schoenmakers, & Field, 2015; Lindgren et al., 2015; Wiers et al., in press). Hence, an important issue concerning the application of CBM to the domain of health is that participants should first be at least somewhat motivated to change for CBM to exert effects. For example, a study in community smokers unmotivated to quit was successful in changing an attentional bias for cigarettes, but did not result in a change in smoking behavior (Kerst & Waters, 2014).

Increasing Motivation to Change

Motivation to change can be effectively increased through motivational interviewing (MI), a technique originally developed in addiction **(p.170)** treatment research and now used more widely to increase motivation to change behaviors related to (mental) health (Miller & Rollnick, 2013). Tailored varieties have been developed (combined with CBT elements), to increase motivation to change and motivation to perform the training for alcohol-dependent outpatients (Boffo, Pronk, Wiers, & Mannarini, 2015), and for smoking youth (Kong et al., 2015). Another strategy can be to select people with at least some level of motivation to change. A recent study on smoking cessation provides a point in case. Potential participants signed up at an antismoking website for free online training to support their quit attempt. Importantly, the quit attempt was verified and only those people who made an actual quit attempt were selected to participate in the training study and randomized to real attentional retraining or a placebo variety including the same pictures. Results in this sample demonstrated significantly more success in abstinence half a year after the quit attempt after real training compared with placebo training (Elfeddali, de Vries, Bolman, Pronk, & Wiers, 2016). These findings contrast with largely negative earlier trials in smoking (Christiansen et al., 2015) and with an online trial in problem drinkers who did not want to quit but wanted to reduce drinking and succeeded irrespective of training condition (Wiers, Houben, et al., 2015).

Before we further discuss the important question for health psychology—how to influence people who are not motivated to change, it is worth pointing out that CBM also has potential in treating internalizing disorders and related health problems. Training-induced changes in attentional bias have relatively consistently been associated with changes in anxiety or emotional responsiveness to stressors (Macleod & Clarke, 2015; Van Bockstaele et al., 2014). In a similar vein, experimentally induced changes in interpretation bias (i.e., the tendency to interpret a neutral or ambiguous stimulus as being threatening) have also been shown to reduce anxiety (Hirsch, Meeten, Krahé, & Reeder, 2016). Also in this domain, there are some indications that motivation plays an important role. For example, findings regarding interpretation bias retraining appear to be more promising in a clinical sample. Note that there are also negative findings that led some to conclude that CBM is ineffective (Cristea, Kok, & Cuijpers, 2015). **(p.171)** However, a re-analysis considering whether manipulation of the mediator (the cognitive bias) was successful or not, demonstrated that those studies that did not affect the cognitive bias had no effect on emotional and clinical symptoms, but those studies that did succeed in changing the bias resulted in a medium to large effect in emotional and clinical symptoms (Macleod & Clarke, 2015; Grafton et al., 2017). Important for the domain of health psychology is that the negative studies were often conducted over the Internet.

Cognitive Bias Modification and Emotion Regulation

Improved emotion regulation is likely to be the mechanism behind these beneficial effects of CBM in anxiety. Indeed, according to the influential emotion regulation model of Gross (Gross & Thompson, 2007), two important strategies to regulate emotions are attention deployment and reappraisal. Attention deployment refers to people’s ability to selectively attend to specific positive, neutral, or negative aspects of a situation, whereas reappraisal refers to people’s ability to select or change the meaning that is attached to a situation. As such, attentional bias modification procedures have been argued to improve attention deployment (MacLeod & Grafton, 2014; Todd, Cunningham, Anderson, & Thompson, 2012), and interpretation bias modification procedures are likely to improve (re)appraisal skills. In line with dual process views on mental health problems, many emotion regulation researchers have distinguished between relatively automatic, implicit emotion regulation and more effortful, explicit emotion regulation (Gyurak, Gross, & Etkin, 2011; Koole & Rothermund, 2011). Thus CBM techniques may prove crucial in improving implicit emotion regulation.

Unmotivated Participants: Where to Start?

