

Implementation intentions

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1 General background

1.1 The intention–behaviour relation

Several theories that have been used extensively to predict health behaviours construe a person's *intention* to act as the most immediate and important predictor of subsequent action, such as the theory of planned behaviour (TPB; Ajzen 1991; Conner and Sparks, Chapter 5 this volume) and protection motivation theory (PMT; Rogers 1983; Norman *et al.*, Chapter 3 this volume). Intentions can be defined as the instructions that people give themselves to perform particular behaviours or to achieve certain goals (Triandis 1980), and are characteristically measured by items of the form 'I intend to do/achieve X'. Intentions are the culmination of the decision-making process; they signal the end of deliberation about a behaviour and capture the standard of performance that a person has set themselves, their commitment to the performance, and the amount of time and effort that will be expended during action (Gollwitzer 1990; Ajzen 1991). Given the centrality of the concept of intention to models of health behaviour, it is important to ask how well intentions predict behaviour.

Sheeran (2002) approached this question by conducting a meta-analysis of meta-analyses of prospective tests of the intention–behaviour relation. Across 422 studies involving 82,107 participants, intentions accounted for an average of 28% of the variance in behaviour. This is a 'large' effect size according to Cohen's (1992) power primer, and suggests that intentions are 'good' predictors of behaviour. However, Sheeran's (2002) meta-analysis does not address whether *changes* in intentions predict *changes* in behaviour. To answer this question, Webb and Sheeran (2006) performed a meta-analysis of 47 experimental studies that demonstrated that a medium-to-large-sized change in intentions led to a small-to-medium-sized change in behaviour. This suggests that intentions do influence behaviour, but that intentional control of behaviour is more limited than previous meta-analyses of correlational studies have suggested.

To investigate the sources of consistency and discrepancy between intention and behaviour, Orbell and Sheeran (1998) decomposed the intention–behaviour relation into a 2 (intention:

to act vs. not to act) \times 2 (behaviour: acted vs. did not act) matrix (see also McBroom and Reid 1992). This decomposition revealed that intention–behaviour consistency is attributable to participants with positive intentions who subsequently act (termed ‘inclined actors’) and to participants with negative intentions who do not act (‘disinclined abstainers’). Discrepancies between intentions and behaviour, on the other hand, can be attributed to participants with positive intentions who do not act (‘inclined abstainers’) and participants with negative intentions who ultimately perform the behaviour (‘disinclined actors’). Orbell and Sheeran (1998) found that inclined abstainers – rather than disinclined actors – are principally responsible for the intention–behaviour ‘gap’. Sheeran (2002) confirmed this conclusion in a review of health behaviours. Across studies of exercise, condom use, and cancer screening, the median proportion of participants with positive intentions who did not perform the behaviour was 47%, whereas the median proportion of participants with negative intentions who acted was only 7% (see also Rhodes and De Bruijn 2013). These findings indicate that approximately half of people with positive intentions to engage in health behaviours do not successfully translate those intentions into action.

1.2 Explaining intention–behaviour discrepancies

Why is it so difficult for people to enact their intentions? We suspect that three processes underlie intention–behaviour discrepancies. The first process is *intention viability*, which refers to the idea that it is impossible for most decisions to find expression in the absence of particular abilities, resources or opportunities. That is, a behavioural intention can only be realized if the person possesses actual control over the behaviour (Ajzen 1991). Consistent with this idea, Webb and Sheeran’s (2006) review found that intentions have less impact on behaviour when participants lack control over the behaviour.

The second process that is relevant to discriminating between disinclined actors and inclined abstainers concerns *intention activation*. The activation level of an intention refers to the extent to which contextual demands alter the salience, direction or intensity of a focal intention relative to other intentions. To see the importance of situational demands on cognitive and motivational resources, consider that, for any particular time and context that a researcher chooses to specify in a measure of intention (e.g. ‘Do you intend to exercise at the gym twice in the next week?’), research participants are likely to have multiple, and often conflicting, goals pertaining to the same point in time (e.g. ‘Every evening this week is going to be spent writing that report for work’) and context (‘I must ask Ian and Sarah about their trip to Reykjavik when I see them at the gym’). Moreover, accumulated evidence indicates that situational features can activate goals and influence behaviour in a manner that operates outside people’s conscious awareness (e.g. Bargh *et al.* 2001; Aarts *et al.* 2004; Custers and Aarts 2010). Relatedly, when particular goals involve short-term affective costs (e.g. forgoing a tempting dessert) or require mobilization of effort (e.g. bringing a change of clothes to work), then people may be especially vulnerable to more enjoyable or pressing alternatives. Thus, the relative activation level of any particular goal intention may be reduced by the situational activation of alternative goal representations.

Diminution of the activation level of a focal intention can have two important consequences – *prospective memory failure* and *goal reprioritization*. Prospective memory failure occurs when people forget to perform the behaviour. Empirical support for this explanation of

intention–behaviour discrepancies comes from retrospective reports by inclined abstainers. For example, Orbell *et al.* (1997) found that 70% of participants who intended to perform a breast self-examination but did not do so offered ‘forgetting’ as their reason for non-performance (see also Milne *et al.* 2002). Goal reprioritization occurs when an intention fails to attract sufficient activation to permit its realization and is postponed or abandoned (at least temporarily). Consistent with this idea, Milne *et al.* (2002) found that 45% of participants who failed to enact their intention to exercise said that they were ‘too busy’, while Abraham *et al.* (1999) found that intentions to use a condom were not enacted because the goal of having sex was more important at the time than was the goal of protecting oneself against HIV/AIDS. Similarly, numerous studies attest to the lack of salience of pregnancy prevention *in situ* (reflected in statements such as ‘I could not be bothered at the time’ or ‘We were carried away in the heat of the moment’) as explanations of contraceptive non-use (for a review, see Sheeran *et al.* 1991).

The third process that can help to explain the intention–behaviour gap concerns *intention elaboration*. Thus, people may fail to engage in, or to elaborate in sufficient detail, an analysis of the particular responses and contextual opportunities that would permit realization of their intention. Most of the behaviours of interest to health psychologists are goals that can be achieved by performing a variety of behaviours (e.g. the goal or outcome ‘losing weight’ can be achieved by exercise, making changes to diet or both; cf. Bagozzi and Kimmel 1995). Equivalently, behavioural categories such as exercising or dieting may be indexed by a variety of specific actions (Abraham and Sheeran 2004; for an empirical example, see Sewacj *et al.* 1980). Moreover, health behaviours may involve complex action sequences wherein the failure to initiate relevant preparatory behaviours is likely to undermine goal pursuit. For example, the intention to use a condom might only be realized if the person has (a) bought, stored or carried condoms, (b) suggested using one to a sexual partner, and (c) thought of ways of overcoming a partner’s reluctance to use a condom (Abraham *et al.* 1998; Sheeran *et al.* 1999). Understanding that health goals involve hierarchies of single acts undertaken in specific situational contexts clarifies how important it is to identify both the means (responses) and the context (internal or external cues) that will permit intention realization – especially in the case of behaviours that involve deadlines or windows of opportunity (e.g. a health check appointment). In the absence of such elaboration, the person is likely to miss opportunities to act, or not know how to act even if an opportunity presents itself.

1.3 Theoretical background to implementation intentions

Forming implementation intentions has been proposed as an effective tool for handling problems with sub-optimal elaboration of goal intentions, viability, activation or contextual threats (Gollwitzer 1993, 1996, 1999; Gollwitzer and Schaal 1998; Gollwitzer *et al.* 2005; Gollwitzer and Sheeran 2006; see Section 2.2). The theoretical background to the implementation intention construct is the model of action phases (MAP; Heckhausen and Gollwitzer 1987; Gollwitzer 1990). The MAP is a framework for understanding goal achievement that is based on the distinction between the motivational issue of goal-setting (intention formation) and the volitional issue of goal-striving (intention realization). The model assumes that the principles that govern intention formation and intention realization are qualitatively different. Whereas intention formation is guided by people’s beliefs about the desirability and feasibility of particular courses of action,

intention realization is guided by conscious and unconscious processes that promote the initiation and effective pursuit of the goal. The distinction between intention formation and intention realization is important because it clarifies the distinctiveness of the concept of implementation intentions. Social cognition models such as the TPB and PMT focus on the motivational phase of action. The primary concern of these theories is the specific types of feasibility and desirability considerations that determine intention formation – little attention is paid to how intentions are translated into action (Oettingen and Gollwitzer 2001; Sheeran 2002). Research on implementation intentions, on the other hand, provides an explicit theoretical analysis of processes that govern the enactment of intentions.

2 Description of the model

2.1 The nature of implementation intentions

Implementation intentions are if–then plans that connect good opportunities to act with cognitive or behavioural responses that are likely to be effective in accomplishing one's goals. Whereas behavioural or goal intentions specify what one wants to do or achieve (i.e. 'I intend to do/achieve X'), implementation intentions specify the response that one will perform in the service of goal achievement and the opportunity in which one will enact it (i.e. 'If opportunity Y occurs, then I will initiate goal-directed response Z!'). Implementation intentions are subordinate to goal intentions because, whereas a goal intention indicates *what* one will do, an implementation intention specifies the *when, where, and how* of what one will do.

To form an implementation intention, the person must first identify a response that will lead to goal attainment, and second, anticipate a suitable opportunity to initiate that response. For example, in order to enact the goal intention to exercise, the person might specify the behaviour 'go jogging for 20 minutes' and specify a suitable opportunity as 'tomorrow morning before work'. Implementation intention formation is, therefore, the mental act of linking the anticipated opportunity with a suitable goal-directed response. This process involves a conscious act of willing that results in an association being forged between the mental representation of the specified opportunity and the means of attaining the focal goal (i.e. cognitive or behavioural responses).

Goal and implementation intentions can therefore be differentiated both in terms of structure (goal intentions specify *what* one will do, while implementation intentions are if–then statements that *plan out in advance how this is to be executed*), and in terms of their impact on goal attainment. Evidence suggests that forming implementation intentions substantially increases the likelihood that goal intentions will be translated into action (for a review, see Gollwitzer and Sheeran 2006). In addition, studies of the neural processes involved in goal-striving also support a distinction between goal and implementation intentions (Gilbert *et al.* 2009; Hallam *et al.* submitted).

