2014-10-20

Elaborated Intrusion theory: Explaining the cognitive and motivational basis of desire.

May, Jon

Guilford

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This is the Author Copy of a work to appear as:

Andrade, J., May, J., van Dillen, L., & Kavanagh, D. J. (in press). Elaborated Intrusion theory: Explaining the cognitive and motivational basis of desire. To be in: W. Hofman & L. Nordgren. *The psychology of desire*. New York: Guilford.

In 2005, we published a new theory of desire (Kavanagh, Andrade & May, 2005). Although there was plenty of prior research on desire, that research typically focused on specific drug or food cravings, or on sexual desire. With Elaborated Intrusion (EI) theory, we aimed to provide a coherent theory of desire that integrated the diverse literature on drug cravings and was applicable to the entire range of desires experienced in everyday life. We wanted to explain desire itself, rather than its precursors, correlates or behavioral consequences. This chapter provides an overview of EI theory and of research testing its key predictions, ending with a discussion of the implications of the theory for measurement of desire, and for interventions to tackle unwanted desires and strengthen desired desires.

Understanding desire is important because many behaviors are driven by moment-to-moment decision-making that involves choices between competing goals. Those choices are influenced by desire, thus strong desires – cravings – to smoke are associated with relapse after a quit attempt (Shiffman et al., 1997) and cravings for food are associated with binge eating (Ng & Davis, 2013) and failed weight loss attempts (Sitton, 1991). Desire may influence choices between a longer-term healthy goal and an immediate temptation (e.g., a goal to lose weight versus the hedonic pleasure derived from eating; Stroebe, van Koningsbruggen, Papies & Aarts, 2013), and may also influence choices when there is conflict between goals with similar timescales. Being fitter and spending more time with the family may seem compatible, but the actions required to reach these goals can prove incompatible – exercise can be hard to fit into days full of work and childcare commitments – and the person may opt for the one that they desire more strongly at the moment of deciding which path to take. Desires and goal conflicts are common events, forming a major feature of people's conscious mental lives. Hofmann, Baumeister, Förster, & Vohs (2011) showed that people experience desires to do or consume something during half their waking hours, and half of these desires conflict with other goals: respondents actively tried to resist a desire for

40% of the time. A theory of desire can thus potentially account for a substantial part of people's everyday experience.

EI theory views desire as a conscious wanting, an affectively charged cognitive event that can vary in intensity, duration and frequency and 'in which an object or activity that is associated with pleasure or relief of discomfort is in focal attention' (Kavanagh et al., 2005, p.447). Desires are not exclusively physiological events. Desires to eat chocolate or drink coffee are not the same thing as hunger or thirst, and cravings for heroin are not the same thing as opiate withdrawal, though they may be triggered by these deficits. EI theory explains the cognitive processes that lead from a trigger to the desire itself. As the name suggests, the key tenet of the theory is that desire is the experience of cognitively elaborating a verbal thought or image, of a target associated with pleasure or reward, which intrudes into conscious awareness. This cognitive elaboration involves affectively-charged sensory imagery of the target of desire, which motivates further desire thoughts and imagery, and behavior, through contrasting of that imagery with one's current state. Figure 1 illustrates the main components of EI theory.