As outlined previously, cognitive training paradigms have rather consistently demonstrated effectiveness in participants with some motivation to change (provided that the bias was indeed successfully changed). Through **(p.172)** techniques like MI, motivation can be increased, but to participate in MI, there should be at least some level of motivation, to . . . participate in MI. What to do when this is not the case, an especially thorny problem with emerging substance use problems in youth? One obvious method is simply to pay for participation and hope that more intrinsic motivation will be activated during the following brief intervention. This may have some effect in adolescents (Kong et al., 2015), but not in students (Lindgren et al., 2015). Another strategy in adolescents and young adults is to seize the opportunity, when there is at least for some time some motivation to change, for example after an alcohol-related injury. In this context MI has been successfully applied (Monti et al., 1999), but we are not aware of interventions targeting more automatic cognitive processes in addition in this context. Short-lived effects on cognitive processes and behavior have been reported for samples (typically students) who were not motivated to change for some of the CBM interventions mentioned earlier, including selective inhibition (Allom et al., 2015), approach-bias modification (Wiers, Rinck, Kordts, Houben, & Strack, 2010), and using other techniques such as evaluative conditioning (Houben, Havermans, & Wiers, 2010), formation of implementation intentions (Sheeran et al., 2013; Veling et al., 2014), mindfulness meditation (Ostafin, Bauer, & Myxter, 2012), and physical exercise (Rensburg & Taylor, 2009). Although these paradigms may nudge people toward better health outcomes, we believe that for more enduring change, activation of goals incompatible with continuation of the unhealthy behavior is crucial (Kopetz et al., 2013; Wiers et al., 2016). Hence, from this perspective, for health interventions to be effective, a start with addressing impulsive affective processes may be helpful, and could be subjected to further investigation, but some cognitive restructuring appears to be a necessary additional ingredient for long-term change.

Substance Use as a Moderator in Health Behavior

Some final words follow about substance use and prevention from the present perspective. First, substance use can be considered as one of the **(p.173)** possible outcomes in (dual) process models of health, but it is also an important moderator. There is ample evidence that the relative balance in decision-making shifts in favor of more impulsive processes as a result of intoxication, which affects also other health behaviors such as condom use (T. K. MacDonald et al., 2000) and snacking (Hofmann & Friese, 2008). In relation to dieting, alcohol has multiple effects: it may loosen dietary control and increase reactivity to attractive high-caloric foods, and adds many hidden calories by itself (Hofmann, Förster, Stroebe, & Wiers, 2011). This shift in control appears to be related to both strengthening of impulsive processing and weakening of EC-processes (Field, Wiers, Christiansen, Fillmore, & Verster, 2010). Further, there is some evidence for an increase in impulsive personality traits as a result of binge-drinking in adolescents (White et al., 2011), which may in the long run also affect other health behaviors, as a consequence of increased impulsivity.

Prevention

Finally, from the present perspective, traditional prevention methods may be effective, to the extent that they activate goals incompatible with initiation of the health-endangering behavior. However, the danger of nonintended effects should not be underestimated (Krank et al., 2010), and effects of general school-based prevention efforts in the substance use area are often small at best (Tobler et al., 2000). Two alternatives deserve brief mentioning. First, in (young) children an alternative could be to stimulate a relatively reflective way of processing (Diamond, 2012), and self-control training in schoolchildren has been demonstrated to delay onset of alcohol and cigarette use years later (Lier, Huizink, & Crijnen, 2009). Second, Conrod and colleagues developed a personality-based targeted intervention approach in adolescents, where adolescents scoring high on personality traits related to increased risk for substance use and related problems (impulsivity, sensation seeking, anxiety sensitivity, and hopelessness) receive a brief group-based CBT program, which teaches them different ways to deal with their needs than alcohol and drug use **(p.174)** (e.g., participate in exciting sports in sensation seekers). Long-term effects have been found across different samples (Conrod, Castellanos-Ryan, & Strang, 2015), with specific outcomes depending on the targeted personality type (e.g., strongest effects on binge-drinking in sensation seekers who are most prone to develop these behaviors).

Conclusion

In conclusion, although dual process models have been criticized, especially when equated with specific brain processes, we argue that at a psychological level they can still be useful, for example to understand challenges to the development of a healthy lifestyle and for the development of interventions. Affective processes can influence impulsive decision-making in health, but also reflective processes, when they concern affectively relevant goals. Cognitive training methods have shown some success in changing health-behaviors, but a critical variable for long-term success appears to be motivation to change. Ideally therefore, interventions should be developed that nudge people not motivated to change toward motivation to change and then help them (if necessary) to overcome cue-induced interfering processes with long-term healthy behaviors.

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Notes:

(1.) Note that ego-depletion has been criticized recently and appears at least to some extent to be dependent on beliefs (Job, Walton, Bernecker, & Dweck, 2013).