Heather Barry Kappes and Carey K. Morewedge

Mental simulation as substitute for experience

Article (Accepted version)
(Refereed)

Original citation:
Kappes, Heather Barry and Morewedge, Carey K. (2016) *Mental simulation as substitute for experience.* Social and Personality Psychology Compass, 10 (7). pp. 405-420. ISSN 1751-9004

DOI: 10.1111/spc3.12257

Running Head: Simulations as Substitutes

Mental Simulation as Substitute for Experience

Heather Barry Kappes

London School of Economics and Political Science

Carey K. Morewedge

Boston University

Address correspondence to:

Heather Kappes

Department of Management

London School of Economics and Political Science

Houghton Street

WC2A 2AE London

+44(0)20 7107 5418

H.Kappes@lse.ac.uk

Abstract

People spend a considerable amount of their time mentally simulating experiences other than the one in which they are presently engaged, as a means of distraction, coping, or preparation for the future. In this integrative review, we examine four (non-exhaustive) cases in which mentally simulating an experience serves a different function, as a *substitute* for the corresponding experience. In each case, mentally simulating an experience evokes similar cognitive, physiological, and/or behavioral consequences as having the corresponding experience in reality: (1) imagined experiences are attributed evidentiary value like physical evidence, (2) mental practice instantiates the same performance benefits as physical practice, (3) imagined consumption of a food reduces its actual consumption, and (4) imagined goal achievement reduces motivation for actual goal achievement. We organize these cases under a common superordinate category and discuss their different methodological approaches and explanatory accounts. Our integration yields theoretical and practical insights into when and why mentally simulating an experience serves as its substitute.

Mental Simulation as Substitute for Experience

Much of life is spent thinking about experiences other than what one is doing. People frequently mentally simulate experiences by recalling episodes from their past, contemplating alternatives to their present circumstances, and anticipating or fantasizing about their future. Indeed, Americans explicitly divert their thoughts to experiences other than their present for more than a tenth of their day by watching television (American Time Use Survey, 2014). For roughly a third of their waking hours, the mind wanders away from the activity in which it is engaged (Killingsworth & Gilbert, 2010; Schooler et al., 2011). Much of this simulation is engaged in for its immediate hedonic, semantic, and functional benefits: to divert the mind toward more pleasure than is afforded by the present circumstances, regulate emotions, solve problems, or prepare for and anticipate the future (e.g., Buechel & Morewedge, 2013; Gollwitzer & Oettingen, 2012; Kahneman & Tversky, 1982; Kumar, Killingsworth, & Gilovich, 2014; MacInnis & Price, 1987; Markman, Klein, & Suhr, 2009; Morewedge & Hershfield, 2015; Schacter, Addis, & Buckner, 2008; Taylor, Pham, Rivkin, & Armor, 1998; Taylor & Schneider, 1989). Simulations, however, do not only serve as mental representations of other past, present, and future experiences. The permeable boundary between thought and reality leads simulations to sometimes produce the same downstream consequences as the corresponding actual experiences. In this paper, we elucidate these effects by presenting four cases in which mental simulations act as *substitutes* for experience.

MENTAL SIMULATIONS

Mental simulations are imitative episodic mental representations of one or a series of events (Taylor et al., 1998). In contrast to semantic representations, which are more general or abstract, mental simulations typically entail detailed mental representations of a specific real or hypothetical event (Szpunar, Spreng, & Schacter, 2014). Recalling a moment swimming in the ocean during a recent Mediterranean vacation, imagining the sun glimmering off the waves of the Mediterranean while in one's office, and anticipating how its warm sand will feel under one's feet, are all examples of the mental simulation of an experience. Mental simulations of past, future, and alternative experiences share many commonalities including having similar developmental trajectories (Suddendorf & Busby 2005), being affected by similar experimental manipulations (e.g., Morewedge, 2013; Morewedge, Gilbert, & Wilson, 2005; Nussbaum, Liberman, & Trope, 2006), and relying on a common "core network" of brain regions, comprised of the medial prefrontal cortex, medial temporal lobe, retrosplenial/posterior cingulate cortex, and inferior parietal lobule (Schacter et al., 2008).