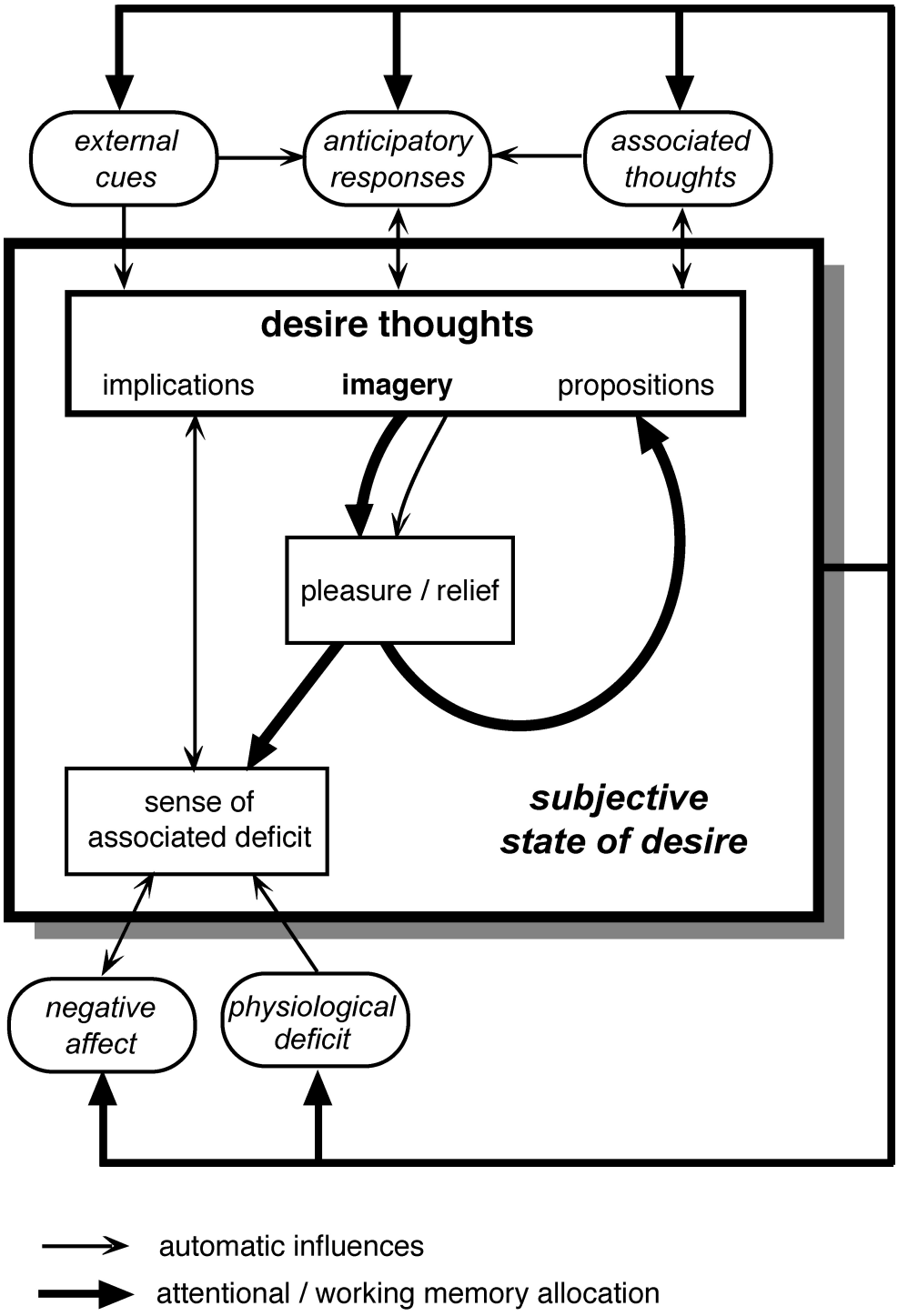

Figure 1. The Elaborated Intrusion theory of motivation, showing the contribution of triggers (rounded external boxes), intrusive thoughts ('desire thoughts'), and sensory imagery to desire (central square box). Thick arrows show the controlled processing cycle of conscious imagery and associated affect; thin arrows represent automatic influences on desire (reprinted from Kavanagh, Andrade & May, 2005, with permission).

A cognitive approach to desire

Any view that desires are purely biologically determined underestimates the important and often overriding role of cognitive factors in basic, appetitive behaviors. Asking people to recall what they ate for lunch reduces the amount that they eat on a subsequent 'taste test' (Higgs, 2005), and amnesic patients will eat again even if they have only just finished a meal (Rozin, Dow, Moscovitch, & Rajaram, 1998). Cravings for addictive substances are often attributed to withdrawal or opponent processes, but these physiological effects often follow a different time course to that of drug craving. Dar, Rosen-Korakin, Shapira, Gottlieb, & Frenk (2010) found that flight-crews' cravings to smoke are determined by the proximity of landing rather than duration since take-off, showing that cognitive factors such as expectations can be more important determinants of craving than nicotine deprivation or physiological withdrawal.

If desires were merely automatic or visceral processes that must be opposed by effortful willpower, impairing willpower should leave us at the mercy of our desires. In fact, cognitive loads that interfere with other conscious and controlled tasks do not increase the risk of indulging a desire: they weaken the desire (e.g. Van Dillen & Koole, 2007; Van der Wal & Van Dillen, 2013). In one recent study (Van Dillen, Papies, & Hofmann, 2013), participants exposed to tempting food cues were less likely to select a more attractive snack over a less tasty one when they performed a high working memory load task during the exposure than if the load was low.

