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Nonconscious Processes and Health

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Objectives: Health behavior theories focus on the role of conscious, reflective factors (e.g., behavioral intentions, risk perceptions) in predicting and changing behavior. Dual-process models, on the other hand, propose that health actions are guided not only by a conscious, reflective, rule-based system but also by a nonconscious, impulsive, associative system. This article argues that research on health decisions, actions, and outcomes will be enriched by greater consideration of nonconscious processes. ***Methods:*** A narrative review is presented that delineates research on implicit cognition, implicit affect, and implicit motivation. In each case, we describe the key ideas, how they have been taken up in health psychology, and the possibilities for behavior change interventions, before outlining directions that might profitably be taken in future research. ***Results:*** Correlational research on implicit cognitive and affective processes (attentional bias and implicit attitudes) has recently been supplemented by intervention studies using implementation intentions and practice-based training that show promising effects. Studies of implicit motivation (health goal priming) have also observed encouraging findings. There is considerable scope for further investigations of implicit affect control, unconscious thought, and the automatization of striving for health goals. ***Conclusion:*** Research on nonconscious processes holds significant potential that can and should be developed by health psychologists. Consideration of impulsive as well as reflective processes will engender new targets for intervention and should ultimately enhance the effectiveness of behavior change efforts.

Keywords: nonconscious, automatic, dual-process models, health behavior change, interventions

The dominant theories of health behavior (e.g., Ajzen, 1991; Bandura, 1998; Prochaska & DiClemente, 1983; Rogers, 1983; Rosenstock, 1966) focus on reflective precursors of action and assume that changing a person's conscious cognitions (e.g., behavioral intentions, risk perceptions, etc.) will engender substantial changes in behavior. However, meta-analyses indicate that a medium-to-large change in intention produces only a small-to-medium change in behavior (d = .36; Webb & Sheeran, 2006) and that a large change in risk perception has only a small effect on behavior (d = .23; Sheeran, Harris, & Epton, 2011). Changing conscious thought does not, it seems, guarantee health behavior change.

More recently, dual-process models of health behavior have been proposed (e.g., Friese, Hofmann & Wiers, 2011; Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008; Hofmann, Friese, & Wiers, 2008) that draw upon social psychological accounts of information processing such as the Reflective-Impulsive Model (RIM) of Strack and Deutsch (2004). The RIM distinguishes two information-processing modes. The *impulsive* mode draws upon the store of associations that the person has acquired over many experiences; the key impulsive process is spreading activation whereby perceptual input activates elements in the associative store that in turn activate other, related elements. This mode of information processing is fast and occurs outside of awareness. The *reflective* mode, on the other hand, is slow and is based on rules (of language and logic) rather than associations. It is accessed intentionally and draws upon the person's knowledge of values and probabilities. Here the key processes are reasoning (e.g., from knowledge about the consequences of an action to a decision to act) and intending. The RIM assumes that the reflective and impulsive system can activate different (conflicting) behavioral schemata and that the schema that is activated to a certain threshold is carried out.

The present review focuses squarely on nonconscious (impulsive or implicit) processes (i.e., mental operations of which the person is unaware, Dehaene, 2008) and outlines implications for health psychology of the conceptual and empirical progress made on this topic during the past 15 years. Dual-process models remain controversial (see, e.g., Evans, 2009; Keren & Schul, 2009), and emphasizing potential conflict between the reflective and impulsive systems may hinder appreciation of how nonconscious pro-

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cesses can *promote* as well as compromise health. It is also the case that research on nonconscious processes has burgeoned and so organizing and taking stock of this voluminous literature is timely and worthwhile. In line with the classic tripartite distinction between knowing, feeling, and willing as core features of mental life (e.g., Hilgard, 1980), the review considers research on implicit cognition, implicit affect, and implicit motivation in turn. For each of these topics, we describe the key ideas and how they have been taken up in health psychology, outline the possibilities for behavior change interventions, and identify directions that might profitably be taken in future research. We close with discussion of the potential for integrating research on nonconscious processes and traditional health behavior models.

Implicit Cognition

Implicit cognition refers to knowledge (e.g., stereotypical beliefs) or cognitive processes (e.g., attention, recognition) that stay outside of the person's awareness. Implicit cognition research on health behaviors has focused almost exclusively on the phenomenon of *attentional bias*. For instance, regular smokers and drinkers exhibit attentional bias for smoking- and alcohol-related stimuli—these stimuli capture the person's attention (see, e.g., Field & Cox, 2008, for a review). Attentional bias is typically measured by modifications of the Stroop (1935) color-naming task or the visual dot probe task (VDP; e.g., MacLeod, Mathews, & Tata, 1986). In modified Stroop tasks (e.g., Cox, Fadardi, & Pothos, 2006), participants have to name the font color of words that are substance-related and control words; the difference in the response times or error rates for substance-related versus control trials is used to infer the degree of attentional bias. In the modified VDP, two words or pictures are presented simultaneously on a computer screen, and one is replaced by a dot or other symbol. The participants' task is to indicate where the dot is presented (top/bottom, left/right). Some of the words or pictures are substance-related, whereas others are control stimuli. Attentional bias scores are derived by comparing reaction times (RTs) to probes that replaced substance-related versus neutral stimuli—based on the idea that detection latencies are shorter in the attended area. Varying the duration of stimulus presentation (the stimulus onset asynchrony or SOA) can index different attention mechanisms. SOAs between 50 and 200 ms are assumed to assess shifts in attention or *initial orienting,* whereas SOAs of 500 ms or greater index maintenance or *disengagement* of attention (Field & Cox, 2008).

Several studies indicate that attentional bias is associated with behavioral outcomes. For instance, Cox, Hogan, Kristian, and Race (2002) found that changes in attentional bias during treatment predicted relapse by alcohol abusers. Fadardi and Cox (2008) showed that attentional bias predicted weekly alcohol consumption after controlling for explicit motivation, and Calitri, Lowe, Eves, and Bennett (2009) reported significant associations between attentional bias to exercise words and physical activity. Restrained eaters, but not unrestrained eaters, showed an attentional bias for palatable for food items when they had previously been exposed to food cues (Papies, Stroebe, & Aarts, 2009). Finally, Calitri, Pothos, Tapper, Brunstrom, and Rogers (2010) reported that greater attentional bias for health foods and less attentional bias for unhealthy foods both predicted reductions in body mass index over 1 year.