2.2 Implementation intentions and overcoming volitional problems in goal pursuit

When people have only formed goal intentions, they may encounter volitional problems that undermine goal pursuit and give rise to inclined abstainers rather than inclined actors. However, evidence suggests that these problems can be overcome by the psychological processes engendered by implementation intentions. Forming an implementation intention promotes goal

achievement because the person is perceptually ready to encounter the cues specified in the if-component of the plan, and because these cues evoke the specified response swiftly and without the need for conscious awareness or effort. These benefits help to overcome volitional problems related to intentions that are not elaborated, not viable, not activated or thwarted by contextual threats.

2.2.1 Problems of intention elaboration

Forming an implementation intention helps to manage the problem of poorly elaborated goal intentions because if-then plans specify the response that one will perform in the service of the goal and the opportunity in which one will perform it. Whereas the person who has only formed a goal intention still has to identify the specific response(s) that will be effective in achieving their goal *and* identify a good opportunity in which to enact it, all of this work is finished when the person has formed an implementation intention: the plan specifies the response and opportunity in advance. This means that good opportunities to initiate a response that leads to goal attainment are recognized swiftly and precisely, rather than missed. Moreover, encountering a good opportunity instigates specific responses in a more immediate and less effortful fashion instead of generating deliberation about what one should do and/or the need to energize oneself to perform it.

2.2.2 Problems of intention viability

Forming an implementation intention can also help to deal with problems related to the viability of intentions – namely, that intentions may only translate into action if the person has the required abilities, resources or opportunities. If-then planning overcomes problems of unviable intentions because the person has to devote thought in advance to when, where, and how they will strive for the goal, and hence is more likely to anticipate and account for potential difficulties. Moreover, implementation intentions can be used to boost self-efficacy directly in order to overcome problems of intention viability. For instance, Bayer and Gollwitzer (2007) demonstrated that specifying a self-efficacy-enhancing response in an if-then plan ('And if I start a new task, then I will tell myself: I can solve this task!') was effective in promoting the realization of intentions to perform well in a mathematics test.

2.2.3 Problems of intention activation

Implementation intentions also help to circumvent problems associated with the activation level of the superordinate goal intention. This is because if-then plans delegate control of responses to specified cues that serve to elicit these responses directly. This contrasts with the predicament of the person who has only formed goal intentions and who must maintain the activation level of the intention in the face of multiple and often competing goals (and is vulnerable to prospective memory failure and goal reprioritization). Although research indicates that constructs such as anticipated regret and temporal stability of intention (for reviews, see Sheeran 2002; Cooke and Sheeran 2004) moderate the intention-behaviour relation, studies to date suggest little that the person could *deliberately* or strategically do to maintain the activation level of his or her intention (over and above cognitive rehearsal of that self-instruction and/or deployment of mnemonic devices such as diaries or knotted handkerchiefs). Forming implementation intentions is, therefore, a helpful intervention in this regard.

2.2.4 Problems of contextual threats

Recent research has explicitly tested whether implementation intentions can be used to help people overcome contextual threats, such as priming of goals that are antithetical to focal goal pursuit, the presence of attractive distractions, and detrimental self-states such as anxiety. Gollwitzer *et al.* (2011) tested whether implementation intentions can protect against the effect of priming goals that are antithetical to the focal goal. Across three studies, Gollwitzer *et al.* demonstrated that forming an implementation intention countered the effects of priming participants with slowness (Study 1), cooperation (Study 2), and moving fast (Study 3). Thus, implementation intentions may be used to offset the impact of cues that activate task-inhibiting or alternative goals – the strategic automaticity of if–then plans can overcome the automatic activation of antithetical goals (see also Webb *et al.* 2012).

Gollwitzer and Schaal (1998) showed implementation intentions could overcome the impact of attractive distractions on the time taken to solve boring arithmetic problems. Similar findings were obtained by Wieber *et al.* (2011), who demonstrated that, compared with forming intentions ('I will ignore distractions!'), forming implementation intentions ('If a distraction comes up, then I will ignore it') helped schoolchildren aged 5–8 years to deal with moderately or highly attractive distractions.

In summary, there is good evidence that forming implementation intentions helps to overcome contextual threats to intention activation that may undermine the realization of goal intentions. If–then plans prove useful (a) whether the threat is within or outside conscious awareness, and (b) whether the threat resides in the environment or is an internal self-state.

2.3 Operation of implementation intentions

Two processes are thought to explain the efficacy of forming if–then plans in improving the likelihood of goal attainment compared with only forming a respective goal intention (Gollwitzer 1993, 1996, 1999; Gollwitzer and Sheeran 2006). First, forming implementation intentions helps people to identify good opportunities to act. This is supported by demonstrations that forming implementation intentions increases the accessibility of cues (specified in the *if*-component of the plan) and that detection of, and attention to, the critical cue is thereby facilitated (Aarts *et al.* 1999; Webb and Sheeran 2004, 2007, 2008). Second, forming implementation intentions helps to automate the execution of the goal-directed response (specified in the *then*-component of the plan). This idea is supported by demonstrations that the initiation of responses in the presence of the critical cue are more automatic following the formation of implementation intentions, with responses being initiated more immediately, efficiently, and without the need for conscious awareness (Gollwitzer and Brandstätter 1997; Brandstätter *et al.* 2001; Lengfelder and Gollwitzer 2001; Webb and Sheeran 2004, 2007, 2008; Sheeran *et al.* 2005; Wieber and Sassenberg 2006; Bayer *et al.* 2009). The mere formation of a goal intention is not sufficient to produce these effects – the person still has to identify appropriate opportunities and goal-directed responses and then mobilize the self to act. Action control in this mode is, therefore, slower by comparison and requires conscious attention and effort.

2.3.1 Identification of the critical opportunity

Specifying a good opportunity to act in the *if*-component of an implementation intention means that the mental representation of the cues that comprise this opportunity become highly accessible. This heightened accessibility enhances information processing related to the specified cue

with the result that it becomes easier to detect and attend to. Aarts *et al.* (1999) obtained evidence that forming implementation intentions heightens the accessibility of the specified cues in an experiment that asked one-half of participants to form an implementation intention about how they would later collect a coupon from a nearby room; the other half of participants (controls) formed an irrelevant implementation intention about how they would spend the coupon. All of the participants then took part in an ostensibly unrelated word recognition task (their task was to indicate as quickly and accurately as possible whether or not letter strings were words or non-words). Among the letter strings presented were words related to the location of the room where the coupon should be collected (e.g. 'corridor', 'swing-door').

Consistent with predictions, participants who formed if-then plans responded faster to words related to the cues representing the opportunity for action (e.g. 'corridor'), suggesting that the mental representation of the anticipated opportunity was rendered more accessible. Importantly, only 50% of participants in the control condition (who planned when they would spend, rather than collect, the coupon) collected a coupon, whereas 80% of participants who formed implementation intentions did so. Thus, implementation intentions affected both cue accessibility and goal achievement. Further analyses indicated that the accessibility of cues mediated (i.e. explained) the impact of forming implementation intentions on goal achievement.

Heightened accessibility should also mean that the specified cues attract and focus attention even though the person is occupied by other concerns. Achtziger *et al.* (2012, Study 1) tested this idea using a dichotic listening task. Findings indicated that the critical cues earlier specified in an implementation intention were highly disruptive, when presented in one ear, for attention to the focal tasks (switching off a light and repeating words in the other ear). Thus, words related to the critical opportunity grabbed participants' attention even though participants were supposed to be concentrating on demanding other tasks. These findings suggest that even though people may be wrapped up in their thoughts, emotions or activities that have nothing to do with an underlying goal intention, the critical opportunity specified in an if-then plan will penetrate current preoccupations and capture attention (see also Webb and Sheeran 2004).

2.3.2 Execution of the goal-directed response

Webb and Sheeran (2008, Study 2) tested the importance of the accessibility of cues and the strength of cue-behaviour links in mediating action control by implementation intentions. The study replicated the key features of the coupon collection paradigm used by Aarts *et al.* (1999); the main innovation was using a sequential priming procedure in the lexical decision task. Participants had to respond, as quickly as possible, to a target to indicate whether it was a word using a button box. The target was preceded by a masked priming word (related to the location of the coupon [e.g. 'corridor', 'right'] or matched neutral words). The target words were the specified behaviour ('collect'), an unrelated behaviour ('confirm'), the location words (cues), and filler words. In this way, it was possible to determine the impact of implementation intentions on both cue accessibility (response latencies to *neutral prime-location cue* targets) and the strength of cue-behaviour links (response latencies to *location prime-specified behaviour* targets) and all other prime-target combinations.

Findings showed that participants who formed implementation intentions were significantly more likely to collect the coupon than were participants who only formed goal intentions (64% vs. 39%). Moreover, both heightened accessibility of the specified opportunity and strong cue-response links mediated the impact of if-then plans on coupon collection. These findings

support theoretical predictions about the processes underlying action control by implementation intention (Gollwitzer 1993), and provide good evidence that enhanced identification of critical cues and automated execution of responses are the mechanisms by which implementation intentions promote goal achievement.

A study by Papiés *et al.* (2009) suggests that the process underlying implementation intention effects may not be merely associative. Requiring participants to visit the experimenter via the cafeteria (see Aarts *et al.* 1999), participants had to (1) form an implementation intention to go to the experimenter via the cafeteria, (2) complete an associative learning task to link the cue with the behaviour, or (3) complete an unrelated associative learning task (control condition). Rates of goal completion were similar across the implementation intention and associative learning conditions (and superior to the control group). However, when participants returned one week later and were provided with the same goal (without further implementation intention or associative learning manipulations), the implementation intention group outperformed those in both the associative learning and control groups. This suggests that the mechanisms underlying implementation intentions go beyond mere cue-behaviour association, with the authors speculating that forming implementation intentions leads to richer mental representations of goal-directed actions, which increase the likelihood that they are activated even after a delay.