Research outside the laboratory also highlights the beneficial potential of cognitive load for self-regulation: Van Dillen and Andrade (2014) asked commuters on a train to choose a three-course meal from a menu. Those who said they were easily tempted by foods subsequently desired food more strongly and chose a high calorie reward more often than those who said they were less easily tempted. However, this difference vanished when they

completed word puzzles after making selections from the menu: When cognitive resources were unavailable, participants were not tempted to choose chocolate over a pen. Notably, when people are instructed to quickly categorize appetitive and neutral images (Van Dillen et al., 2013), working memory load reduces selective attention to more attractive food pictures and (for male participants) to pictures of more attractive female faces.

These findings are consistent with the idea that desire involves cognitive processing. EI theory explains the nature of that processing, from the automatic triggering of desire via associative processes to the cognitive elaboration of desire thoughts using controlled working memory processes.

Triggers of desire

In EI theory, desires are activated by a range of triggers, often outside awareness, including associated thoughts, physiological cues (e.g. hunger pangs or drug withdrawal symptoms), or awareness of conditioned responses such as salivation. Negative mood can be a cue, as it broadly triggers desires to act to improve one's current state (Petty & Cacioppo, 1984).

Triggers do not always lead to an episode of desire and, when they do, the nature of the desire is not always predictable. Physiological deficits can be misattributed to a particular source. For example, cocaine users who are shown erotic pictures experience increased craving for cocaine (Bauer & Kranzler, 1994). Environmental cues have been given a particularly prominent role in the literature on drug craving, for example in provoking conditioned withdrawal (Ludwig & Wikler, 1974). However, a given environmental cue can trigger multiple goals, whereas desires are specific to a particular target. While chocolate-related cues often trigger desires to eat chocolate (Kemps, Tiggemann & Grigg, 2008), Fishbach, Friedman, and Kruglanski (2003) showed that they can also trigger weight-loss

goals in those wanting to diet, and can do so as effectively as explicit diet and fitness cues. In EI theory, whether a particular trigger leads to a desire depends on a sequence of cognitive processes that begins with priming of mental representations.

Desire-related thoughts

Triggers of desire activate or prime desire-related representations in memory. We assume that these representations are embodied, in the sense that they incorporate sensory, affective and motor output information (e.g., Barsalou, 2008), and are activated by automatic associative processes operating outside conscious awareness. This activation or priming of representations increases the likelihood of an apparently spontaneous desire thought intruding into awareness (*I need a cigarette* or *I want lunch).* Supporting this assumption is research that shows associations between the extent of priming of food-related words on a lexical decision task and the frequency of intrusive thoughts about eating experienced by participants while completing the task (Berry, Andrade & May, 2007).

The apparent spontaneity of intrusions is a key feature of the phenomenology of desire for food (May et al., 2004; May, Andrade, Kavanagh & Penfound, 2008; May, Andrade, Kavanagh et al., 2014), cigarettes (May et al., 2004, 2014), alcohol (Kavanagh, May, & Andrade, 2009; May et al., 2014; Statham, Connor, Kavanagh et al., 2011), and physical exercise (May et al., 2008), with most respondents feeling that their desire began with a thought popping into mind, and not being able to report why their desire arose.

As in other intrusive thoughts, attempted suppression of desire-related thoughts can be counterproductive, leading to stronger desire (Salkovskis & Reynolds, 1994) and increased behavior (for example, increased chocolate consumption after suppression of thoughts about chocolate; Erskine, 2008; Erskine & Georgiou, 2010). Interventions that instead encourage participants to accept intrusive thoughts and focus on unrelated imagery

(Hamilton, Fawson, May, Andrade, & Kavanagh, 2013; May, Andrade, Willoughby & Brown, 2012) lead to weaker desire and lower consumption.