Possibilities for Intervention

Although these findings are suggestive, evidence that changing attentional bias engenders behavior change is needed to infer causality. Recent work where participants are trained to attend to neutral, and not anxiety-related, stimuli has proved effective in reducing anxious symptoms (Hakamata et al., 2010). Attention Bias Modification Treatment (ABMT; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002) comprises a variant of the VDP where the probe always appears in the same location as neutral stimuli (never the location of anxiety stimuli). The stimuli are presented for 500 ms on the assumption that problems disengaging from threatening stimuli, and not initial orienting of attention to threat, is the critical factor in maintaining anxiety. Hakamata et al.'s (2010) meta-analysis of 12 randomized control trials observed that the difference in anxiety levels for treatment versus control participants was of medium magnitude ($d = .61$).

Schoenmakers et al. (2010) observed parallel findings in a study of people with alcohol dependence. The ABMT was modified to alcohol stimuli, and intervention participants undertook five sessions of training over a 3-week period; the control group engaged in five sessions of sham training. Training facilitated faster disengagement from alcohol-related stimuli for intervention participants and had behavioral effects over the 3-month follow-up. In particular, ABMT speeded patient discharge and delayed subsequent relapse. Fadardi and Cox (2009) developed a training variant of the Stroop task that was similarly effective. Harmful drinkers who engaged in four sessions of attention retraining showed reduced attentional bias to alcohol-related stimuli. Alcohol consumption also declined significantly from baseline to posttraining, and this reduction in consumption was maintained at 3-month follow-up. Thus, 4–5 sessions of ABMT, but not a single session (e.g., Field et al., 2007), were effective in changing health behavior.

ABMT tries to affect implicit cognition (attentional bias) by weakening the attentional response to unhealthy stimuli through practice; in particular, the attentional response is repeatedly frustrated by replacing the desired stimulus with a neutral one. A more time-efficient way of weakening attentional bias has recently been explored in research on implementation intentions (Gollwitzer, 1993, 1999; Gollwitzer & Sheeran, 2006). Implementation intentions are if–then plans that link critical situational cues to a goal-directed behavior in the format of *if(cue)–then(response*). For example, in order to support the task goal of reducing attentional bias to threatening stimuli on the VDP task, a person might form the plan, "If I see a neutral word, then I focus all of my attention on it!"

Implementation intentions enhance the accessibility of the mental representation of the specified cue (e.g., Webb & Sheeran, 2007, 2008) and allow people to easily identify the critical situation when they subsequently encounter it (Parks-Stamm, Gollwitzer, & Oettingen, 2007; Webb & Sheeran, 2004). Implementation intention formation also forges a strong association between the critical cue and the specified response (Webb & Sheeran, 2007, 2008). The upshot of these strong links is that the specified cue acquires the capability to *automatically* elicit the goal-directed response (i.e., immediately, efficiently, and without the need for conscious intent; see Gollwitzer & Sheeran, 2006, for a review). This interpretation is supported by recent neuroimaging data (Gilbert, Gollwitzer, Cohen, Oettingen, & Burgess, 2009) indicating

that implementation intentions switch action control from effortful, reflective, top-down control by goals to efficient, automatic, bottom-up control by specified stimuli. The implication is that although if–then plans originate in the reflective system in an act of will, their formation recruits implicit cognitive processes that should be able to modify (implicit) attentional bias.

In fact, four studies of socially anxious participants indicated that if–then plans geared at directing participants' attention to neutral stimuli in the VDP task, reduced attentional bias to the level exhibited by their nonanxious counterparts (Webb, Onanaiye, Sheeran, Reidy, & Lavda, 2010). This effect was not observed when participants formed mere goal intentions to control their attention. The behavioral implications of attempting to control attention via if–then plans have also been examined (Achtziger, Gollwitzer, & Sheeran, 2008, Study 1). Participants first indicated their goal intention to reduce their consumption of a self-nominated high-fat food over the coming week; a subset of participants formed an if–then plan ("And if I think about my high-fat food, then I ignore that thought!"). Findings indicated that implementation intention participants exhibited a greater reduction in consumption over the subsequent week compared to controls and were more likely to reach their goal.

Future Directions

Future research on implicit cognition and health might want to explore how such biases are best ameliorated. One wonders whether practice-based interventions or implementation intention inductions are similarly effective; do they differ in the immediacy of effectiveness, the strength of respective effects, and their durability over time? There is also the question of vulnerability to failure experiences: Will a single lapse on attentional bias undo the intervention effects, and do the two types of intervention differ in this respect? Moreover, will the strength of the attentional bias differentially moderate the effectiveness of the intervention as associative accounts of habit might suggest (Wood & Neal, 2006). Another issue that is worth exploring pertains to the question of whether it is beneficial to simultaneously reduce attentional bias to unhealthful stimuli (e.g., beer) *and* induce attentional bias to healthful stimuli (e.g., juice). Finally, the question of whether new health behaviors might be inculcated by attentional bias interventions (e.g., increasing attention to exercise stimuli and reducing attention to sedentary stimuli) also warrants research.

It is important to note that health psychology's concern with implicit cognition has so far primarily focused on attentional processes. However, higher cognitive processes such a complex reasoning and decision making have been observed to potentially run off effectively within the impulsive system (i.e., at the implicit level) as well. Research on Unconscious Thought Theory (review by Dijksterhuis & Nordgren, 2006) has revealed that a period of distraction in the wake of presenting a decision problem (i.e., a period of unconscious thought) engenders higher quality decisions compared to both decisions made immediately and decisions made after an equivalent period of conscious thought. Moreover, it is complex decisions that demand the consideration of many different dimensions that particularly benefit from unconscious thought, as confirmed by a recent meta-analysis (Strick et al., in press). However, the decision problems (choice options) that are targeted in research on unconscious thought theory mostly pertain to decisions between different products (e.g., apartments varying on a host of dimensions). One wonders therefore whether impulsive decision making also helps when people have to make complex health decisions (e.g., choosing between different doctors, medical procedures, or types of fitness regimen). Initial evidence suggests that clinical decision making (e.g., correct diagnoses by psychiatrists) does indeed benefit from unconscious thought (de Vries, Witteman, Holland, & Dijksterhuis, 2010).