2.3.3 Features of automaticity

Forming an implementation intention involves a strategic abdication of action control to the extent that the person specifies that they will perform a particular goal-directed response (in the *then*-component of a plan), at the moment specified in the *if*-component of the plan. Forming implementation intentions thus delegates control of the intended response from the self to specified cues that directly elicit the response (see Gollwitzer and Sheeran 2006). Nothing more needs to be done to ensure initiation of the intended response except encounter the specified opportunity. The consequence is that the execution of a response specified in an implementation intention exhibits features of *automatic* processes. According to Bargh (1992, 1994), key features of automatic processes are immediacy, efficiency, and lack of awareness (see also Moors and De Houwer 2006). Automaticity characterizes highly over-learned activities such as driving a car or typing. For example, drivers respond quickly to changes in the flow of traffic or road conditions. They can hold a conversation with a passenger despite the demands while they are driving at the same time (supporting the idea that driving is efficient in terms of cognitive resources). Drivers need devote little attention to the process of driving itself; they need only be aware of other traffic and their conversation partner. So what evidence is there that action control by implementation intentions exhibits features of automatic processes?

The *immediacy* of implementation intention effects is supported by several studies that have employed speed of responding as the dependent variable. For example, Webb and Sheeran (2004, Study 3) used a reaction time task to compare whether forming an implementation intention to respond especially quickly to a critical stimulus (in this case, the number 3) led to faster responses compared with merely holding equivalent goal intentions. Findings indicated that participants who formed if-then plans responded faster to the critical stimulus compared with both non-critical stimuli and participants who only formed goal intentions (see also Parks-Stamm *et al.* 2007). A field study by Orbell and Sheeran (2000) afforded a similar conclusion. Patients undergoing joint replacement surgery were asked to form implementation intentions about resuming functional activities upon their discharge from hospital. Despite equivalent

goal intentions to resume the activities, three months later patients who formed implementation intentions initiated 18 of 32 activities sooner than did patients who had not formed if-then plans. Participants who formed implementation intentions were functionally active two and a half weeks sooner, on average, than were controls. Finally, Gollwitzer and Brandstätter (1997, Study 3) reported that participants who formed implementation intentions were quicker to make counter-arguments to racist remarks than participants who only formed goal intentions. Taken together, the evidence suggests that participants who form if-then plans are quicker to seize the opportunities to act than those who form goal intentions alone.

The *efficiency* of implementation intention effects is supported by studies that manipulated cognitive load either through selection of the sample (e.g. schizophrenic patients, heroin addicts under withdrawal) or by using a dual-task paradigm in experiments with college students (Brandstätter *et al.* 2001; Lengfelder and Gollwitzer 2001). For example, Brandstätter *et al.* (2001, Study 2) found that forming implementation intentions benefited task performance for schizophrenic patients just as much as for matched controls, even though schizophrenics are likely to have been preoccupied by unwanted thoughts. Similarly, forming an implementation intention to compose a curriculum vitae increased the likelihood of completing the task by the deadline regardless of whether or not addicts were still experiencing symptoms of opiate withdrawal (Brandstätter *et al.* 2001, Study 1). Two further studies manipulated the amount of mental load that participants experienced by having them perform two tasks at once (Brandstätter *et al.* 2001). Consistent with the idea that implementation intentions do not require much in the way of cognitive resources, enacting planned responses did not compromise performance on a secondary task (Study 3) and did not show evidence of task interference even when the task was very difficult (Study 4).

Efficiency is usually construed in terms of the cognitive demands that are placed on participants at the time of acting (e.g. Bargh 1992). However, Webb and Sheeran (2003) examined how effective implementation intentions were in promoting goal achievement when people's overall capacity for self-control (i.e. 'willpower') was diminished by prior exertion of self-control. Their study drew upon Baumeister and colleagues' research on 'ego-depletion' (e.g. Baumeister *et al.* 1998; for reviews, see Muraven and Baumeister 2000; Hagger *et al.* 2010). Ego-depletion refers to the temporary depletion of self-regulatory capacity brought about by an initial act of self-control. Webb and Sheeran (2003, Study 2) induced ego-depletion by asking participants to perform a dual balance-and-maths task that required considerable self-control (or not). Participants then either formed or did not form an implementation intention in relation to a subsequent Stroop colour-naming task. Consistent with previous research, ego-depleted participants performed worse on the Stroop task than did non-depleted controls. However, ego-depletion did not influence responses when participants had formed implementation intentions. Participants who formed if-then plans were as fast and accurate in their Stroop performance as were participants who had not been ego-depleted. These findings are consistent with the idea that implementation intentions are 'efficient' in that they do not draw on potentially limited self-regulatory resources. Even when participants' capacity for self-control was substantially diminished, forming an implementation intention still benefited task performance.

Two aspects of *lack of awareness* have been investigated with respect to the operation of implementation intentions, one related to the anticipated opportunity and the other related to the underlying goal intention. Bayer *et al.* (2009) obtained evidence that awareness of the specified cue is not required for implementation intention effects. In a first study, Bayer *et al.* used a retaliation paradigm wherein participants who had been insulted by an experimenter during an

initial study were encouraged to form a goal intention to complain to the rude experimenter. In addition, a subset of participants formed implementation intentions (e.g. 'As soon as I see this person again, I'll tell her what an unfriendly person she is!'). In a second (ostensibly unrelated) study, participants had to read a series of adjectives used to describe people as quickly as possible. However, 100 ms before each adjective, either the face of the unfriendly experimenter or a neutral face was presented subliminally (participants were not consciously aware of the presentation because the face was pattern masked and appeared for only 10 ms). Findings indicated that participants who formed implementation intentions to tell the unfriendly experimenter what they thought of her were slower to respond to positive adjectives and faster to respond to negative adjectives following subliminal presentation of a picture of the unfriendly experimenter compared with the neutral face. These findings were not obtained among participants who only formed goal intentions or a second control group who had not been insulted. Thus, awareness of the critical cue is not needed for that specified opportunity directly to elicit cognitive responses that are consistent with the intended action.

Sheeran *et al.* (2005, Study 2) examined whether participants need be consciously aware of the goal underlying implementation intentions. Participants were given the goal to solve a series of puzzles as accurately as possible and they formed either an implementation intention to solve the puzzles quickly (relevant implementation intention condition) or they formed an irrelevant implementation intention. In addition, the goal to respond quickly was primed outside participants' awareness (using a word-recognition task that contained words related to being quick such as 'fast' and 'rapid'; cf. Bargh *et al.* 2001), or a neutral goal was primed. Debriefing indicated that participants were not aware of the activation of the goal to respond quickly. However, despite this lack of awareness of the respective goal, implementation intention effects were contingent upon activation of the goal to respond quickly. Specifically, solution times were fastest when participants had been primed with the goal to respond quickly and had formed a relevant implementation intention. Participants did not have to be consciously aware of the superordinate goal intention for implementation intentions to affect performance.

2.3.4 Alternative mechanisms

Although accumulating evidence points to the importance of cognitive processes such as heightened cue accessibility and strong cue–response links as mediators of the effect of forming implementation intentions on goal attainment, it is important to consider alternative explanations for the beneficial effects of if–then planning. Social cognition models such as the TPB (Conner and Sparks, Chapter 5 this volume) and PMT (Norman *et al.*, Chapter 3 this volume) suggest that motivation and self-efficacy are the proximal determinants of goal achievement. Thus, although implementation intentions are conceptualized as a post-intentional, volitional strategy, it is still possible that implementation intentions promote changes in behaviour because the if–then planning leads to increases in intention and/or self-efficacy. To investigate whether forming implementation intentions promotes goal attainment through motivational processes, Webb and Sheeran (2008) conducted a meta-analytic review. Across 13 studies, implementation intentions had little impact on intentions ($d_+ = 0.10$), and across nine studies, there was a similarly small effect on self-efficacy ($d_+ = 0.10$). Implementation intentions have also significantly affected the likelihood of goal achievement even when almost all of the participants scored at the top of the scale measuring goal intentions (i.e. already had very strong intentions prior to plan formation; Verplanken and Faes 1999; Sheeran and Orbell 2000). Finally, a re-analysis of data from Webb

and Sheeran (2003, Study 1) indicated that participants who formed implementation intentions exhibited greater task persistence than ego-depleted participants even though both groups had equivalent low scores on the 'Reduced Motivation' subscale of the Multidimensional Fatigue Inventory (MFI-20; Smets *et al.* 1995). In summary, motivation appears not to be the mechanism by which implementation intentions promote goal achievement.

2.3.5 Summary of mechanisms

Evidence suggests that action initiation by implementation intentions is relatively immediate, efficient, and does not require conscious intent. Some researchers have asserted that the mechanisms underlying implementation intention effects may differ between health behaviours and behaviours studied in the laboratory (e.g. Sniehotta 2009; Hagger and Luszczynska 2014); however, to date, there is no evidence in support of alternative mechanisms for behaviours outside of the laboratory. Nonetheless, further research is needed to examine this issue.

3 Summary of research

3.1 Meta-analysis

Since implementation intentions facilitate identification of good opportunities to act, and initiate responses more automatically when those opportunities are encountered, forming an implementation intention should make it more likely that decisions become a reality compared with only forming a goal intention. The overall impact of forming implementation intentions on behavioural performance and goal achievement has been tested in several meta-analyses. Some of these meta-analyses have reviewed the effects of if-then planning on a range of behaviours (Koestner *et al.* 2002; Sheeran 2002; Gollwitzer and Sheeran 2006; Howard *et al.* 2009), while others have been domain-specific (diet: Adriaanse *et al.* 2011b; emotion control: Webb *et al.* 2012; physical activity: Bélanger-Gravel *et al.* 2013; Carraro and Gaudreau 2013), and yet others have focused on mechanisms (Webb and Sheeran 2008; Nyman and Yardley 2009). The effect size estimate used in most cases was d_+ , which is the sample-weighted difference between means for an implementation intention condition versus a control condition divided by the within-group standard deviations. According to Cohen (1992), $d_+ = 0.20$ should be considered a 'small' effect size, $d_+ = 0.50$ is a 'medium' effect size, and $d_+ = 0.80$ is a 'large' effect size. Table 10.1 presents the effect sizes obtained in these reviews (note that effect sizes have been converted to d_+ where required).