The neural and conceptual systems engaged in mental simulation overlap considerably with those involved in the corresponding sensory-motor systems engaged during the corresponding behavior being simulated. Evidence from fMRI and TMS studies suggests that mental simulations of motor actions, for example, may be functionally equivalent to the pre-execution stages of those motor actions (Jeannerod, 1994; 2001). Simulations consistently recruit the same brain areas as the corresponding executed actions including the supplementary motor area (SMA), premotor cortex (PMC), and the primary motor cortex (M1; Munzert, Lory, & Zentgraf, 2009). Sensorimotor simulations also comprise the representation of basic conceptual information (Barsalou, 2003; 2008). Information is situated in the modalities and contexts in which it was originally encountered and is presently relevant. The knowledge that an elephant is large, for instance, is not amodal. It is forever tied to the visual representations through which this information was learned. We suggest that the similar systems and processes activated by mental simulations and corresponding actions and stimuli may lead mental simulations to sometimes serve as a substitute for their experience.

SUBSTITUTION EFFECTS

The concept of a substitution effect follows from recognition of humans' limited economic, temporal, and mental resources. Resource allocation in economics, marketing, and psychology is likened to a constant-sum game, in which allocation toward one expenditure of time, money, or cognitive resources necessitates reduced allocation to other resources serving the same goals and needs (e.g., Bass, Pessemier, & Lehmann, 1972; Hamilton et al., 2014; Kruglanski et al., 2002). In economics and marketing, substitution effects occur when the expenditure of resources such as time or money on two or more alternatives is inversely related. As people spend more time on the Internet, for example, the time they spend engaging in face-to-face social interaction declines (Kraut et al., 1998).

Goal-directed action has motivational properties that produce substitution effects. Planning or engaging in one means to goal pursuit (e.g., running) facilitates the activation of the corresponding goal (e.g., getting in shape), but it can inhibit pursuit of that goal by other means (e.g., cycling). Similar ideas have been explored in research on eating (Huh, Vosgerau, & Morewedge, 2016a), moral licensing (Monin & Miller, 2001), personal control (Inesi, Botti, Rucker, Dubois, & Galinsky, 2011), and self-completion theory (Wicklund & Gollwitzer, 1982). When people crave a food that they cannot have, eating a food fulfilling the same consumption goal (e.g., snacking) reduces desire for the absent food (Huh et al., 2016a). Psychological substitution effects work similarly. An initial signal of alternative egalitarian or pro-environmental behavior like endorsing Obama or buying sustainable goods reduces the likelihood of other similar actions, like allocating money to minority groups or recycling, respectively (Effron, Cameron, & Monin, 2009; Longoni, Gollwitzer, & Oettingen, 2014).

We examine a special sort of substitution effect in which mentally simulating an experience induces equivalent downstream psychological and behavioral effects as actually having the corresponding experience. In the four illustrative cases we present, mental simulation of a stimulus or experience produces the same effects as direct exposure to the stimulus or experience: (i) mentally simulated events are attributed evidentiary value like their real counterparts, (ii) mental practice confers similar performance improvements as physical practice, (iii) imagined consumption induces the same habituating effects as actual consumption, and (iv) fantasized achievement decreases goal pursuit in ways similar to actual goal achievement (see Table 1).

These (non-exhaustive) cases illustrate the diversity of substitution effects that mental simulation may produce. The diverse literatures in which they are located suggest that their integration under a superordinate category of substitution effects has the potential to connect a broad swath of otherwise disparate research. A superordinate category is justified by the observation that each form of mental simulation affects perception, cognition, motivation, and action in ways that echo the effects of the experience that is simulated. This straightforward premise provides an avenue to reconcile seemingly contradictory findings—why does mental simulation sometimes produce more of the simulated behavior and sometimes less, for instance. After presenting the four cases below, we discuss predictions and implications of our integration, and identify promising new questions for future research in this area.

I. SIMULATED EVIDENCE AS SUBSTITUTE FOR PHYSICAL EVIDENCE

When inferring the probability of a future event, from a successful performance or social interaction to having been in a car accident, people rely on their mental representation of the event and its similarity to cases with which they are familiar (e.g., Kahneman & Frederick, 2002; Morewedge & Kahneman, 2010). Generally, these inferences are informed by evidence and past experience. Events that people have observed or lived through seem more likely to happen again (Bandura, 1997; Heckhausen, 1991), which is reasonable from a Bayesian perspective. One should update beliefs when new evidence is acquired (Viscusi, 1985). People are often insensitive, however, to the extent to which the evidence and experiences they accumulate accurately reflect their world. By influencing the mental representations of future events, mental simulations can convey considerable evidentiary value.