Elaboration of intrusions

Desire-related intrusions are common but they do not inevitably lead to an episode of desire. Whether they are elaborated is critical in their influence upon an individual's experience and behavior. Thoughts alone do not always elicit the anticipated pleasure or relief that is required for them to constitute a desire. Even in people starting to address alcohol-related problems, when we might expect thoughts about drinking to capture attention, 87% reported that the thoughts sometimes popped into mind but then vanished without effort (Kavanagh et al., 2009). Self-report data on desires confirms that the occurrence of thoughts about a target and elaborated imagery of that target form separate factors, although the hypothesized causal chain between them means the factors are correlated (May et al., 2014; Statham et al., 2011). Elaborated images can also lead to further intrusions, strengthening activation of the current goal or activating a new goal. Intrusions about hunger might lead to an initial image of a meal, but then to elaborated imagery of appetizing foods, and lead to a goal to eat the specific imagined food.

Elaboration has to compete with ongoing cognitive activity for limited capacity resources. When people are engaged in information-rich, conceptually coherent tasks, there is less opportunity for mind wandering of any sort, including elaboration of task unrelated thoughts (Smallwood & Schooler, 2006), amongst which are desire-related cognitions. As discussed above, food cravings are less intense when high competing cognitive loads reduce the opportunity to elaborate thoughts about eating (Van Dillen & Andrade, 2014; Van Dillen et al., 2013). In a study using a primed lexical decision task (Van Dillen et al., 2013), participants were faster to recognize hedonic food-related words (e.g. delicious) than irrelevant words (cozy) when these were primed by tasty food pictures, suggesting that

participants spontaneously formed hedonic associations in response to the pictures. However, this advantage disappeared when participants were placed under high concurrent working memory load and participants reported fewer food cravings. These findings are consistent with the idea that cognitive loads prevent the elaboration of desire-related representations, which weakens priming, even when those representations are associated with pleasure or reward.

Cognitive load inductions can also then reduce approach behavior. In one study on alcohol consumption (Sharbanee, Stritzke, Jamalludin, & Wiers, 2014), an approach avoidance test (AAT) was used to assess people's approach tendencies, while cognitive load was varied. During low cognitive load, there was a positive relationship between an alcohol-related approach bias on the AAT and subsequent drinking on a taste test. During high cognitive load, this relationship disappeared. While Sharnabee et al. (2014) attributed the result to inhibition of an alcohol-related action tendency, the result is also consistent with inhibition of elaborative processing of alcohol as an attractive target, which then also impedes the amount of alcohol that is consumed.

Complementary evidence that desires involve cognitive elaboration comes from studies of the effects of desire on cognitive performance: while cognitive load can interfere with desire, desire can also interfere with concurrent tasks. People perform more poorly on tasks assessing reaction speed, arithmetic, language, and memory performance when craving cigarettes (Madden & Zwaan, 2001; Sweet, Mulligan, Finnerty et al., 2010; Zwaan, Stanfield & Madden, 2000; Zwaan & Truit, 1998) or food (Green, Rogers & Ellimann, 2000; Kemps, Tiggeman & Grigg, 2008; Meule, Skirde et al., 2012). The findings for food craving are often limited to those with high trait craving or restricted diets: Since food is readily available in well-resourced societies, deprivation is usually low, so that effects of elaboration of food-related desires may be restricted to subgroups. Overall, this body of research shows mutual

interactions between desire and cognitive performance, consistent with the assumption that desire involves cognitive elaboration that taps limited-capacity working memory processes.

Elaboration involves affectively-rich embodied sensory imagery

Elaboration may involve generating expectancies (*A drink would make me feel better*) or evaluating self-efficacy (*I can resist* or *I can stop at a bar on my way home*), but EI theory uniquely proposes that the core component is affectively charged sensory imagery that emulates the experience of achieving one's desire. This mental imagery of the target and its acquisition serve to ready the individual for target-directed behavior.

Advertisements for food often use slogans such as 'finger lickin' good' or 'snap crackle and pop' that encourage rich, multisensory imagery – and, through repetition, link it to a specific product. In EI theory, such imagery is at the heart of desire. It is embodied and thus affectively charged (e.g., Moulton & Kosslyn, 2009; Schendan & Ganis, 2012); imagining consuming a delicious treat is itself a pleasurable experience, not just a neutral anticipation of future pleasure. The more vivid and realistic the image, the greater the pleasure: a smoker said to us that the cigarettes he imagined were always perfect—better than the actual cigarette he later had. In line with this, Elder and Krishna (2010) demonstrated that multisensory advertisements for food products resulted in higher taste perceptions than ones focusing on taste alone, and that restricting cognitive resources (imposing cognitive load) attenuated the enhancing effect of the multiple-sense advertisement.