In the largest review of the effects of forming implementation intentions conducted so far, Gollwitzer and Sheeran (2006) reported an effect size of medium-to-large magnitude ($d_+ = 0.65$) across 94 studies ($n = 8461$). In additional analyses, Gollwitzer and Sheeran (2006) reported effect sizes within different domains including health ($d_+ = 0.59$, $k = 23$, $n = 2861$). These findings are supported by reviews that focus specifically on health behaviours, such as diet and physical activity, although these suggest relatively smaller effects (Adriaanse *et al.* 2011b; Bélanger-Gravel *et al.* 2013; Carraro and Gaudreau 2013). Implementation intentions can also be used to modify emotional outcomes, where effect sizes tend to be large (Webb *et al.* 2012) or across a range of behaviours for clinical samples (Toli *et al.*, submitted). Thus, forming an implementation intention makes an important difference to whether or not desired outcomes are obtained, including when the outcomes are health-related, although the effects are somewhat smaller for physical activity and reducing unhealthy eating.

Table 10.1 Effect sizes in meta-analyses of the impact of implementation intentions on goal achievement and related outcomes

Research area	Researchers	Effect size d_+ (number of studies, k)
General	Koestner <i>et al.</i> (2002)	0.54 ($k = 13$)
	Sheeran (2002)	0.70 ($k = 15$)
	Gollwitzer and Sheeran (2006)	0.65 ($k = 94$)
	Howard <i>et al.</i> (2009)	0.54 ($k = 9$)
	Toli <i>et al.</i> (submitted)	0.63 ($k = 27$)
Emotion control	Webb <i>et al.</i> (2012)	0.91 ($k = 21$)
Diet	Adriaanse <i>et al.</i> (2011a)	0.43 ($k = 24$)
		Promoting healthy eating: 0.51 ($k = 15$) Reducing unhealthy eating: 0.29 ($k = 9$)
Physical activity	Carraro and Gaudreau (2013)	0.30 ($k = 21$): average post-intervention and follow-up
	Bélanger-Gravel <i>et al.</i> (2013)	0.24 ($k = 19$): follow-up

Several features of Gollwitzer and Sheeran's (2006) analysis serve to underline the efficacy of implementation intentions in promoting goal achievement. First, the review does not suffer from publication bias. Forty-nine per cent of the studies reviewed were unpublished; moreover, publication status had no impact on the effect size obtained for implementation intentions. Second, experimental designs (i.e. random assignment of participants to implementation intention vs. control conditions) yielded similar effect sizes to those obtained using correlational designs that assessed participants' use of implementation intentions using rating scales ($d_+ = 0.65$ and 0.70 respectively), which increases confidence in the findings. Finally, the efficacy of implementation intentions was not exaggerated by over-reliance on self-report measures of behaviour with similar sized effects when using self-report or objective outcome measures ($d_+ = 0.63$ and 0.67 respectively). In summary, implementation intentions benefited performance when assessed across a range of methods.

The efficacy of implementation intentions has also been noted in meta-analyses comparing the effect of a wide range of behaviour change techniques, including among internet-based interventions (Webb *et al.* 2010), on specific health behaviours such as smoking (Bartlett *et al.* 2014) or on the determinants of health behaviours such as self-efficacy (Olander *et al.* 2013; Williams and French 2011). These meta-analyses typically use taxonomies of behaviour change techniques and compare the effect sizes among studies that use a specific technique in the intervention condition with the effect sizes reported by studies that do not use the specific technique in the intervention condition. While these reviews are useful in comparing the effects of several techniques across a relatively broad range of literature, given the differences in several potentially important features across included studies, one should not ignore individual studies – particularly those using full-factorial designs. In the field of implementation intentions, studies have been conducted using this approach to identify the effect of implementation intentions alone and in conjunction with additional behaviour change techniques. For example, studies suggest that combining implementation intentions with motivational interventions (e.g. decisional balance sheets) produces stronger effects than using neither or either strategy alone (e.g. Prestwich *et al.* 2003, 2008; Sheeran *et al.* 2005).

3.2 Specific health behaviours

Implementation intentions have been used extensively to promote health behaviour change. Research to date has examined both health-protective behaviours (e.g. exercise, healthy food intake, vitamin intake, and cancer screening) and health-risk behaviours (e.g. unhealthy food intake, binge drinking, and smoking) and has used a variety of samples and measures of behaviour (see Table 10.2 for an overview of research to date).

3.2.1 Physical activity

Meta-analyses of the effects of forming implementation intentions on exercise (Bélanger-Gravel *et al.* 2013; Carraro and Gaudreau 2013) support the idea that forming implementation intentions can promote physical activity. Primary studies include interventions targeted at pregnant women (Gaston and Prapavessis 2014), prostate cancer survivors (although significant effects at one month disappeared at three months; McGowan *et al.* 2013), patients undergoing pulmonary rehabilitation (Rodgers *et al.* 2014), adults of low socio-economic status (Armitage and Arden 2010), and children (Armitage and Sprigg 2010). It should be noted that studies that have produced significant effects of implementation intentions on physical activity have tended to examine effects over relatively short periods (e.g. two weeks: Andersson and Moss 2011; four weeks/one month: Wiedemann *et al.* 2011; Gaston and Prapavessis 2014; two months: Rodrigues *et al.* 2013), while studies using longer-term follow-ups tend to report smaller effects on physical activity outcomes (three months: McGowan *et al.* 2013; six months: Prestwich *et al.* 2012; Rodgers *et al.* 2014). Formal meta-analytic tests of the length of follow-up suggested it did not impact on effect size (Bélanger-Gravel *et al.* 2013) or that the evidence was mixed (Carraro and Gaudreau 2013), but these reviews did not include several recent studies that incorporated long-term follow-ups producing small effects (e.g. Prestwich *et al.* 2012; Rodgers *et al.* 2014). Other studies have used implementation intentions successfully alongside other behaviour change techniques to promote physical activity but, by not adopting factorial designs, it is not possible to disentangle the unique effects of implementation intentions and the additional behaviour change techniques (Milne *et al.* 2002; Prestwich *et al.* 2010; Koring *et al.* 2012; Schwerdtfeger *et al.* 2012).

3.2.2 Diet

Since Adriaanse *et al.* (2011b) conducted their review of the effect of forming implementation intentions on dietary outcomes, the number of experimental studies published in the area has approximately doubled. A striking finding from Adriaanse and colleagues' review was that forming implementation intentions appeared to be more effective in promoting healthy dietary habits (e.g. promoting fruit and vegetable consumption) than in reducing unhealthy dietary habits (e.g. reducing dietary fat intake). Findings since then appear reasonably consistent with this pattern. Experimental studies focusing on promoting a healthy diet have reported significant effects of forming implementation intentions (Stadler *et al.* 2010; Zandstra *et al.* 2010; Knäuper *et al.* 2011; Guillaumie *et al.* 2012; Troop, 2013; Harris *et al.* 2014). In contrast, the pattern for reducing unhealthy snacking has been more mixed. While some studies have reported significant benefits of forming implementation intentions on reducing unhealthy food intake (Bukowska-Durawa *et al.* 2010; van Koningsbruggen *et al.* 2011; Karimi-Shahanjarini *et al.* 2013), some have reported more complex findings. For example, Verhoeven *et al.* (2013) found that forming one implementation intention was more effective than forming several implementation intentions.

Table 10.2 Applications of implementation intentions to health goals

Research area	Overview of empirical studies and reviews
<i>Promoting health-protective behaviours</i>	
Exercise	Recent reviews: Bélanger-Gravel <i>et al.</i> (2013), Carraro and Gaudreau (2013) Additional studies not cited in these reviews: Milne <i>et al.</i> (2002), Armitage and Arden (2010), Armitage and Sprigg (2010), Andersson and Moss (2011), Luszczynska <i>et al.</i> (2011), Wiedemann <i>et al.</i> (2011), Prestwich <i>et al.</i> (2012), Bélanger-Gravel <i>et al.</i> (2013), McGowan <i>et al.</i> (2013), Rodrigues <i>et al.</i> (2013), Epton <i>et al.</i> (2014), Gaston and Prapavessis (2014), Jessop <i>et al.</i> (2014), Rodgers <i>et al.</i> (2014)
Diet	Recent review: Adriaanse <i>et al.</i> (2011a) Additional studies not cited in this review: Adriaanse <i>et al.</i> (2010, 20011b), Bukowska-Durawa <i>et al.</i> (2010), Stadler <i>et al.</i> (2010), Tam <i>et al.</i> (2010), Zandstra <i>et al.</i> (2010), Knäuper <i>et al.</i> (2011), Kroese <i>et al.</i> (2011), Soureti <i>et al.</i> (2011), van Koningsbruggen <i>et al.</i> (2011), Guillaumie <i>et al.</i> (2012), Wiedemann <i>et al.</i> (2012), Benyamini <i>et al.</i> (2013), Karimi-Shahanjari <i>et al.</i> (2013), Scholz <i>et al.</i> (2013), Troop (2013), Verhoeven <i>et al.</i> (2013), Epton <i>et al.</i> (2014), Harris <i>et al.</i> (2014), Prestwich <i>et al.</i> (2014a)
Cancer screening	
Breast self-examination	Orbell <i>et al.</i> (1997), Prestwich <i>et al.</i> (2005), Benyamini <i>et al.</i> (2011)
Testicular self-examination	Milne and Sheeran (2002), Steadman and Quine (2004), Heverin and Byrne (2011)
Breast screening	Rutter <i>et al.</i> (2006), Browne and Chan (2012)
Attendance for cervical screening	Sheeran and Orbell (2000), Walsh (2003)
Completing colorectal cancer screening	Lo <i>et al.</i> (2014), Neter <i>et al.</i> (2014)
Medication adherence	Sheeran and Orbell (1999), Steadman and Quine (2000), Liu and Park (2004), Jackson <i>et al.</i> (2006), Brown <i>et al.</i> (2009), Chatzisarantis <i>et al.</i> (2010), O'Carroll <i>et al.</i> (2013), Brom <i>et al.</i> (2014)
<i>Reducing health-risk behaviours</i>	
Smoking	Higgins and Conner (2003), Armitage (2007, 2008), Van Osch <i>et al.</i> (2008), Webb <i>et al.</i> (2009), Conner and Higgins (2010), Elfeddali <i>et al.</i> (2012), Epton <i>et al.</i> (2014)
Alcohol consumption	Murgraff <i>et al.</i> (1996, 2007), Fitzsimons <i>et al.</i> (2007), Gebhardt <i>et al.</i> (2008), Armitage (2009), Chatzisarantis and Hagger (2010), Armitage <i>et al.</i> (2011), Arden and Armitage (2012), Armitage and Arden (2012), Hagger <i>et al.</i> (2012a, 2012b), Epton <i>et al.</i> (2014)