Implicit Affect

Implicit attitudes are "best characterized as automatic affective reactions resulting from the particular associations that are activated automatically when one encounters a relevant stimulus" (Gawronski & Bodenhausen, 2006, p. 693).[1] Nosek, Hawkins, and Frazier (2011) characterized the past 15 years of work on implicit attitudes as the "Age of Measurement." Implicit measures were needed because explicit (self-reported) measures may not capture attitudes that people are unable or unwilling to report. Nosek et al. identified some 20 measurement procedures that routinely are designated as "implicit." The most popular were the implicit association test (IAT, Greenwald, McGhee, & Schwartz, 1998), the evaluative priming task (Fazio, Sanbonmatsu, Powell, & Kardes, 1986), the semantic priming task (Wittenbrink, Judd, & Park, 2007), and the Go/No-Go task (GNAT; Nosek & Banaji, 2001). These measures all use RTs to infer implicit feelings about the target person, object, or behavior (see Payne, Cheng, Govorun, & Stewart's, 2005, affect misattribution procedure for an alternative to RT measures). For instance, an IAT measure of attitudes toward dietary fat might invite participants to classify pictures of high-fat versus low-fat foods along with positive versus negative words (e.g., sunshine vs. rain). The faster participants classify high-fat foods together with positive words (as compared with low-fat foods with negative words), the more favorable is their implicit attitude toward dietary fat. Implicit attitudes are assumed to reflect the strength of associations between targets and feelings that presumably were learned through experience. Consistent with this idea, Rudman, Phelan, and Heppen (2007) found that early smoking experiences (e.g., reactions to parents' smoking) predicted implicit, but not explicit, attitudes to smoking, whereas recent smoking experiences (e.g., with friends) predicted explicit, but not implicit, attitudes (see also Giudetti, Conner, Prestwich & Cavazza, in press; but see Gawronski, 2009, for discussion).

Implicit attitude tests have been undertaken in relation to a variety of health-related behaviors and outcomes. For instance, implicit attitudes are associated with intentions to use condoms (e.g., Czopp, Monteith, Zimmerman, & Lynam, 2004) and condom use by male drug users (Stacy, Ames, Ullman, Zogg, & Leigh, 2006), smoking versus nonsmoking status (e.g., Payne, McCler-

[1] This emphasis on affect as the key component of implicit attitudes parallels the emphasis in definitions of explicit attitude. For instance, Petty and Cacioppo (1981, p. 7) stated that "the term attitude should be used to refer to a general, enduring positive or negative *feeling* about some person, object, or issue" [italics added]. Most studies of implicit attitudes tap the affective associations described by Gawronski and Bodenhausen, (2006). However, implicit attitude measures can be adapted to capture affective (liking, feelings), cognitive (attributes, expectancies), or motivational (wanting, approach/avoidance) responses. For clarity of presentation, these different attitude measures are taken together in this section.

non, & Dobbins, 2007), candy consumption (e.g., Conner, Perugini, O'Gorman, Ayres, & Prestwich, 2007), healthfulness of food purchases (Prestwich, Hurling, & Baker, in press), and eating restraint (e.g., Papies, Stroebe, & Aarts, 2009), frequency of self-reported physical activity (Calitri et al., 2009), and alcohol use (e.g., Wiers, van Woerden, Smulders, & de Jong, 2002). Implicit attitudes also distinguished between chronic low back pain patients and pain-free participants (Goubert, Crombez, Hermans, & Vanderaeten, 2003) and are associated with health care professionals' behavior in relation to different social groups (Major, Mendes, & Dovidio, in press).

Insight into the discriminant validity of implicit attitudes and the strength of relationships with relevant health variables can be gained from three recent meta-analyses (Greenwald, Poehlman, Ulman, & Banaji, 2009; Reich, Below, Goldman, 2010; Rooke, Hine, & Thorsteinsson, 2008). Greenwald et al. (2009) obtained a sample-weighted correlation between the IAT and explicit attitude of $r = .21$ across 184 independent tests ($N = 14{,}900$), supporting the distinctiveness of implicit versus explicit attitudes. The average correlation between IAT scores and criterion variables was $r = .27$. The only studies of health-related behaviors that were included in Greenwald et al.'s review related to alcohol and drug use ($k = 16$, $N = 1718$) and had an average r of .22. This effect size was smaller than the effect observed for equivalent explicit attitude measures ($r = .26$). However, partial correlation analyses revealed that IAT scores were significantly correlated with outcomes even after explicit attitude was taken into account ($r = .18$, $k = 152$). Equivalent findings were obtained by Reich et al. (2010) in a review of drinking and drinking problems ($k = 16$, $N = 1857$). The sample-weighted average correlation between attitudes and drinking was $r = .35$, whereas the unique effect of implicit attitude was $r = .23$. Rooke et al.'s (2008) meta-analysis of substance use (smoking, alcohol, marijuana, or mixture/other drugs) focused solely on behavioral measures and obtained a similar effect across 72 studies ($r = .27$). There is also emerging evidence that implicit attitudes may predict behavior even after the effects of a range of explicit cognitions (e.g., self-efficacy, outcome expectancies, and intention) have been taken into account (Conroy, Hyde, Doerksen, & Ribeiro, 2010; Millar, 2011). In summary, implicit attitude measures appear to be reliably associated with (at least some) health behaviors and account for a significant increment in the variance after accounting for explicit cognitions.

The wide variation in effect sizes (rs ranged from $-.27$ to .79 in the meta-analysis of Greenwald et al., 2009) also beg the question what determines the relative impact of implicit versus explicit attitudes in predicting behavior. Cognitive and neurological models of action selection (e.g., Gurney, Prescott, & Redgrave, 2001; Posner, 1978) adopt a horse-race metaphor wherein the fastest horse (or the neural representation with the greatest salience; Gurney et al., 2001) gains control over behavior schemata that determine action. This analysis implies that factors that influence the strength of the (a) implicit associations or (b) reflective processes that inhibit unwanted responses should both be influential.