Strong desires are characterized by sensory imagery (Kavanagh et al., 2009; Tiggemann & Kemps, 2005; May et al., 2004; 2008; 2014; Statham et al., 2011). In a questionnaire study of triggers and experiences of craving, respondents endorsed items relating to sensory imagery more than items relating to habit, stress, or attempted abstinence (May et al., 2004), and an EI theory factor combining sensory imagery and intrusiveness questions is the strongest unique predictor of craving strength (May et al., 2008). People with

alcohol problems who were trying to control their drinking frequently imagined a drink, tasting and swallowing it, with an average of 2.3 sensory modalities represented (Kavanagh et al., 2009). More frequent sensory imagery was associated with stronger and longer-lasting episodes of alcohol craving. Jauregui-Lobera et al (2012) similarly found that vivid sensory imagery was associated with strength of desire for food.

Imagery is also important in desires for non-consummatory behaviors. Research in sport and exercise shows close associations between imagery and motivation to exercise (Hall, Rodgers, Wilson, & Norman, 2010). The extent that players imagine themselves playing hockey explains a substantial portion of the difference between their weakest and strongest desires to play over the week (May et al., 2008). Consistent with the focus of EI theory on embodied, affectively-charged imagery, it is especially imagery of the positive benefits of exercising, such as enjoyment and feeling energized, which is important for motivation (Stanley & Cumming, 2010).

Studies on the interference of concurrent tasks with desires also provide evidence on the specific sense domains that are implicated in desire imagery. Given the evidence that substance cravings involve more visual than auditory imagery (Jauregui-Lobera, Boleros-Rios, Valero & Prieto, 2012; May et al., 2008, 2004; 2014; Tiggemann & Kemps, 2005), and evidence that imagery requires modality-specific working memory resources (Baddeley & Andrade, 2000), EI theory predicts that a concurrent visuospatial task will have a greater impact on appetitive desires than would an auditory task. Findings are consistent with this prediction, for example showing that imagined neutral visual scenes reduce desires for smoking (May, Andrade, Panabokke & Kavanagh, 2010; Versland & Rosenberg, 2007) and eating (Kemps & Tiggemann, 2007), more than do imagined neutral sounds. Other visuospatial tasks that require working memory capacity (e.g., moulding clay out of sight) reduce desire more than verbal tasks (Andrade, Pears, May, & Kavanagh, 2012; May et al.,

2010). Showing that these findings generalize to naturally occurring cravings, Knäuper, Pillay, Lacaille, McCollam & Kelso (2011) found that imagining a positive activity whenever food cravings struck helped to reduce the intensity of food cravings over a 4-day period, compared with reciting the alphabet or forming intentions to reduce cravings.

Olfactory imagery is also reported as part of the phenomenology of substance cravings (e.g., Kavanagh et al., 2009; May et al., 2008, 2004; 2014; Tiggemann & Kemps, 2005). Again there is evidence that experimentally interfering with olfactory imagery leads to weakened desire: Versland and Rosenberg (2007) found that neutral olfactory imagery reduced craving for cigarettes, while Kemps and Tiggemann reported similar findings for food (2007) and coffee (2009) cravings. Smelling a non-food scent also reduced strength of desire for food and coffee (Kemps & Tiggemann, 2013).

Because EI theory assumes that desires are embodied and that desire imagery emulates the sensory qualities of the desired behavior, auditory or verbal tasks are predicted to reduce the strength of desires to engage in activities where sound is an integral part of the pleasure and reward of the activity. Examples may include racetrack betting, gambling on jackpot machines, videogaming, and noisy sports such as hockey where players report auditory imagery as a feature of their desire to play (May et al., 2008).

Initially, desire imagery is pleasurable, which is why people persist in it even if they are trying to avoid indulging. However, if a strong desire cannot immediately be fulfilled (as in a desire to smoke during a lecture), awareness of the gap between our current and imagined states becomes unpleasant, unless it can be reinterpreted as evidence that we are reaching another highly valued goal (e.g. abstinence). Blackburn, Thompson & May (2012) found that restricted eaters elaborated cues about being hungry in ways that emphasized their personal success in not eating, rather than as cues to eat. Normally, though, negative

emotions arising from unfulfilled desires motivate us to inspect our current situation (Schwarz & Clore, 1983), enhancing the salience of the desired target.