Tam *et al.* (2010) found an interaction between implementation intention formation, regulatory fit, and habit strength. Specifically, when participants had weak unhealthy snacking habits, any related implementation intention formation was useful. However, when participants had strong unhealthy snacking habits, implementation intention formation required regulatory fit (promotion-focused individuals with promotion-focused implementation intentions; prevention-focused individuals with prevention-focused implementation intentions). Additional experimental studies have reported marginal (Kroese *et al.* 2011), mixed (i.e. a similar proportion of significant and null effects; Soureti *et al.* 2011) or non-significant effects of forming implementation intentions in reducing unhealthy food intake (Scholz *et al.* 2013; Prestwich *et al.* 2014a), with certain types of implementation intentions (e.g. negation implementation intentions: 'If [cue X] then not [habitual response Y]') being less effective than implementation intentions designed to replace the unhealthy snack with healthy snacks (Adriaanse *et al.* 2011a).

3.2.3 Cancer screening

Implementation intentions have been shown to be an effective behaviour change technique for increasing the likelihood of self-examinations. For example, in the first test of the efficacy of implementation intentions in promoting health-protective behaviour, Orbell *et al.* (1997) found that participants who formed implementation intentions were significantly more likely to perform a breast self-examination (BSE) than were control participants (64% and 14%, respectively). This group difference was similar when data from participants with strong goal intentions were analysed separately; here 100% of participants who formed implementation intentions conducted a BSE compared with just 53% of the control participants.

In a later study, Prestwich *et al.* (2005) examined the effect of involving partners in BSE using collaborative implementation intentions. While students were randomized to implementation intention or no implementation intention conditions, within each group they chose whether to involve their partner or not. Rates of BSE differed across groups at one-month follow-up (collaborative implementation intentions: 100%; partner/no implementation intention: 83%; implementation intention: 63%; control group: 26%). However, it should be noted that because the study did not fully randomize participants to conditions, it is difficult to draw clear conclusions about the impact of involving partners. In a related study, Benyamini *et al.* (2011) reported that participants who formed BSE plans individually versus participants who also involved their husbands in the BSE planning (but not the actual BSE behaviour) increased their rates of BSE to a similar extent.

Implementation intentions have also been used to successfully increase testicular self-examination (TSE) rates (Milne and Sheeran 2002; Steadman and Quine 2004). However, Heverin and Byrne (2011) reported that neither forming implementation intentions once or twice after watching a TSE demonstration video increased TSE rates compared with a demonstration video-only condition. It should be noted, however, that the demonstration video itself was highly effective, boosting TSE rates from 25% to above 80%, so perhaps there was no volitional problem for implementation intentions to address (see Section 2.2).

For other screening-related behaviours, the evidence regarding the benefits of implementation intentions is more mixed. Sheeran and Orbell (2000) used implementation intentions to increase cervical cancer screening rates (92% vs. 68% in the control group; see also Walsh 2003), while Browne and Chan (2012) used implementation intentions to increase the likelihood that young women would initiate a conversation with an older female family member concerning

mammography (54% vs. 33% in the control group). Such interventions have been scaled-up to large populations with positive effects in relation to promoting adherence to colorectal cancer screening (Neter *et al.* 2014). However, another large-scale test of implementation intentions involving over 23,000 invitations (Lo *et al.* 2014) reported that asking participants to form three pre-formulated implementation intentions did not increase the likelihood that participants returned a screening test kit for colorectal cancer (39.7% uptake vs. 40.4% in the control condition; see also Rutter *et al.* 2006). The authors noted that the lack of an effect may have been attributable to the nature of the test kit, which may have reduced the motivation of individuals to take the test, which could, in turn, undermine the potential benefit of implementation intentions (see Section 4.2). Moreover, the manipulation was embedded in a leaflet (which requires no response from participants) rather than a questionnaire (where a response is required), which may have resulted in lower rates of implementation intention formation.

3.2.4 Medication adherence

Older adults who formed implementation intentions were five times more likely to take a blood pressure reading (Brom *et al.* 2014) and were more likely to monitor their blood glucose (Liu and Park 2004). Furthermore, there is evidence that people with epilepsy (Brown *et al.* 2009) and stroke survivors (O'Carroll *et al.* 2013) took their medication more regularly when they had formed implementation intentions, while students have been shown to be more likely to take vitamin C tablets (Sheeran and Orbell 1999; Steadman and Quine 2000) or multivitamin tablets (Chatzisarantis *et al.* 2010) when they had formed if-then plans, compared with control groups not forming implementation intentions. However, not all studies have reported positive effects of forming implementation intentions in relation to medication adherence. Jackson *et al.* (2006) reported that, in a sample of patients recruited through a pharmacist and taking a course of antibiotics, there was no difference in the proportion of individuals taking all of their medication between patients who formed their own implementation intentions, patients given an implementation intention, and one of two control groups (who differed only on whether they completed a questionnaire assessing constructs from the TPB; Ajzen 1991). Jackson *et al.* (2006) suggested that the implementation intention manipulations may not have promoted adherence, as the course of treatment was short (less than seven days on average) and the sample were highly motivated. Indeed, the studies demonstrating beneficial effects of forming implementation intentions on medication adherence have detected significant effects at longer follow-ups versus shorter follow-ups (e.g. Sheeran and Orbell 1999). On balance, the evidence across these studies suggests that implementation intentions represent a promising means of helping people to take their medication regularly and on time.

3.2.5 Alcohol intake

In the first test of the effect of forming implementation intentions on alcohol intake, Murgraff *et al.* (1996) reported that, compared with a control group, participants who were asked to form implementation intentions drank alcohol less frequently over a two-week period. More recently, Hagger *et al.* (2012a) found that combining implementation intentions with a motivational intervention (namely, a mental simulation task involving participants visualizing successful alcohol-related goal achievement and then reflecting on subsequent feelings arising from this achievement) was a particularly effective method to reduce drinking among a sub-sample of heavy drinking students. However, forming implementation intentions did not influence

drinking when the full sample was considered, or within samples drawn from various countries reported elsewhere (Hagger *et al.* 2012b). Other successful applications have used implementation intentions to reduce the likelihood that students choose the offer of a free alcoholic drink (Chatzisarantis and Hagger 2010), to minimize binge drinking on Fridays but not Saturdays (Murgraff *et al.* 2007), and to reduce alcohol drinking in the general population using implementation intentions produced by the experimenter or by the participant themselves (Armitage 2009). Ravis and Sheeran (2013) found that implementation intentions attenuated the automatic influence of binge drinker stereotypes, and reduced binge drinking behaviour.

3.2.6 Smoking

Several studies have found that forming implementation intentions can help smokers to quit and prevent non-smokers from starting to smoke (but see van Osch *et al.* 2008). Armitage (2007) found that forming implementation intentions (specifying when and how to quit smoking in the following two months) significantly increased quit rates, compared with a control group, at two months in adult smokers (12% vs. 2%) and also reduced objectively measured levels of nicotine dependence. In adolescents, Conner and Higgins (2010) found that repeatedly forming implementation intentions every four months over a two-year period led to lower self-reported rates of smoking (26.3%) compared with three comparison groups (self-efficacy group: 34.0%; control 1: 30.5%; control 2: 34.5%). Conner and Higgins also found that implementation intentions led to lower rates of smoking on an objective measure of smoking (see also Higgins and Conner 2003). Using 12-month quit rates as their key outcome, Elfeddali *et al.* (2012) found that providing feedback on perceptions of smoking and quitting alongside implementation intention formation improved abstinence rates (33% in an observed case analysis) compared with a control group completing questionnaires only (22%). The implementation intention manipulation was delivered both before and after their quit date. Providing additional feedback on negative affect, self-efficacy, recovery self-efficacy and plans, in an augmented planning condition, did not improve quit rates further (31% in the observed case analysis). However, while implementation intentions may be useful in helping smokers to reduce the number of cigarettes smoked when their habit is weak or moderate, Webb *et al.* (2009) found that they may not be helpful for those with strong smoking habits. Whether implementation intentions are effective in breaking habits depends on the relative strength of implementation intentions. Breaking strong habits requires the formation of strong implementation intentions. Gollwitzer (2014) presents an overview of means through which the effects of implementation intentions can be strengthened to tackle habits including enriching implementation intention formation with imagery (e.g. Knäuper *et al.* 2011). Some sub-types or variants of implementation intentions (see Figure 10.1) may also prove more effective than others.

4 Developments

The first question that should be asked about the concept of implementation intentions is: 'Do implementation intentions facilitate the translation of intentions into action?' Findings from studies in social and health psychology and meta-analyses (see Section 3) indicate that the answer to this first question is 'yes'. A second question that should be asked in order to gain a more complete understanding of how implementation intentions can be used to promote health behaviours is *when* do implementation intentions facilitate translation of intentions into action?

An answer to this question can be gleaned from recent research on the moderators of implementation intention effects (Gollwitzer *et al.* 2010; Prestwich and Kellar 2014).