Factors that may relate to the strength of the underlying associations include the habitualness of the behavior, self-activation, and whether the person is focused on affective versus cognitive features of the stimulus. Conner et al. (2007) report that implicit attitudes better predicted candy consumption over 1 week when participants had strong as compared to weak consumption habits. Perugini, O'Gorman, and Prestwich (2007) found that self-activation manipulations (e.g., circling "I," "me," "myself" in a piece of text) enhanced the predictive validity of the IAT in relation to consumption of junk food versus healthy food as well as alcohol consumption over 1 week. Finally, Scarabis, Florack, and Gosejohann (2006) observed that asking participants to focus on how much they would enjoy fruit versus chocolate (as compared to asking participants to provide reasons for their choice) resulted in better prediction of choice behavior by IAT scores. These three manipulations did not influence the explicit attitude–behavior relation.

Several factors that compromise the person's capacity to inhibit or suppress the behavioral impact of implicit attitudes have been identified including aspects of executive function, cognitive capacity, and dispositional and situational manipulations of self-control. Greater focused attention, inhibitory control, and affect regulation each independently reduced the influence of automatic affective reactions on eating behavior (Hofmann, Friese, & Roefs, 2009). Similarly, participants with lower working memory capacity, when given an opportunity to eat candy, were guided more by their favorable implicit attitudes and less by their intentions to forego candy (Hofmann, Gschwendner, Wiers, Friese, & Schmitt, 2008, Study 2). Manipulating cognitive capacity by having participants remember a one-digit versus an eight-digit number prior to choosing five items from a selection of fruit and chocolate moderated the predictive validity of implicit and explicit attitudes (taken in a previous session). When cognitive capacity was high, explicit, but not implicit, attitude predicted the number of chocolates chosen, whereas when capacity was low, implicit, but not explicit, attitude predicted behavior (Friese, Hofmann, & Wänke, 2009).

Implicit attitudes did not predict alcohol intake or the amount of potato chips consumed in a taste test among participants with high dispositional self-control, whereas implicit attitudes were highly predictive of behavior for participants with low self-control (Friese & Hofmann, 2009). Similar findings emerged when participants' self-control resources were depleted (or not) by an emotion suppression task (Hofmann, Rauch, & Gawronski, 2007). Implicit attitudes but not a measure of dietary restraint predicted candy consumption in a taste test for depleted participants; when participants were not depleted, dietary restrain but not implicit attitudes predicted consumption (see also Friese et al., 2009). Equivalent findings were obtained when the manipulation involved the administration of alcohol or not (Hofmann & Friese, 2008).

Possibilities for Interventions

Although the vast majority of research on implicit attitudes is correlational, a small literature on interventions has emerged. Interventions have targeted both the valence of implicit attitudes and people's capability for reflective control over the behavioral impact of implicit attitudes. The paradigm typically used to modify implicit attitudes is evaluative conditioning (EC). "EC refers to a change in the valence of a stimulus (the effect) that is due to the pairing of that stimulus with another positive or negative stimulus (the procedure)" (Hofmann, De Houwer, Perugini, Bayens, & Crombez, 2010, p. 390). Few studies have assessed the impact of EC on health-related attitudes and behavior. Recently, however, Hollands, Prestwich, and Marteau (2011) measured implicit and

explicit attitudes in relation to snacks (vs. fruit) and then used an EC procedure wherein images of snacks were paired with aversive images of obesity and heart disease or were paired with a blank screen (controls), for 100 trials. Implicit attitudes and behavior (choice of fruit vs. snack as a reward for participation) were measured in the wake of the intervention. The EC procedure reduced the favorability of implicit attitudes toward snacks but had no effect on explicit attitudes. EC also reduced the likelihood that participants chose a snack as a reward. Mediation analyses indicated that postintervention implicit attitudes partially mediated the impact of EC on behavior; this mediation effect turned out to be stronger among participants who had more positive implicit attitudes toward snacks at the outset of the study. These findings suggest that EC may be a promising strategy for changing implicit attitudes and subsequent health behaviors (see also Ebert, Steffens, von Stulpnagel, & Jelenec, 2010; Houben, Schoenmakers, & Wiers, 2010).

Related research has targeted approach–avoidance associations by training participants to approach healthful stimuli and avoid unhealthful stimuli. Wiers, Eberl, Rinck, Becker, and Lindenmeyer (2011) trained alcohol-dependent patients to make an avoidance movement when pictures of alcohol were presented (push a joystick) and to make an approach movement to pictures of nonalcoholic soft drinks (pull a joystick). Two control groups either did not receive training or received sham training. Findings showed that four 15-min sessions on consecutive days altered implicit approach responses to alcohol. A striking finding was that training influenced rates of relapse over the subsequent year (rates were 59% vs. 43% for control and intervention participants, respectively).

Training studies that aimed to enhance reflective action control have also demonstrated promising effects in reducing the influence of implicit attitudes and changing health behaviors. Houben, Wiers, and Jansen (2011) found that 25 sessions of working memory training (one session every 2 days) significantly increased memory span. Training also reduced weekly alcohol consumption relative to baseline both 1 week and 5 weeks posttraining. A moderated mediation effect was observed such that working memory training proved especially effective in reducing alcohol consumption among participants who had strong implicit preferences for alcohol to begin with. Studies of inhibitory control training have obtained equivalent effects on eating behavior (Houben, 2011; Houben & Jansen, 2011). Intervention participants were trained to withhold responses to designated snack foods on Stop Signal or GNATs, and consumption of snacks was assessed in subsequent taste tests. Findings showed that even brief training (256 or 320 trials) reduced consumption relative to controls (Houben & Jansen, 2011) and that training was particular effective among participants who had low inhibitory control at the outset of the study (Houben, 2011). Inhibitory control training also reduced consumption of the designated foodstuff during the following day (Veling, Aarts, & Papies, 2011). Brief mindfulness-based training, wherein participants were asked to view their thoughts as mere transient mental constructions, also proved successful in abolishing implicit approach responses to fattening foods in three experiments (Papies, Barsalou, & Custers, 2012).