Vivid, fictional, and imagined evidence has undue effect on estimations of the likelihood of future events. Real events that are particularly vivid, such as those that are unusual, negative, or have been recently witnessed or experienced, are perceived to provide especially compelling evidence, and are perceived to be especially likely to occur in the future (e.g., Kahneman & Tversky, 1982; MacInnis & Price, 1987; Risen & Gilovich, 2008). Because a person's unusual past behavior is more memorable than her typical past behavior, for instance, people overweight it when predicting her future behavior (Morewedge & Todorov, 2012). People do not disentangle the frequency with which they are exposed to events and the frequency with which events occur. People who watch more television are exposed to more fictional depictions and factual news coverage of violent acts. Consequently, they perceive themselves as more likely to be victims of violent crime (Cohen & Weimann, 2000). Moreover, merely mentally simulating an event makes it seem more likely to occur (Anderson, 1983; Carroll, 1978; Gregory, Cialdini, & Carpenter, 1982; Koehler, 1991; Sherman, Skov, Hervitz, & Stock, 1981).

Evidence. People attribute evidentiary value to their mental simulations of events, whether those events are or are not under their control. Prior to the 1976 Presidential election, voters instructed to imagine Carter winning the election predicted that he was more likely to win than voters instructed to imagine Ford winning (Carroll, 1978). Similarly, people were more likely to predict a major bowl bid for the football team that won the college championship the previous year if they were assigned to imagine a good rather than bad season for the team (Carroll, 1978). For controllable behaviors, mental simulations can increase the perceived likelihood of the event and the perceived self-efficacy of the thinker. Research participants who mentally stimulated donating blood, changing their major, or taking a vacation exhibited increases in their expectations of so doing (Anderson, 1983). Participants guided through a visualization of perfect execution on a team obstacle course subsequently believed their team was more capable of performing at a high level relative to controls (Shearer, Mellalieu, Thomson, & Shearer, 2007).

Subsequent behavioral intentions and behaviors are affected by these simulation-changed expectations. Expectancy-value models show that people set and pursue goals whose achievement is valuable (e.g., desirable, important) and attainable (Atkinson & Birch, 1970; Bandura, 1997; Eccles & Wigfield, 2002). When an achievement is valuable but its attainability is unclear—such as a socially anxious speaker giving a presentation at work—people may mentally simulate successful accomplishment to convince themselves that this good outcome is possible (Buechel & Morewedge, 2013). Competitive athletes report frequently using simulations to build motivation and confidence (Hall, 2001; Murphy, Nordin, & Cumming, 2006). Simulating the successful outcome fosters confidence by serving as evidence that this outcome will actually happen.

By heightening expectations of success, simulations can increase the motivation and production of the simulated behavior. Imagining successfully interacting with outgroup members (e.g., the elderly) leads people to expect to feel less anxious and more relaxed during such an interaction, increasing their willingness to actually interact with those outgroup members (Stathi & Crisp, 2008; Turner, Crisp, & Lambert, 2007). Consumers who imagined using a cable television service saw it as more likely that they would want the service and would subscribe than did consumers simply given information about it. Moreover, the former were more likely to actually accept a free trial and subscribe when the service was offered (Gregory et al., 1982). In short, simulating an experience makes it seem more likely to occur, which can increase motivation to produce (desirable) simulated experiences, and thereby increase the chance of their production.

Process. The effect of simulations on expectations has been typically attributed to availability. Simulated events are more likely to come to mind at the time of judgment, just as events that are experienced, and what readily comes to mind is perceived to be more likely (e.g., Hoch, 1984; Kahneman & Tversky, 1982; Tversky & Kahneman, 1973). For instance, just as vivid demonstrations—those that are recent, unusual, or conveyed by word of mouth—have a pronounced effect on expectations (Dickson, 1982), so too do vivid mental simulations (Bone & Ellen, 1992; Brown, MacLeod, Tata, & Goddard, 2002; MacInnis & Price, 1987; Sherman, Cialdini, Schwartzman, & Reynolds, 1985).

Availability is not the only process underlying heightened expectations of simulated events. The inferences people draw from simulations echo those drawn when witnessing their real counterparts. Generally, people are more likely to attribute the behavior of an actor to dispositional influences when they are observers of the behavior than when they are the actor who performed it (Jones & Nisbett, 1971). Libby and Eibach (2011) found an analogous effect on the inferences about mentally simulated actions. People who imagined a future action using a third-person (observer) rather than a first-person (actor) perspective drew more dispositional inferences from that simulated behavior, and accordingly, intended to and did engage more in corresponding actions (e.g., voting; Libby, Shaeffer, Eibach, & Slemmer, 2007; see also Vasquez & Buehler, 2007). Simulations affect expectations about the future because, like actual experience, they are interpreted as providing evidence about why and how events will actually occur.