4.1 Presence of self-regulatory problems

Several factors are likely to determine how strongly implementation intentions affect goal achievement. The first key moderator of implementation intentions effects concerns the presence of a self-regulatory problem. If enacting a behaviour is easy and there are few obstacles to performance, then motivational factors (e.g. goal intentions, self-efficacy) should satisfactorily promote action; little additional benefit can be obtained from forming an implementation intention. A good example is Webb and Sheeran's (2003, Study 2) analysis of the impact of ego-depletion and implementation intention formation on Stroop performance. Webb and Sheeran found that implementation intentions had a strong effect on task speed and accuracy when participants were ego-depleted. However, when participants were not ego-depleted, implementation intentions did not benefit performance – presumably because participants possessed sufficient self-regulatory capacity to perform the task well (see also Lengfelder and Gollwitzer 2001). In addition, Gollwitzer and Brändstatter (1997, Study 1) used participants' ratings to divide goals into 'easy' versus 'difficult' categories and found that implementation intentions only promoted the achievement of difficult goals. Koestner *et al.* (2002) also showed that implementation intentions are more effective for difficult goals. These findings all seem to indicate that implementation intention effects are more likely to emerge when the focal behaviour presents a volitional challenge or when people have difficulty regulating their behaviour (but see Dewitte *et al.* [2003] for an alternative perspective that implementation intentions are effective also for easy goals as long as the baseline enactment rate is not too high, causing a 'ceiling effect').

4.2 Motivation and habits

Empirical findings indicate that the beneficial effects of forming implementation intentions are contingent upon the presence of strong superordinate goal intentions. For example, Sheeran *et al.* (2005) found a significant interaction between intention strength and the effect of forming implementation intentions, such that implementation intentions only affected the amount of independent study that students undertook when participants' goal intentions strongly favoured the behavioural performance. Similarly, the effect of forming implementation intentions has proved more pronounced among participants with strong (vs. weak) intentions in the context of various health behaviours, including physical activity (Prestwich *et al.*, 2003; Lippke *et al.* 2004; De Vet *et al.* 2009), diet (Prestwich *et al.* 2008), compliance with speed limits (Elliott and Armitage 2006), and sunscreen use (Van Osch *et al.* 2008); however, this finding does not always emerge (e.g. Sheeran and Silverman 2003; de Nooijer *et al.* 2006). There is evidence also that the effect of forming implementation intentions may be larger when *self-efficacy* is strong (Luszczynska and Haynes 2009; Luszczynska *et al.* 2011), particularly on tough tasks (Wieber *et al.* 2010), and that the effects of forming implementation intentions could be bolstered by self-efficacy-based interventions (Koestner *et al.* 2006). However, combining implementation intentions with self-efficacy-enhancing techniques failed to lead to more pronounced effects on fruit and vegetable intake (Guillaumie *et al.* 2012). Other moderators have been considered across multiple studies but have produced inconsistent results. For example, whereas Koestner *et al.* (2002) obtained

evidence consistent with the idea that implementation intention effects were especially effective when participants' goal intentions were more *self-concordant* versus less self-concordant, Chatzisarantis *et al.* (2008) reported the opposite effect (i.e. implementation intention effects were strongest when motivation was self-discordant).

Habits constitute another potential moderator of the effect of forming implementation intentions on goal attainment. Specifically, evidence suggests that forming implementation intentions may be less effective when enacting the plan involves changing strong *habits*. In two studies, one conducted in the laboratory (a target detection task) and another in the field (smoking), Webb *et al.* (2009) showed that implementation intentions were more useful when habits were weak or moderate rather than when they were strong.

In summary, the strength of the respective superordinate goal intention, along with self-efficacy and habit, are likely to represent important moderators of action control by implementation intentions in many contexts.

4.3 Plan quality

A third potential moderator of implementation intention effects is the quality of implementation intention formation. Field studies have demonstrated that participants vary in the extent to which they follow instructions within implementation intention manipulations. For example, Michie *et al.* (2004) reported that only 63% of individuals who were asked to form a plan to attend an antenatal screening actually did so. Similarly, in a trial to promote physical activity, around 70% of participants in the experimental condition formed a specific implementation intention as directed (De Vet *et al.* 2011b), and rates were even lower (e.g. 18% of participants formed a specific implementation intention as directed for the target behaviour) in a trial designed to promote condom use (De Vet *et al.* 2011a). Studies have indicated that forming higher quality plans (as indexed by the extent to which individuals have followed directions to identify specific cues and responses) is related to higher levels of physical activity (Ziegelmann *et al.* 2006; De Vet *et al.* 2011b) and reduced levels of smoking (Van Osch *et al.* 2010) and alcohol intake (Armitage 2009). Relatedly, Allan *et al.* (2013) have demonstrated that forming implementation intentions is more effective when individuals are *poor planners*. Therefore, it is imperative that participants not only form plans, but form plans that specify an opportunity, an intended response, and link the two together. Poor planners may need even more assistance and could make use of volitional help sheets in this regard (see Section 6.2).

As well as examining the extent to which individuals follow the instructions to form implementation intentions and its impact on behaviour, the nature of the planning intervention itself is likely to influence the accessibility of cues and the strength of cue-response links. Certain procedures should, thereby, fortify implementation intention effects (for a detailed consideration of the effects of different types of implementation intentions, see Section 6.2). For example, Gollwitzer *et al.* (2002) manipulated the strength of participants' commitment to their implementation intention by providing feedback from extensive personality tests that supposedly indicated that participants would benefit from sticking closely to their plans (high commitment) or would benefit from not rigidly adhering to the plan (low commitment). Findings from a cued recall paradigm indicated that the high-commitment group had superior memory for selected opportunities compared with the low-commitment group. Prestwich *et al.* (2009) examined the efficacy of augmenting implementation intentions with text message reminders of their

implementation intention designed to help strengthen the link between cue and response, finding that reminding individuals of their implementation intentions increased effects on physical activity (but see Schwerdtfeger *et al.* 2012). Thus, there is evidence that the degree of implementation intention formation, commitment, and plan reminders moderate the impact of if-then plans on goal achievement.

5 Operationalization of the model

5.1 Preliminary considerations

The paradigm adopted in most studies using implementation intentions to promote health goals has involved questionnaire measures followed by random assignment of participants to an experimental condition that contains questions designed to prompt implementation intention formation or to a control condition that does not contain these questions. Of course, random assignment should ensure that participants in both conditions have equivalent previous experience with, and motivation to achieve, the goal. However, an advantage of taking measures of experience and motivation is that randomization checks can be conducted and any differences on these variables can be controlled for in statistical analyses. Relatedly, if the behavioural follow-up involves further contact with participants, then measures of motivational variables could also be taken at the same time as the measure of behaviour. These procedures allow researchers to conduct statistical analyses to ensure that the impact of implementation intentions on goal attainment is not attributable to pre-intervention differences in motivation or past behaviour, or to potential differences in motivation accruing from the formation of the if-then plan.

Most studies of implementation intention effects in health psychology have involved passive control conditions – that is, participants in the control condition have not been asked to complete questionnaire items of similar content or duration as participants in the experimental group. Strictly speaking, this procedure confounds the impact of the experimental manipulation with potential differences in expectancies and attentional demands between conditions. However, studies that have employed active control conditions wherein participants formed implementation intentions about what to do after they had accomplished their goal (e.g. Aarts *et al.* 1999) or formed plans regarding an irrelevant goal (e.g. Sheeran *et al.* 2005) have obtained strong implementation intention effects as well. Nevertheless, it seems wise to employ an active control condition whenever possible in order to rule out alternative explanations of differences in behavioural performance or attained outcomes. Reviews have also found smaller effects of implementation intention formation on goal achievement when participants asked to form implementation intentions have been compared with participants in control conditions asked to form goal intentions, rather than control conditions where the goal is not specified or emphasized (Webb *et al.* 2012). This difference is understandable; the difference between implementation intention and goal intention instructions represents the effects of a volitional strategy, whereas the difference between implementation intention and no instructions likely represents the effects of both motivational and volitional processes because planning instructions typically also incorporate motivational instructions (e.g. participants are asked to increase the amount of exercise that they do, before being asked to form a plan to help them). Therefore, goal intention instructions represent the more stringent and specific comparison condition for evaluating the effect of forming implementation intentions.

Implementation intention manipulations can take many forms, although they each follow the format: ‘if opportunity X, then response Y’. The variants of implementation intentions, and how they are manipulated, are described in Section 5.2 and illustrated in Figure 10.1. Because implementation intention inductions often ask participants to specify an appropriate opportunity and goal-directed response in an open-ended format, considerable care must be taken to ensure that participants do not skip relevant items. Answering open-ended questions can be perceived as onerous when participants have already completed a long questionnaire and have become used to ticking a box to indicate their response. Indeed, studies have reported that many participants may fail to formulate plans as instructed (e.g. Michie *et al.* 2004; De Vet *et al.* 2011a, 2011b). To alleviate this potential problem, some studies have hinted at the benefits of forming an implementation intention in order to encourage participants to complete the respective section of the questionnaire (e.g. Orbell *et al.* 1997; Sheeran and Orbell 1999; Milne *et al.* 2002). Even though this procedure seemed likely to generate expectancies about the impact of planning, none of these studies observed significant effects on subsequent motivation to perform the behaviour, and Chapman *et al.* (2009) have shown that such hints do not moderate the effects of forming implementation intentions on goal attainment. Other studies have used other techniques such as providing relevant examples and checklists to ensure that participants had formed implementation intentions accurately and sufficiently to meet the target goal (e.g. Prestwich *et al.* 2008). In summary, careful consideration needs to be given to features of the overall questionnaire (e.g. length, order) and to the wording and layout of the implementation intention induction to ensure that participants engage with the process of forming an if-then plan.

5.2 Taxonomy of implementation intentions

Implementation intentions have the format ‘If opportunity Y occurs, then I will initiate response Z!’ The importance of using an if-then format in wording the plan was demonstrated by Oettingen *et al.* (2000, Study 3). All participants were asked to perform four concentration tasks on their computers each Wednesday morning for the next four weeks. Participants in the control condition were asked to indicate what time they would perform the task by responding to the statement, ‘I will perform as many arithmetic tasks as possible each Wednesday at ____ (self-chosen time before noon)’. Participants in the implementation intention condition, on the other hand, indicated their chosen time by responding to the statement, ‘If it is Wednesday at ____ (self-chosen time before noon), then I will perform as many arithmetic tasks as possible!’ Despite the apparent similarity between the control and implementation intention instructions, the conditional structure of the implementation intention instructions had a dramatic impact on how closely participants performed the task to their intended time: the mean deviation from the intended start time was nearly five times higher in the control condition (8 hours) compared with the implementation intention condition (1.5 hours). These findings indicate that using the defining if-then format in implementation intention inductions is important to ensure strong implementation intention effects.