There is also evidence that forming implementation intentions can both modify implicit attitudes and moderate the impact of implicit attitudes on health behavior. First, Webb, Sheeran, and Pepper (2012) could show that even strongly negative implicit attitudes (e.g., IAT scores for gender and subordinate job role associations among personnel managers, college students' Muslim-terrorism associations as measured by the GNAT) could readily be modified by implementation intentions formed on the spot. Interestingly, the changes in personnel managers' implicit attitudes were maintained at a 3-week follow-up. Second, Hofmann, Deutsch, Lancaster, and Banaji (2010) targeted health-related implicit attitudes and found that participants who wrote down idiosyncratic temptation situations (in the "if" part of plans) and how they would resist the temptation (in the "then" part of the plans) exhibited less favorable implicit attitudes toward chocolate compared to participants in three control conditions.

Tidswell, Sheeran, and Webb (2011) showed that if–then plans geared at promoting deliberation in the face of the temptation to eat chocolate ("And if I am tempted to have chocolate, then I ask myself 'do I really want to do this?' ") reduced self-reported chocolate consumption over the subsequent week. Implementation intentions also moderated the effects of implicit attitudes toward chocolate on behavior. Implicit attitudes strongly predicted consumption among participants who did not plan, but were not associated with behavior among implementation intention participants. A second study showed that planning out how to act toward a person with schizophrenia ("As soon as I get a chance to be friendly and warm to this person, then I'll take it!") reduced seating distance and moderated the impact of implicit attitudes toward schizophrenia on behavior. These effects were not observed when participants formed mere goal intentions about how to act ("Your goal is to be friendly and warm to this person!").

Future Directions

Fifteen years of implicit attitude research has made considerable progress in terms of measurement issues (Nosek et al., 2011) The time now seems ripe for critical tests of implicit attitude effects on health behaviors, for sophisticated conceptual analyses of moderator effects, and for greater deployment of interventions targeting implicit attitudes. To date, only a handful of studies have demonstrated significant incremental effects of implicit attitudes after the impact of variables from traditional health behavior theories (intentions, self-efficacy, etc.) has been taken into account (Conroy et al., 2010; Millar, 2011). Further tests—that move beyond merely comparing the effects of implicit attitudes versus explicit attitudes—are crucial in order to make the case that implicit attitudes constitute important additional predictors of health behaviors. Testing potential interactions between implicit attitudes and explicit cognitions should also be routine. Given that implicit attitude effects are stronger when self-presentational or social desirability concerns are salient (Greenwald et al., 2009), it may be worthwhile for health psychologists to focus on behaviors or samples where such concerns are prevalent (e.g., medication adherence, HIV testing, prescribing behavior).

Although several factors pertaining to the strength of the underlying associations (e.g., habit, self-activation) or the capability for reflective control (e.g., executive function, resource depletion) have been found to moderate the relationship between implicit attitudes and health behaviors, the mechanisms underlying these effects are not yet clear. Sherman et al. (2008) argued that the classic distinction between impulsive processes and reflective

processes may mask important distinctions within these processes. Sherman et al.'s QUAD model proposes that impulsive processes can be subdivided into *activation* (the likelihood that a stimulus activates an association or feeling) and *guessing* (biased responding in the absence of an activated construct, e.g., the preference for items on the right-hand side of a display, Nisbett & Wilson, 1977), whereas controlled processes can be divided into *detection* (how likely it is that the person can identify an appropriate response) and *overcoming bias* (the likelihood that the activated association is overcome and the appropriate response is provided instead). QUAD model analyses have permitted finer-grained analysis of implicit attitude effects. For instance, internal motivation to respond without prejudice (Devine, Plant, Amodio, Harmon-Jones & Vance, 2002) reduced the activation of biased associations and facilitated detection of appropriate responses but had no influence on overcoming bias or guessing. A high dose of alcohol, on the other hand, reduced participant's ability to regulate automatic racial associations (overcome bias) but did not influence activation, guessing, or detection (Sherman et al., 2008). It would seem worthwhile to deploy QUAD model analyses to better understand the interrelationships between implicit health attitudes and explicit health cognitions and how moderators such as executive function exert their effects on the relationship between implicit attitudes and health behavior.

So far, research on implicit attitudes is dominated by correlational studies that do not permit causal inferences; a program of intervention research would therefore seem valuable. Future research might want to adopt a translational approach by developing interventions that effectively change the strength and valence of implicit attitudes and the impact of implicit attitudes on behavior. Evaluative conditioning seems a promising approach to changing affective associations (e.g., Hollands et al., 2011; Houben, Havermans, & Wiers, 2010), but a systematic program of research is needed on how best to implement this intervention strategy in field settings. Similarly, given the evidence that self-control resources moderate implicit attitude effects, it would seem worthwhile to test interventions geared at strengthening self-control (cf. Muraven, 2010). Research will have to address how many training sessions are needed to promote "good" self-control and how attrition can best be prevented during the course of training. Comparing the impact of different strategies for reducing unwanted implicit attitude effects (e.g., evaluative conditioning vs. self-control training vs. implementation intentions) should also be a priority. Finally, the paucity of tests of environmental or policy interventions (Grande, Frosch, Perkins, & Kahn, 2009; Harris, Bargh, & Brownell, 2009a) on implicit attitudes and their expression needs to be tackled.

It is important to note that although research on implicit affect in health psychology has to date focused on implicit attitudes, implicit affect can, however, also be analyzed from an affect control perspective. In this context, one wonders whether people can regulate their affect implicitly. Three routes are discussed in the literature. One was suggested by Williams, Bargh, Nocera, and Gray (2009) and pertains to priming the goal of using an effective conscious affect regulation strategy such as reappraisal of the situation (e.g., reframing the situation as interesting rather than scary; Gross, 1998). The second one uses implementation intentions to ignore strong affect-inducing stimuli. For instance, Schweiger Gallo, Keil, McCulloch, Rockstroh, and Gollwitzer (2009) gave spider-phobic participants the if–then plan to ignore presented images of spiders and observed reduced self-reported arousal. Most interesting was the fact that EEG recordings revealed that the P100 (i.e., an event-related potential observed over visual cortex in spider-phobic individuals at 100 msec after the presentation of a spider picture) was significantly attenuated. This finding supports the idea that implementation intentions automatize emotion control. Third, recent research by Bargh and his colleagues suggests that certain environmental stimuli directly influence the person's affective state (e.g., Bargh & Shalev, in press; Williams & Bargh, 2008). For instance, the experience of physical warmth or coldness directly induces a feeling of social warmth. In line with this postulate, it was observed that experiences such as holding a cup of hot coffee or being seated in a warm room engendered greater feelings of interpersonal closeness and trust and more generous behavior toward others. Health psychologists may wish to exploit the described three implicit routes to affect control to (a) down-regulate positive emotions to attractive but unhealthy stimuli so to as facilitate healthful decisions and (b) down-regulate negative emotions and promote patient well-being.