II. SIMULATED PRACTICE AS SUBSTITUTE FOR PHYSICAL PRACTICE

Athletes, patients in physical therapy, musicians, and surgeons all benefit from *mental practice*: visualizing or otherwise mentally rehearsing a motor task in the absence of the corresponding physical movement (Driskell, Copper, & Moran, 1994; Munzert, Lorey, & Zentgraf, 2009). For instance, a golfer might simulate the basic action concepts – preparation, backswing, forward swing, impact, and attenuation – that comprise the more general phases of movement involved in the successful execution of a golf putt (Frank, Land, Popp, & Shack, 2014). Referred to as imaginary practice (Perry, 1939), covert rehearsal (Corbin, 1967), symbolic rehearsal (Sackett, 1934), introspective rehearsal, or conceptualization (Egstrom, 1964), mental practice is a distinct kind of a broader class of mental preparatory behavior that includes other activities such as positive imagery, relaxation techniques, and attention focusing.

Evidence. Meta-analyses comparing participants who engage in mental practice without physical practice to participants who engage in no mental or physical practice have found that mental practice is effective across a broad range of cognitive and physical skill-based tasks (Driskell et al., 1994; Feltz & Landers, 1983; Feltz, Landers, & Becker, 1988; Hinshaw, 1991; Richardson, 1967a, 1967b). Golf putting, rock climbing, piano playing, and surgery are just a few examples of skill-based tasks improved by mental practice (Frank et al., 2014; Hardy & Callow, 1999; Meister et al., 2004; Sanders, Sadoski, Bramson, Wiprud, & Van Walsum, 2004). A meta-analysis of 35 studies including 65 tests of mental practice effects by Driskell and colleagues (1994) found a significant combined mental practice effect that was small to moderate in magnitude ($r = .26$, $d = .53$, $p < .001$; Driskell et al., 1994). As is probably true of physical practice, mental practice effects on performance are strongest in the short term, and yield no appreciable benefit after a few weeks have passed (Driskell, et al., 1994). Mental practice is effective for both mental and physical tasks, but tasks for which cognitive activities are critical (i.e., perceptual input, mental operations, output and response) show greater mental practice effects than tasks requiring physical strength, endurance, and coordination.

Even though mental practice effectively improves performance, it is not a perfect substitute. Mental practice of a task alone is generally less effective than physical practice (Driskell et al., 1994). A *combination* of mental and physical practice, however, can be as or more effective in improving task performance than physical practice alone. Research participants who mentally and physically practiced putting a golf ball showed more consistent improvement, for instance, than did participants who only engaged in mental or physical practice (Frank et al., 2014).

Process. Two processes have been suggested to explain mental practice effects. One symbolic process account attributes mental practice effects to the creation or restructuring of representational frameworks of complex actions, facilitating their planning through the chunking and linking of action units (Driskell et al., 1994; Sackett, 1934). Consistent with this account, mental practice appears to facilitate the association of basic action concepts, movement postures and the sensations associated with the physical action (Frank et al., 2014).

A second, functional equivalence account of mental practice effects, suggests that mental practice engages covert stages of action, activating the same visual and kinesthetic motor programs activated by physical practice, prior to execution of the action itself (Decety, 1996; Jeannerod, 1994; 2001). Mental practice is thus purported to entail the practice and subtle activation of these covert processes, which is supported by its activation of similar motor-associated brain regions (e.g., M1), the similar timing of mentally simulated and corresponding physical movements, and increases in muscle activity and strength resulting from mental practice (for a review, see Munzert, Lorey, & Zentgraf, 2009).

Recent experiments testing both accounts suggest that mental practice facilitates action planning rather than covertly activates the motor programs associated with actions. People need to have engaged in physical practice at least once for mental practice to be effective for some novel tasks (Mulder, Zijlstra, Zijlstra, & Hochstenbach, 2004). Moreover, mental practice inhibits performance of unrelated actions with the body part engaged in practice, suggesting that it relies on representation systems involved in planning. By contrast, subtle activation of motor programs or muscles involved in the practiced action would suggest that mental practice should prime or facilitate unrelated actions with body parts engaged in mental practice (Bach, Allami, Tucker, & Ellis, 2014).