A number of variants on implementation intention interventions have emerged over recent years, such as collaborative implementation intentions, booster implementation intentions, and dyadic plans. Here, we present a taxonomy of implementation intention interventions in which we attempt to classify the different variants or sub-types of implementation intentions (see Figure 10.1). The taxonomy comprises seven questions or levels and the idea is that any

if-then plan can be classified according to the different options under each level. Moreover, any option on one level can be paired with any option on another level. While certain combinations have been widely tested (e.g. questionnaire-manipulated implementation intentions, targeting individuals, without boosters, with single plans incorporating external cues to do more of a particular behaviour), other combinations have not been considered at all (e.g. mere-measurement implementation intention manipulations of dyadic planning).

5.2.1 Are implementation intentions formed spontaneously or prompted by an intervention?

Spontaneous implementation intentions, in which an individual forms an implementation intention without being prompted by an experimenter or researcher, have typically been assessed through correlational designs (e.g. Brickell *et al.* 2006) that measure the extent to which participants have specified when, where, and how they will perform goal-directed behaviours. In

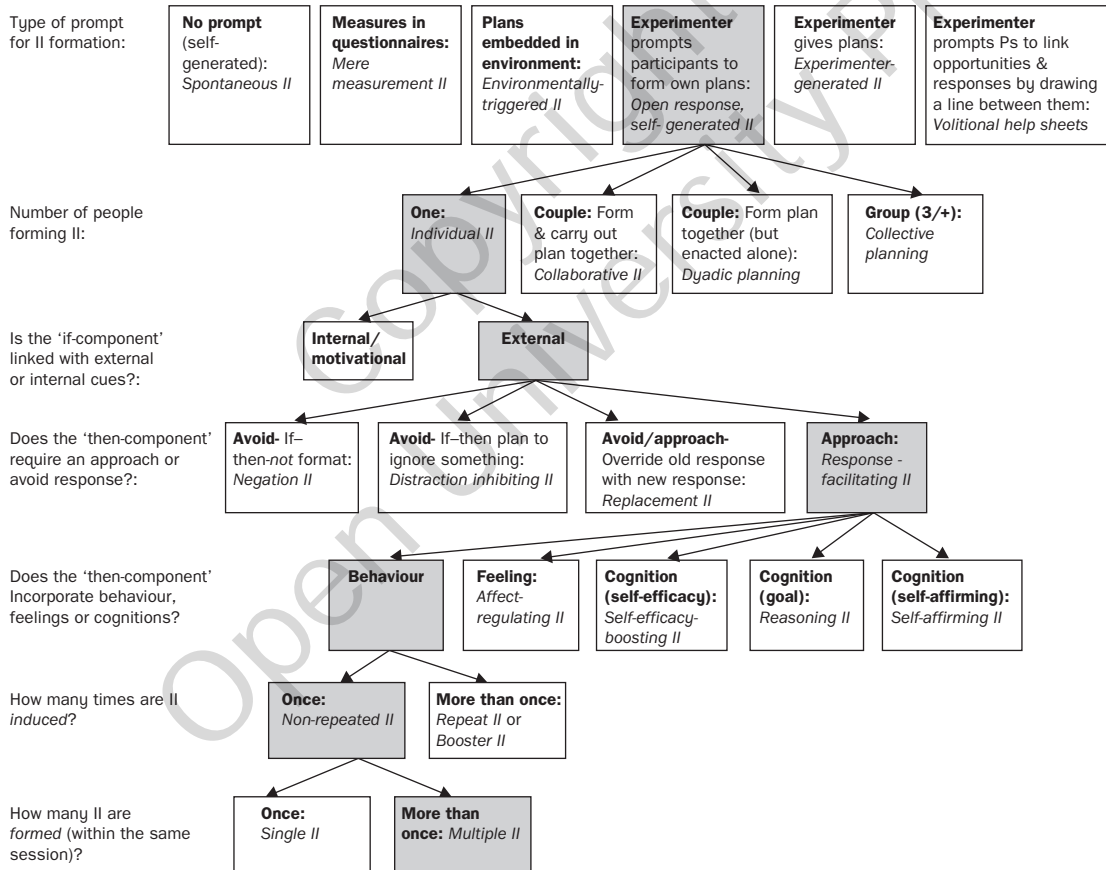


Figure 10.1 Taxonomy of implementation intentions (II) illustrating an II manipulation commonly used in field-based studies promoting health behaviours (shaded boxes reflect the II manipulation used by Prestwich *et al.* 2003)

contrast, there are a number of ways in which *prompted implementation intentions* can be generated and such studies typically adopt experimental designs where the effects of (prompted) planning are compared with an alternative or no intervention. For example, *mere measurement implementation intentions* involve simply embedding measures of implementation intentions within questionnaires (e.g. 'I have made a detailed plan regarding... when to exercise over the next 2 weeks, where to exercise over the next 2 weeks, how to exercise over the next 2 weeks, how often to exercise over the next 2 weeks', with anchors of 'not at all true' to 'exactly true') and have been used successfully to promote physical activity (e.g. Conner *et al.* 2010) and blood donation (e.g. Godin *et al.* 2010). *Volitional help sheets* list opportunities or temptations on one side of a page and possible responses on the other side. Participants are typically asked to choose an opportunity/temptation that is relevant to them, select a response from those provided, and then draw a line to link the relevant opportunity/temptation to the selected response. They have been used successfully to promote healthy behaviours such as physical activity (Armitage and Arden 2010), and to reduce unhealthy behaviours (alcohol intake: Armitage and Arden 2012; binge drinking: Arden and Armitage 2012; smoking: Armitage 2008).

Open-response, self-generated implementation intentions (the most commonly used type of implementation intention in field studies) directly ask participants to formulate their own plans. Examples of implementation intentions (e.g. 'If it is the end of work on Mondays through to Fridays, then I will briskly walk home'; see Prestwich *et al.* 2012) are often provided alongside open-response, self-generated implementation intentions to illustrate how these plans should be formed. On the other hand, *experimenter-generated implementation intentions* (most often used in experimental, laboratory-based studies) provide participants with specific implementation intention(s) that they are required to use. In contrast to directly requesting implementation intention formation, the final type of prompted implementation intention formation relates to *environmentally triggered implementation intentions*. In this approach, if-then plans are induced indirectly by embedding them within features of the environment such as advertisements or product packaging. This approach has been utilized within a website advocating fair-trade products to increase purchasing of sustainable food items (see Fennis *et al.* 2011, Study 2). Environmentally triggered implementation intentions are distinguishable from spontaneous implementation intentions in that they are intentionally triggered by the interventionist.

5.2.2 How many people formulate the implementation intention? Individuals vs. pairs vs. groups

The vast majority of studies have focused on individuals forming if-then plans to support performance of their own health behaviour. However, Prestwich *et al.* (2005) developed *collaborative implementation intentions* that require pairs of individuals to identify critical opportunities and responses that they will enact together. Collaborative implementation intentions (e.g. 'If it is the end of work on Mondays through to Fridays, then we will briskly walk home together') have been successfully used to promote physical activity (Prestwich *et al.* 2012) and breast self-examination (Prestwich *et al.* 2005), although they appear to be less effective in tackling risk behaviours such as unhealthy food intake (Prestwich *et al.* 2014a), possibly due to the difficulty in capturing all of the cues that can influence risk-related behaviour and ensuring that both individuals are together when these cues are encountered. A variant of collaborative implementation intentions, *dyadic planning* (Burkert *et al.* 2011), involves two people formulating if-then plans but with the target individual then enacting the target behaviour alone. For

example, in the study by Burkert *et al.* (2011), participants in the dyadic planning condition completed, with the help of a partner, a planning sheet involving consideration of when, where, and how they alone would perform the target behaviour (regular pelvic floor exercises) while those in the individual condition completed the form alone. The idea of joint planning has also been extended to groups. *Collective planning* involves a group deciding when, where, and how to act towards their collective goal. This approach has been used to increase the likelihood of selecting the best choice on a decision-making task, to increase the probability that participants disengage from a failing course of action (investing in an unsuccessful, unpopular venture), and to increase cooperation in schoolchildren (for a review, see Wieber *et al.* 2012).

5.2.3 Cue component: is the 'if-component' linked with external or internal cues?

When formulating if-then plans, the cues can be external, such as an environmental feature (e.g. encountering an object, time of day, etc.) or internal, such as a feeling (e.g. boredom) or motivation (e.g. to be social). While the majority of studies have focused on the effects of if-then plans specifying external cues, there is some evidence in support of forming implementation intentions based on internal cues. For example, Adriaanse *et al.* (2009) demonstrated that forming implementation intentions based on motivational cues (e.g. feeling bored) but not situational cues (e.g. being at home) were significantly more effective than a control condition in promoting healthy snacking and reducing unhealthy snacking.

5.2.4 Response component 1: does the 'then-component' require an approach or avoidance response?

Implementation intentions have been used successfully to promote a variety of different responses. These successful applications include using implementation intentions to do more of a desired response or less of an undesired response, as well as being used to tackle a variety of behaviours, feelings or cognitions (see Section 5.2.5). Sub-types of implementation intentions may be delineated based on the different types of responses that are specified in the 'response' component of the plan. *Response facilitating implementation intentions* involve an individual planning how to initiate a response (e.g. planning to do an additional session of vigorous physical activity during the week). In contrast, *distraction-inhibiting implementation intentions* involve an individual formulating an if-then plan to ignore something (e.g. 'If I see a person, then I will ignore his race'; Mendoza *et al.* 2010). Related to these concepts are *replacement implementation intentions* (that involve overriding an old response with a new one), or planning to not do something, termed *negation implementation intentions* (e.g. 'If opportunity X, then not habitual response Y'), which have been shown to backfire (e.g. increase unhealthy snacking; Adriaanse *et al.* 2011a).