Implicit Motivation

Traditional models of human motivation have assumed an agentic, conscious self at the controls, making decisions about courses of action to take and then guiding behavior along those lines (e.g., Ajzen & Fishbein, 1980; Bandura, 1998; Locke & Latham, 2002; Mischel, 1973; see Bandura, 2006, for a review). However, research on implicit motivation shows that there is an alternative route to human goal pursuit, one that does not require instigation and guidance by an agentic self and operates outside of conscious intention and awareness. Much of the evidence has come from studies using priming techniques. "Priming" refers to the passive, subtle, and unobtrusive activation of relevant mental representations by external, environmental stimuli, such that people are not aware of the influence exerted by those stimuli (Bargh & Chartrand, 2000). The goal-priming literature (for reviews see Dijksterhuis & Aarts, 2010; Bargh, Gollwitzer, & Oettingen, 2010) has shown that the mental representations of goals can be activated without the individual knowing about or intending it—either through subliminal presentation of goal-relevant stimuli or through subtle and unobtrusive supraliminal presentation. A wide variety of environmental triggers have been demonstrated: not only verbal stimuli semantically related to the goal (as in many studies), but also material objects such as backpacks and briefcases (Kay, Wheeler, Bargh, & Ross, 2004), scents such as cleaning fluids (Holland, Henriks, & Aarts, 2005), power-related features of a situation such as a professor's desk chair (Chen, Lee-Chai, & Bargh, 2001), the names of one's significant others (Fitzsimons & Bargh, 2003; Shah, 2003), and the observation of other people's goal striving (i.e., goal contagion; Aarts, Gollwitzer, & Hassin, 2004).

Moreover, a wide variety of goals have been studied and shown capable of nonconscious operation: information processing goals such as impression formation (Chartrand & Bargh, 1996; Mc Culloch et al., 2008), achievement and task performance goals (e.g., Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001), as well as interpersonal goals such as helping and cooperation (Bargh et al., 2001, Study 2; Fitzsimons & Bargh, 2003). These

studies have shown further that once activated outside the person's knowledge, these goals operate autonomously, without any conscious guidance, to direct cognition and behavior toward the desired end-state (see reviews in Bargh, 2005; Bargh & Ferguson, 2000; Dijksterhuis & Aarts, 2010).

Studies have shown that nonconscious goal pursuit produces the same outcomes as conscious goal pursuit. The goal concept, once activated without the participant's awareness, operates over extended time periods (also without the person's conscious intent or monitoring) to guide thought or behavior toward the goal. Not only do nonconsciously operating goals produce the same outcome as when consciously pursued, they do so following the same processing stages as well. For instance, Mc Culloch et al. (2008) have shown this in the case of an impression formation goal. Compared to a nonprimed control group, priming the impression formation goal caused participants to (a) be faster to encode behaviors in trait-categorical terms, (b) be more likely to form associations between behaviors, and (c) to notice and remember impression-inconsistent behaviors, all known subprocesses of conscious impression formation (e.g., Hamilton, Katz, & Leirer, 1980; Srull & Wyer, 1989). Priming a goal, therefore, puts the means to attain the goal (i.e., component subgoals) into active operation as well.

Moreover, nonconscious goal pursuit is shown to possess the same signature qualities previously demonstrated and ascribed to conscious, deliberate goal pursuit (Bandura, 1977, 1982; Gollwitzer & Moskowitz, 1996; Heckhausen, 1991; Lewin, 1926; Oettingen & Gollwitzer, 2001). These include persistence in the face of obstacles, resumption of interrupted goal pursuits in the face of intrinsically more attractive activities, and evaluative and motivational consequences of the goal pursuit attempt (see Bargh et al., 2001). The affective (mood) and motivational consequences of conscious and nonconscious goal pursuit are also the same: Success at the attempt produces positive mood and increased tendencies to pursue that goal in the future, whereas failure produces the opposite consequences (Bongers, Dijksterhuis, & Spears, 2008; Chartrand & Bargh, 2002). Moreover, several studies have found that once a nonconscious goal is satisfied, its influence on persistent striving disappears (e.g., Kawada, Oettingen, Gollwitzer, & Bargh, 2004).

There is of course one significant difference between conscious and nonconscious goal pursuit: unlike conscious goal strivers, nonconscious goal strivers do not know why they do what they do. As a consequence, nonconscious and conscious goal pursuit are found to have different effects on subsequent affect if goal pursuit requires an explanation, as nonconscious goal pursuit occurs in an explanatory vacuum (i.e., cannot be readily attributed to the respective goal intention). For instance, when a person is primed to compete and thereafter acts competitively even though the task at hand demands cooperation, then some explanation for one's competitive behavior is needed. This is easy when one held the conscious intention to compete, as the person can simply point to this intention. If, however, competition accrued from nonconscious goal priming, the person is at a loss. Indeed, findings indicate that people feel irritated and upset when they find themselves in such an explanatory vacuum (Oettingen, Grant, Smith, Skinner, & Gollwitzer, 2006). Moreover, people are liable to jump on any available, plausible explanation to reduce these negative feelings (Parks-Stamm, Oettingen, & Gollwitzer, 2010).