Imagery motivates behavior

The research reviewed in the previous section supports EI theory by showing how sensory imagery is closely linked with desire. We contend that desire is not epiphenomenal, but rather drives behavior towards the desired goal, by keeping the goal active until it is attained. Studies of substance craving support our claim that imagery is associated with goal-directed behavior: there are positive associations between the intensity and frequency of desire imagery and drug use (Kavanagh et al., 2009; May et al., 2014; Connor et al 2014).

As shown in Figure 1, EI theory assumes that desire imagery increases awareness of current deficit. Oettingen and colleagues have argued that mental contrasting an image with one's current state is an important part of the motivational power of imagery, thus Achtziger, Fehr, Oettingen, Gollwitzer and Rochstroh (2009) reported MEG data consistent with mental contrasting involving imagery, and Oettingen, Mayer and Thorpe (2009) showed that mental contrasting instructions increased success at quitting smoking.

However, correlations between desire strength and behavior are not always strong (Maude-Griffin & Tiffany, 1996), because successful goal acquisition is also strongly influenced by factors such as opportunity, acquisition and control skills, and related self-efficacy (Bandura, 1986). Furthermore, predictions from a particular desire are often moderated by the presence of competing desires. Thoughts about a drug, for example, might trigger both approach and avoidance responses, because they activate goals to use it, but also goals to avoid drugs in order to become healthy, save money, or retain a valued relationship or job (Krieglmeyer, Deutsch, De Houwer, & De Raedt, 2010).

Implications of EI theory

Measuring desire

In a recent review of tools for measuring drug craving, we concluded that measures often confound desire with behavioral intentions, expectancies and self-efficacy (Kavanagh et al., 2013). For example, the Questionnaire on Smoking Urges includes expectancy items, e.g., '*I would enjoy a cigarette right now'* and behavior items, e.g., '*I will smoke as soon as I get the chance'*, potentially giving a high score to someone who intends to smoke soon – perhaps because they know they will not have another opportunity for some time – even though they are not experiencing a strong desire for a cigarette.

We developed the Alcohol Craving Experience (ACE) questionnaire (Kavanagh et al., 2009; Statham et al., 2011) to help disentangle desire from these confounds, using EI theory to help formulate items assessing the intensity, vividness, and intrusiveness of desire for alcohol. In a recent study of young adults, scores on the imagery component of the ACE predicted 12-16% of the variance in alcohol consumption (Connor et al., 2014), supporting the inclusion of imagery in measures of desire. The Craving Experience Questionnaire (CEQ) is a generalized version of the ACE designed to measure strength and frequency of desires for various substances over variable timescales ranging from the past week or month to the past few minutes of an experimental lab session. The CEQ has a consistent three-factor structure, comprising desire intensity, imagery and intrusiveness, and has undergone preliminary validation against measures of nicotine dependence and obsessional drinking (May et al., 2014).

Changing behavior

Laboratory studies on cognitive interference with desires for food or drugs suggest that simple tasks can weaken desires if they load the working memory processes that support desire imagery. Recent research extends these findings to real-world settings. Knäuper et al's (2011) study, cited above, showed selective reductions in food cravings over four days when people imagined a favourite activity whenever cravings struck. Skorka-Brown, Whalley, Andrade and May (in preparation) used SMS messages to prompt participants seven times a day for a week to report cravings and, in the experimental group, to play Tetris® for 3 minutes before reporting craving strength again. Playing Tetris weakened cravings by approximately 13 percentage points, similar to the reduction seen in laboratory research with a range of desires for food, physical activity and addictive substances (Skorka-Brown, Andrade & May, 2014). Also building on lab studies, Kemps and Tiggemann (2013) found that undergraduates experienced less intense food cravings over 4 weeks and consumed fewer calories when they used a hand-held device to display dynamic visual noise in response to food cravings. Hsu et al. (2013) trialled a smartphone app (iCrave), which provided written cues to imagine neutral visual scenes whenever users craved snacks and asked users to record both snacking and successful behavioral control. Over a week, community volunteers using iCrave ate fewer unhealthy snacks (but similar amounts of healthy snacks) than those who simply tracked their snacking.