5.2.5 Response component 2: does the 'then-component' incorporate behaviour, feelings or cognitions?

While the majority of studies encourage implementation intention formation that specifies a behavioural response, others serve to activate other responses. *Reasoning implementation intentions* (Prestwich *et al.* 2008) involve an individual deciding what they will think at a specific opportunity in order that they will perform/not perform the target behaviour. Activating a higher-order goal within the risky situation in this fashion has been shown to enhance self-control in terms of reducing unhealthy food intake (Prestwich *et al.* 2008; van Koningsbruggen *et al.* 2011). Reasoning implementation intentions are distinct from activating a why mindset

after forming an implementation intention, which has been shown to reduce implementation intention effects. For example, Wieber *et al.* (2014) asked all participants to form a goal intention (to hold a handgrip closed for as long as possible, Study 1; to respond to numbers quickly, Study 2) and then for some of these participants to supplement their goal intention with an if–then plan ('And if my muscles start hurting, then I will ignore the pain!'; 'And if the number 3 appears, then I will press the left mouse button particularly fast!'). Participants then either completed a second task to activate a *why* mindset (writing down *why* they would form and maintain personal relationships) or a *how* mindset (writing down *how* they would form and maintain personal relationships). While the why-mindset was shown to improve performance in the control (goal-intention) condition, it was shown to reduce the benefits of forming implementation intentions.

Bayer and Gollwitzer (2007) demonstrated that forming implementation intentions designed to boost self-efficacy (e.g. 'And if I start a new problem, then I will tell myself: I can solve it!') improved mathematical test performance in females (Study 1) and analytical reasoning test performance in males (Study 2). We term such plans *self-efficacy boosting implementation intentions*. In *self-affirming implementation intentions* (Armitage *et al.* 2011), means of affirming oneself are incorporated in the then-component of the plan (e.g. 'If I feel threatened or anxious, then I will think about the things that I value about myself'). A final category of implementation intentions involves specifying a particular feeling in the then-component of the plan. For example, Azbel-Jackson (2012) investigated the effect of forming the plan: 'If I see a weapon, then I will keep calm and relaxed!' on levels of arousal upon encountering the specified cue. We term such plans *affect-regulating implementation intentions*.

5.2.6 How many implementation intention inductions are used?

While most studies require participants to formulate implementation intentions once at the start of the study, some studies have encouraged participants to form new plans at some stage after the initial formulation of an if–then plan (*repeat implementation intentions*, de Vet *et al.* 2009; or *booster implementation intentions*, Luszczynska and Haynes 2009; Chapman and Armitage 2010). These plans could either be the same as the previous formed plan(s) or new. While de Vet *et al.* (2009) did not find a significant effect of implementation intentions (a repeated implementation intention vs. a non-repeated implementation intention condition) on physical activity, they did report that repeated implementation intentions were effective for strong intenders. Luszczynska and Haynes (2009) found that, compared with a control condition, a group who formed implementation intentions at baseline and then again at six weeks and nine weeks increased their fruit and vegetable intake more at four months. This study, however, did not include a condition in which implementation intentions were only formed once. Thus it is unclear how much benefit was gleaned from booster planning. Chapman and Armitage (2010) provide stronger evidence for the benefit of booster implementation intentions. They reported that participants who formed booster implementation intentions (booster at three months) consumed more fruit and vegetables at six months than participants who only formed a single plan. However, a study that manipulated the number of boosters observed no impact of the manipulation on dietary outcomes (Scholz *et al.* 2013).

5.2.7 How many implementation intentions are formed?

Studies have also compared the effect of forming different numbers of plans (multiple plans vs. single plans). For example, Wiedemann *et al.* (2012) asked participants to formulate one,

two, three, four or five plans in relation to increasing their daily intake of fruit and vegetables (or none if they were assigned to the control condition). The number of plans formulated influenced effectiveness, with greater effects of planning on fruit and vegetable consumption being observed among participants who formed four or five plans. For physical activity, too, more plans seem to be associated with more success (Wiedemann *et al.* 2011). In contrast, Verhoeven *et al.* (2013) found that forming a single plan (in this case, to reduce unhealthy snacking) was more effective than forming multiple plans. The authors' explanation of this finding was that forming multiple plans could lead to interference at the moment of acting, especially if the plans are formed with respect to the same opportunity.

Variation in the number of plans could be restricted to the initial session or be manipulated across sessions (see booster/repeated implementation intentions). In a study that manipulated the number of boosters, the number of plans had no impact on dietary outcomes (Scholz *et al.* 2013). Rather than the number of plans, whether the plans are sufficient in order to reach the target goal may be the crucial factor. For example, if an individual had the goal to exercise five times per week but then planned only to go for a run in the evening every Saturday and Sunday, then their plan would likely be insufficient to reach the goal and forming more plans would most likely be beneficial.

6 Future directions

The concept of implementation intentions has shown clear promise for promoting health behaviour and hopefully continues to have a bright future in health psychology. Indeed, it is pleasing to note that since our original chapter on this topic (in the second edition of *Predicting Health Behaviour*, published in 2005), the number of primary studies has increased substantially. Accumulated evidence indicates that forming if-then plans makes an important difference to whether or not people realize their goals (e.g. Gollwitzer and Sheeran 2006) – both when goal attainment is contingent upon promoting wanted responses and controlling unwanted responses. In addition, a good deal of research indicates that implementation intentions promote goal achievement both by facilitating identification of specified opportunities to act and by automating goal-directed responses (e.g. Aarts *et al.* 1999; Webb and Sheeran 2008). Finally, there is evidence that a variety of factors moderate the impact of implementation intention formation on goal achievement, including difficulties in behaviour regulation, motivation-related variables and habits, and plan quality. In summary, substantial progress has been made in answering questions about *whether*, *when*, and *why* implementation intentions facilitate the enactment of goal intentions.

Despite this substantial progress, there remains considerable scope for future research to examine efficacy through rigorously conducted trials, to confirm mediating processes, and to identify additional moderating variables (see also Gollwitzer 2014). There have also been relatively few high-quality, pre-registered trials of implementation intentions using objective behavioural measures (see Hagger and Luszczynska 2014). While taking steps, for example, to blind key personnel to study condition and to protect the allocation sequence is rare in health behaviour interventions (e.g. Prestwich *et al.* 2014b, 2014c), such steps are important to ensure that estimates of the effects of forming implementation intentions on health behaviours are accurate. We would also point to the importance of pre-registering trials and publishing protocols,

which can provide a number of benefits, including minimizing the risk of selective outcome reporting. (For examples of published protocols involving implementation intentions, see Conner *et al.* [2013] and Epton *et al.* [2014].)

As the body of empirical research on the effects of forming implementation intentions grows, there will likely be more opportunities to apply implementation intentions to population-level health behaviour change, especially as implementation intentions can be applied to large populations relatively easily (i.e. interventions are typically relatively short and cheap to implement). For example, Neter *et al.* (2014) successfully demonstrated, in an overall sample of nearly 30,000 adults aged 50–74, that forming implementation intentions can increase adherence to colorectal cancer screening.

While there has now been quite a lot of work on identifying when, and for whom, implementation intentions are most effective (for related reviews, see Gollwitzer *et al.* 2010; Prestwich and Kellar 2014), there is a need to conduct similar research on variants on implementation intentions (e.g. collaborative implementation intentions, dyadic plans). For these variants, the need for high-quality trials and for further work on mechanisms and to identify boundary conditions is particularly acute.

Some studies have assessed the impact of forming multiple implementation intentions. These have involved forming the same type of implementation intentions multiple times either at the start of the study period (i.e. *multiple plans*) and/or at a later stage (i.e. *booster/replacement implementation intentions*) or forming different types of implementation intentions (usually *coping plans* plus *action plans*). However, there remains considerable scope for examining whether combining different types of implementation intentions leads to stronger effects than using either type alone. For example, for behaviours that an individual sometimes performs alone and sometimes performs with a partner (e.g. dietary-related behaviours), combining individually formed implementation intentions with collaborative implementation intentions may yield stronger effects than forming either type of implementation intention alone. The ease with which implementation intentions can be applied within mobile- (e.g. Prestwich *et al.* 2010) and internet-based technologies (e.g. Hurling *et al.* 2006) also shows that there are opportunities to test whether implementation intentions augment the impact of technology-based interventions on behaviour change. Such studies should utilize full-factorial designs, whenever possible, to clearly identify the added benefit of if–then plans.

Finally, an exciting, recent development in research on if–then plans relates to interventions that combine mental contrasting with implementation intentions (MCII interventions; for reviews, see Oettingen and Gollwitzer 2010; Oettingen *et al.* 2013). Mental contrasting involves mentally elaborating the best outcome of a desired future and then elaborating the biggest obstacle to that future, and repeating this exercise for the second best outcome and second biggest obstacle. Mental contrasting energizes goal-striving and creates strong implicit links between future and reality and between obstacles and the means to overcome those obstacles; mental contrasting also changes rates of goal attainment in line with success expectancies (see Oettingen 2012 for a review). Mental contrasting aids implementation intention formation by helping participants to identify key volitional problems that stand in the way of their desired future – so that if–then plans can then be formulated to tackle those problems. MCII interventions have already proved effective in changing such health behaviours as fruit and vegetable consumption (Stadler *et al.* 2010), snacking habits (Adriaanse *et al.* 2010), and physical activity among chronic back pain sufferers (Christiansen *et al.* 2010).

While there is evidence that forming implementation intentions is effective in promoting health behaviour change, more work is needed to establish whether if–then plans promote long-lasting change through the mechanisms identified previously in laboratory work. When the effects of forming implementation intentions are examined in combination with other behaviour change techniques, it is important to adopt full-factorial designs to isolate both the independent and multiplicative effects of implementation intentions and the other techniques. Undertaking further research into the effects of forming implementation intentions on health behaviour represents a challenging, but important, step for health psychologists in order to advance both our theoretical understanding of the effects of implementation intentions on behaviour and their applied benefit.

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