Little research on health behaviors has exploited work on implicit motivation. One important exception, however, is the goal conflict model of eating (GCME; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008; review by Papies, Stroebe, & Aarts, 2007). The GCME was designed to elucidate how the goal of enjoying food influences eating behavior and, in particular, to explain the motivational processes underlying differences in eating behavior between restrained eaters (i.e., chronic dieters) and unrestrained eaters. According the model, the eating behavior of restrained eaters accrues from a conflict between two incompatible goals, namely, the goal of eating enjoyment and the goal of controlling one's weight. Eating enjoyment is a powerful goal for restrained eaters (e.g., Papies et al., 2007), and priming this goal engenders overeating in restrained but not unrestrained eaters (e.g., Fedoroff, Polivy & Herman, 2003). The GCME proposes that these behavioral effects emerge because priming the goal of eating enjoyment inhibits the goal of weight control among restrained eaters—activating eating enjoyment causes restrained eaters to lose sight of their dieting goal. This prediction was supported in two experiments that subliminally primed stimuli related to eating enjoyment and assessed the accessibility of the weight control goal via lexical decision tasks (Stroebe et al., 2008). Findings showed that activating eating enjoyment indeed inhibited the goal of controlling one's weight among restrained eaters, but not unrestrained eaters. A subsequent experiment revealed that these implicit goals effects are sensitive to restrained eaters' success at losing weight. In particular, whereas restrained eaters who were unsuccessful at losing weight showed inhibition of the weight control goal in wake of priming eating enjoyment (as described above), restrained eaters who were good at losing weight actually showed increased accessibility of weight control goal in the wake of priming—these participants were able to keep the goal of weight control in mind and could refrain from overeating (Papies, Stroebe, & Aarts, 2008). The GCME thus provides a valuable exemplar of how research on nonconscious goals can provide insights into health behaviors that traditional motivational models did not or could not offer.

Possibilities for Intervention

A small literature has emerged concerning the impact of goal-priming interventions on health behaviors. The following four studies assessed eating behavior as the dependent variable. Harris, Bargh, and Brownell (2009b) investigated an unhealthful "real world" prime—TV food advertising. Children watched a cartoon that contained either food advertising or advertising for other products, and Harris et al. found that food advertising caused children to eat 45% more snacks while watching TV (Experiments 1a and 1b). In Experiment 2, adults watched a TV program that included snack food advertising, food advertising that promoted nutrition benefits, or no food advertising. Participants who were exposed to the snack food advertising ate more in a subsequent taste test than participants in the other conditions, and this was true even though participants did not believe that the advertised foods could have influenced their eating behavior. In both experiments, the advertised snack foods were different from those available for consumption, and consumption was independent of rated hunger and other conscious considerations.

Albarracin and colleagues' research on general action and inaction goals (review by Albarracin, Tepler, & Tannenbaum, 2011) revealed paradoxical effects of messages that exhort people to "be active." Participants who were exposed to actual health communications concerning physical activity or were primed with words commonly associated with exercise (e.g., active) consumed more food in a subsequent taste test compared to control participants (Albarracin, Leeper, & Wang, 2009).

Two other studies used goal-priming interventions to reduce eating behavior. Fishbach, Friedman, and Kruglanski (2003, Study 5) varied whether participants were exposed to magazines about slimming, food (e.g., *Chocolatier* magazine), or neutral topics (e.g., geography) in the room where they waited to take part in an experiment. The slimming and food magazine conditions both led to increased activation of the goal of dieting (measured in a lexical-decision task) compared to the control condition. Moreover, participants in these conditions behaved in line with the activated goal—they were more likely to select an apple rather than a chocolate bar as a parting gift. An important field test of goal-priming effects was reported by Papies and Hamstra (2010). People entering a local butcher's store were primed with the goal of dieting or not (participants either did or did not encounter a poster for a recipe that was "good for a slim figure," p. 386). Meat snacks were available on the store counter and the number eaten by each participant was recorded. Participants also completed a measure of dietary restraint. Findings showed that the diet prime reduced the number of snacks consumed by restrained eaters.

Finally, a recent study targeted exercise behavior. Participants were asked to complete scrambled sentences containing words related to effort and persistence immediately before they entered the university gym (Sheeran, 2011). Control participants either completed scrambled sentences containing neutral words, completed a questionnaire about their views of the gym, or they were merely observed as they entered and left the gym. The length of time that participants spent in the gym was recorded. Consistent with predictions, participants in the effort/persistence goal-priming condition spent more time in the gym compared to participants in the other three conditions.

But is priming goals the only way to automate goal striving? Research on implementation intentions has found a clear answer to this question (reviews by Adriaanse, Vinkers, de Ridder, Hox, & de Wit, 2011; Bélanger-Gravel, Godin, & Amireault, in press; Gollwitzer & Sheeran, 2006). When people consciously set themselves goals, they can, in a second step, plan out in detail how they will act on these goals. That is, people can make if–then plans that specify when, where, and how these goals will be implemented. As described above, such plans automate action control so that even though the goal was set consciously, subsequent goal striving runs off automatically. A host of studies on a wide variety of health behaviors from cancer screening to weight reduction have shown that such strategic automation is both possible and beneficial.

Forming implementation intentions is also useful when it comes to controlling goal-priming effects that are unwanted (Gollwitzer, Sheeran, Trötschel, & Webb, 2011). In a series of studies, it could be shown that when people set themselves conscious goals (e.g., to drive only as fast as safety allows) and furnish these goals with implementation intentions that specify how to behave toward this goal at critical junctures (e.g., "And if I enter a corner, then I will slow down!"), goal striving is no longer influenced by antagonistic goal primes (e.g., the goal of being fast). In other words, when goal primes are encountered that could send striving off track, if–then plans protect the consciously selected goal from disruption. These findings are important as they suggest that people who set themselves conscious health goals may be in a position to overcome the impact of adverse goal primes (e.g., advertisements for high-fat foods).

Future Directions

Living a healthy life often requires that we overcome bad habits (e.g., smoking, snacking). So the question arises whether primed goals are strong enough to override such habitual responses? There is some research suggesting a positive answer to this question. Sassenberg and Moskowitz (2005) primed a "think different" goal of generating creative solutions to a problem. Participants in the think-different condition, compared to a control group, indeed generated more unusual (i.e., nonhabitual) uses for a given object and more uncommon answers in a free-association task, instead of the habitual or automatically generated ones. Moskowitz, Gollwitzer, Wasel, and Schaal (1999) also demonstrated that a primed goal can dominate antagonistic automatic processes. In their studies, all participants showed evidence of automatic stereotype activation upon the mere perception of minority group features. However, participants whose goal to be egalitarian was activated successfully inhibited automatic stereotyping, such that the stereotype no longer influenced perceptions of minority group members.