Rodríguez-Martín, Gómez-Quintana, Díaz-Martínez and Molerio-Perez (2013) reported that a self-help manual based on EI theory helped overweight and obese people to manage their cravings. 'Imagery diversion' techniques such as imagining a pleasant activity (Knäuper et al., 2011) or neutral scene (May et al., 2010), and olfactory or visual imagery interference techniques were particularly helpful. Over 3 months, BMI decreased by 6% for

participants randomly allocated to the manual condition, compared to no change in the control group who were asked to use their willpower to control their cravings.

Changing behavior in the long term is not just a matter of maintaining abstinence by managing cravings. Rather, there is a need to shift the balance of desire from immediate rewards to the long-term goal. EI theory predicts that people's behavior can be shifted towards functional goals by encouraging vivid, emotive imagery of those goals. Although imagery of the negative consequences of continuing a behavior might also be effective (Giuliani, Calcott & Berkman, 2013; Kober, Kross, Mischel, Hart, & Ochsner, 2010; Szasz, Szentagotai & Hofmann, 2012), there is a risk that thinking about negative future consequences will lead people to avoid thinking about the future because it is unpleasant, or because they assume that something so bad would never happen to them (Ruiter, Abraham & Kok, 2001). EI theory predicts that behavior change interventions will be most effective when they encourage people to imagine positive benefits of change, which is a more rewarding mental exercise, rather than negative consequences of not changing. This strategy shifts attention from present to future rewards in a way that strengthens desire for the future goal, while also absorbing the imagery capacity that would otherwise support desire for immediate rewards.

Consistent with this prediction, Daniel, Stanton and Epstein (2013) showed that positive future imagery aided motivation as well as decision-making. Overweight and obese women who were cued to imagine personally relevant positive future events before making decisions showed less delay discounting and consumed fewer calories on a taste test compared with women who imagined events described by a travel writer. In this study, imagining personal future events helped focus attention on future rather than immediate rewards, and this increased decisions in favour of the future rewards.

Goals in the distant future can be motivating if vivid imagery about them can be generated, but often it cannot – future events are not typically construed in sufficient detail to support vivid imagery (Trope & Liberman, 2003). We suggest that motivation will be maximized if distal goals are linked to proximal steps that also provide valued outcomes. Highly realistic imagery for proximal outcomes is easier to elicit, and this imagery serves as an effective contrast against one's current state. Greater likelihood of achieving the goal may also be inferred when an expected outcome is proximal. Both elements augment the affective charge of the functional stepwise goals.

A related point is that more vivid imagery for the functional behavior and for the context in which it is required is also likely to assist in ensuring that it occurs. Implementation intentions (Gollwitzer & Sheeran, 2006) can be seen as a way of lowering the construal level of goals. Implementation intentions are detailed behavioral plans for achieving a goal, which specify how, when and where goal-directed behaviors take place. They are argued to work in part by strengthening and automatizing links between cues and goal-related actions, so that cues for desired behaviors become more salient among the multitude of cues for other behaviors, and ambiguous cues become more likely to trigger the desired rather than alternative behavior.

EI theory predicts that implementation intentions will be more effective when they encourage the generation of detailed vivid imagery. If people imagine possible scenarios while constructing their plan (Which day shall I go to the gym? How will I get there?), this imagery would be expected to contribute to the memorability and motivational power of the plan. This may be especially true of implementation intention interventions in field settings with complex behavioral choices, for example, when planning how to raise the issue of condom use with one's partner (Martin, Sheeran, Slade, Wright, & Dibble, 2009). Explicit instructions to imagine carrying out a plan or overcoming present obstacles increase goal

achievement compared with simply making an implementation intention (Adriaanse, Oettingen, Gollwitzer, et al., 2010; Knäuper, McCollam, et al., 2011), consistent with EI theory's prediction.

A problem with making plans to achieve future rewards is that people's estimates of how they will feel in the future tend to be biased by how they feel right now. For example, someone who has just eaten Christmas dinner might underestimate the difficulty of sticking to their New Year's resolution to diet. Sayette, Loewenstein, Griffin, & Black (2008) found that smokers who had just smoked a cigarette underestimated the value they would place on smoking in the future, compared with smokers who had abstained from smoking for 12 hours before the study. In EI theory, a reason for this so-called empathy gap is that images are constructed from all the information available, and it is hard to prevent current sensory information being incorporated into an image of a future self or situation. We predict that explicitly instructing participants to generate and rehearse detailed images of the future, which incorporate information from past experiences as well as present feelings, will help them make more realistic and detailed plans for behavior change and increase their chance of success.

There is also a need to weaken desires for immediate temptations. The laboratory studies discussed above show that any competing sensory imagery can reduce cravings, and future goal-related imagery will also do this. Strategies that seek to enhance awareness of other bodily sensations from competing behaviors, such as body scanning (Hamilton et al., 2013), mindful attention (Westbrook et al., 2013), or more extended mindfulness training (Witkiewitz & Bowen, 2010) may also help block craving imagery, not only by competition for modality-specific working memory resources, but also drawing attention to competing sensations. Another advantage of these strategies is that they typically involve instructions to notice but ignore sensations and thoughts, encouraging mental detachment from immediate

bodily sensations and tempting thoughts that should help prevent elaboration of goals to indulge immediate temptations. Papies, Pronk, Keesman and Barsalou (2014) have shown that brief training in mental detachment from (or 'mindful attention' to) responses to food cues can reduce consumption of unhealthy foods, while Bowen and Marlatt (2009) reported reduction in smoking in the seven days following mindfulness instructions (although they did not find decreases in self-reported craving in response to smoking cues). Mindfulness-related approaches may also therefore find a place in a motivational intervention inspired by EI theory, although extended training and practice may be needed for optimal results from this specific strategy.

Putting it all together: Functional Imagery Training

In sum, desire to pursue a future goal requires vivid, detailed and positively affectively charged imagery of goal success and the behavioral path towards that success. Engaging in such imagery also brings the benefit of diverting cognitive resources from imagery of immediate rewards, protecting the good intention from temptation. A corollary for treatment is that this functional imagery needs to be made salient in temptation situations. We suggest that three strategies can help with this task: Repeated rehearsal in clinical sessions of the imagery about valued outcomes, past successes and detailed plans; linking home practice to a frequent routine task; and setting reminders to practise imagery in situations where the functional behavior is most needed.

Based on EI Theory and the above findings, we have developed a new motivational intervention to support functional behavior change, which we call Functional Imagery Training (FIT). FIT uses a motivational interviewing style (Miller & Rollnick, 2012) to encourage people to develop vivid imagery about both distal and proximal positive consequences of behavior change, past relevant successes, and detailed hypothetical plans. If the person elects to commit to the functional goal, they are encouraged to rehearse imagery

about their plan and its likely benefits whenever they undertake a particular routine task such as washing their hands. Brief phone sessions over the next weeks reinforce the imagery. They also set reminders on their mobile phone to practise imagery in the form of a televised advertisement about their plan and its outcomes, where they feature in the advertisement. They record or write a statement about their goal, why they have adopted it and the reason they believe they can do it, and are encouraged to share the statement with a person who will give non-intrusive support, and to read or replay the statement, imagining its elements whenever their motivation flags. In some versions of FIT, they can also access audios that guide them in mindful body scanning and attention to environmental stimuli, and help them view temptations as just one part of their total experience. We predict that FIT will promote sustained behavior change, by developing habits of vividly imagining future goals rather than immediate pleasures. Trials of FIT for a range of functional behaviors are currently underway.

Conclusion

According to EI theory, desire is what we feel when making a controlled, cognitive response to a seemingly spontaneous thought about a target associated with pleasure or reward. Embodied sensory imagery, which emulates attainment of the target, is central to desire cognition. Such imagery is reported as a potent feature of desire and correlates with desire strength. EI theory has stimulated development of tools for measuring desire in its own right, distinguished from correlates such as behavioral control and intention. It provides a framework for developing strategies to support people quitting addictions, maintaining a healthy weight, or taking more physical exercise. Behavior change interventions need to develop habits of vividly future goals and the paths to their achievement: we argue that future-focused imagery can divert cognitive resources from imagery associated with immediate desires, and can help strengthen desire for future goals. Future-focused imagery

should be positive and vivid, personally relevant and detailed. Distant events can be difficult to imagine vividly because they are underspecified – uncertain and abstract - so interventions should help people to identify proximal subgoals that are easier to imagine vividly and more likely to be achieved. Seen through the lens of EI theory, self-regulation might be partly a matter of adopting the mental habit of vividly imagining the benefits of change towards, or maintenance of, healthy goals. Our new intervention, Functional Imagery Training, assists people to use imagery to maintain this self-regulation.

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