In principle, then, goal priming could be used to develop interventions geared toward both facilitating health-related behaviors and undermining habitual health-damaging behaviors. Depending on which route is taken, priming needs to target different types of goals. Let us take hazardous/harmful drinkers as an example. It seems to us that there are three options: one may want to prime the goal to reduce drinking, prime the goal to enhance the drinking of nonalcoholic beverages in situations that habitually are associated with drinking alcohol, or prime goals that are antagonistic to the long-term consequences of heavy drinking (e.g., interpersonal, achievement, or health goals that can only be reached if one reduces one's drinking). Future research may want to find out which route (or which combination of routes) is most effective with respect to immediate and long-term reductions in drinking behavior.

Note that the research on implicit motivation has mainly focused on priming goals and making if–then plans. But what if incentives (i.e., rewards such as money) are activated outside of awareness? Recent research by Aarts and colleagues (for a review see Veltkamp, Aarts, & Custers, 2009) suggests that participants subliminally primed with the goal of exertion outperformed a control group in a hand-grip squeezing task, but those primed simultaneously with both the exertion goal *and* positive stimuli (incentives) performed the best of all (Aarts, Custers, & Marien, 2008). Moreover, experimental work by Custers and Aarts (2005, 2007) observed that conditioning a positive affective response to the name of a particular goal increases the chances the individual will pursue that goal when primed outside of awareness. All of these studies provide support for the assumption that goal-priming effects are stronger when the goal is linked to positive incentives—even if the individual is not aware of these links.

The most striking demonstration that the presence of positive/negative incentives matters for successful goal striving comes from

research where incentives are presented subliminally while the research participant works on an assigned task goal. The task goals studied relate to performing well on various executive function tasks (e.g., the Stroop, the stop signal task, the arrow flanker task, or exerted effort). As it turned out in various recent studies, subliminally presented incentives (e.g., coins) managed to affect performance on these tasks (e.g., Pessiglione et al., 2007; Schmidt, Palmintieri, Lafaruge, & Pessiglione, 2010). As it seems safe to assume that executive functions (such as response inhibition, task switching, focusing attention, conflict resolution, effort expenditure) are crucial for the success of our healthful goal strivings, it will be an important objective for future research to learn which of these functions are positively affected by subliminally presented incentives and which are hampered (e.g., Bijleveld, Custers, & Aarts, 2010). This research has important implications for interventions geared at training executive function (Wiers et al., 2011) and for ensuring that healthful goal priming is as effective as possible.

Integrating Research on Nonconscious Processes and Prevailing Theories of Health Behavior

Research on implicit cognition, implicit affect, and implicit motivation has the potential to enrich the dominant theories of health behavior (e.g., Ajzen, 1991; Bandura, 1998; Prochaska & DiClemente, 1983; Rogers, 1983; Rosenstock, 1966). Prevailing models have not proved so effective in predicting and changing health behaviors that enlargement and improvement of these models can be deemed unnecessary (e.g., Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Rothman, Sheeran & Wood, 2009; Sheeran et al., 2011; Webb & Sheeran, 2006). Moreover, the prevailing models' sole focus on the reflective precursors of health actions seems difficult to sustain in the light of accumulated evidence concerning the importance of nonconscious processes (reviewed above), and evidence from social psychology that—in certain circumstances—reflective thought may even have negative consequences (for instance, for performance on insight problems, e.g., Schooler, Ohlsson, & Brooks, 1993; for consumer choices, e.g., Wilson et al., 1993; and for familiarity-based decisions, e.g., Halberstadt & Catty, 2008). A key starting point for improving health behavior theories then would be to acknowledge the significance of implicit cognitive, affective and motivational processes.

Such acknowledgment would have at least three interrelated advantages. First, nonconscious processes may help to explain why explicit factors afford modest prediction of, or change, in health behavior. For instance, implicit processes may be responsible for dietary lapses despite people's conscious intentions to lose weight or account for the finding that people obtain cervical cancer screening despite having little intention to do so (Orbell & Sheeran, 1998). Moreover, research on implicit processes may offer traction on key problems for traditional models—notably, how to break strong, unhealthy habits (Wood & Neal, 2007). Second, research on nonconscious processes offers new targets for prediction and intervention in health-related behavior. The dominant health behavior theories collectively specify a relatively small family of causal variables—risk perception, fear/worry, perceptions of severity, attitude (and equivalent constructs such as costs vs. benefits, response efficacy, pros vs. cons, outcome expectancies), social norms, self-efficacy/perceived behavioral control, and intention/willingness—and identifying further key determinants is an important advance. A clear implication of the present review is that understanding and changing health behaviors is likely to be more effective if due consideration is given to implicit processes as targets for intervention. Third, research on dual-process models and nonconscious processes offers a host of intervention strategies that may complement current intervention practice. Abraham and Michie (2008) identified 26 behavior change techniques from interventions based on the prevailing theories. The present review indicates that techniques such as attentional bias modification training, implementation intentions, evaluative conditioning, approach/avoidance training, working memory training, inhibitory control training, mindfulness-based interventions, and goal priming could supplement this taxonomy.

Conclusion

Contemporary research in social psychology shows that people's thoughts, feelings, and actions are guided not only by the conscious, reflective, rule-based system but also by the nonconscious, impulsive, associative system. This insight has implications for appreciating what factors increase health protection and reduce risk, and for understanding why interventions that target only reflective factors may not be entirely effective. The research on implicit processes reviewed here encourages a focus on environmental features as well as characteristics of the person and thus holds the potential to enhance the impact of both social cognition and ecological (Brug, Kremers, van Lenthe, Ball, & Crawford, 2008; Wansink, 2010) approaches. Ultimately, health behavior theories, behavior change interventions, and public policy initiatives will benefit from taking cognizance of nonconscious processes as so doing will enable health psychologists to exploit the reflective and impulsive systems separately as well as their interaction in order to maximize behavior change efforts.

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