III. SIMULATED CONSUMPTION AS A SUBSTITUTE FOR ACTUAL CONSUMPTION

A third case in which simulations have been demonstrated to serve as substitutes for experience is that of *sensitization and habituation/satiation*. Sensitization denotes an increase in one's responsiveness to a stimulus upon initial exposure to it. Seeing and smelling chocolate cookies, for example, whets one's appetite for the cookies. Habituation and satiety denote the decrease in motivational and hedonic response, respectively, elicited by a stimulus upon repeated or extended exposure to it. One's motivation to eat and enjoyment of eating a tenth cookie, for example, is less than for a first cookie. People and other animals exhibit habituation and satiation to a wide variety of appetitive stimuli, such as food, music and television, alcohol, drugs, social contact and sexually appealing stimuli (Kavanagh, Andrade, & May, 2005; McSweeney & Swindell, 1999).

Evidence. Imagining sensory cues related to appetitive stimuli can evoke a sensitization response similar to actual exposure to those sensory cues. If a person vividly imagines the smell of a food, for example, they exhibit increased salivation, a stronger desire to eat the food, and greater subsequent actual consumption of the food they imagine smelling (Krishna, Morrin, & Sayin, 2014). As does actually eating a food, imagined consumption of a food increases the desire for, consumption of, and willingness to pay for complementary foods by activating a goal to consume them (Huh, Vosgerau, & Morewedge, 2016b). Imagined and smelt odors have similar influences on taste perception (Djordjevic et al., 2004), and lead to the activation of similar brain regions (Djordjevic et al., 2005; Simmons, Martin, & Barsalou, 2005). Imagining the smell of strawberries, for instance, increases the perceived sweetness of a water solution.

The habituating and satiating effects of mental simulation are further evidence that mental stimulation can act as a substitute for an experience (i.e., elicit the same responses as actual exposure to a stimulus). Habituation and satiation has mostly been demonstrated in cases where people (or other animals) are actually exposed to a stimulus repeatedly, which decreases how much they want and like the stimulus. New research has shown that the mere mental simulation of an experience can similarly lead people to exhibit habituation or satiation to a stimulus they imagine consuming. Research participants who first imagined eating 30 M&M's one-at-a-time and then subsequently ate as many M&M's as they would like from a bowl, for instance, actually ate fewer M&M's from that bowl than did participants who first imagined eating 3 M&M's or no M&M's (Morewedge, Huh, & Vosgerau, 2010). Imagined consumption only reduced subsequent actual consumption when people simulated the actual experience of *eating* the food. Participants in a follow-up experiment only ate fewer M&M's when they imagined eating the M&M's. Participants who imagined *moving* 30 M&M's into a bowl one-at-a-time did not eat fewer M&M's than did participants who imagined moving 3 M&M's into a bowl. In other words, imagining an experience only elicited habituation when the experience imagined would have elicited habituation.

People seem to spontaneously mentally simulate appetitive experiences, which may serve a preparatory function. Seeing the handle of a cup elicits a simulation of a grasping motion (Tucker & Ellis, 1998). Beyond facilitating action performance, spontaneous simulations can affect the desire to perform the simulated action. Consumers presented with goods in a manner that facilitates the simulation of their consumption perceive those goods to be more desirable (e.g., a picture of a cake with a fork positioned so that it can be grasped by their dominant hand; Elder & Krishna, 2012). One possibility is that these spontaneously evoked simulations increase the desirability, and thus the likelihood of the simulated actions, by making them easier and thus more pleasant to process (Krishna & Schwarz, 2014).

Habituation and satiation evoked by spontaneous simulation suggest that increased desirability through fluency, however, is not the only effect of spontaneous simulation. People seem to spontaneously simulate eating a food when they consider how much they would enjoy eating it, and whether they would prefer to eat it or a different food. Producing an effect opposite of that predicted by processing fluency, people who evaluate or choose between many similar food options (e.g., sweet foods) exhibit a decreased desire to eat those foods than do people who evaluate or choose between fewer or different foods (e.g., savory foods; Larsen, Redden, & Elder, 2013).

This substitution effect appears to reduce consumption through the same mechanism as actual consumption. Like habituation through actual consumption, its effect is reasonably stimulus specific. Imagined consumption only reduces actual consumption when people imagine eating the kind of food they will later eat. For instance, research participants who first imagined eating 30 cubes of cheddar cheese subsequently ate less cheddar cheese than did participants who imagined eating 3 cubes of cheddar cheese. However, participants who first imagined eating 30 M&M's ate no less cheese than did participants who first imagined eating 3 M&M's (Morewedge et al., 2010).

Process. The process by which mental simulation induces habituation and satiation has not been demonstrated directly. If it is through the same cognitive pathways as actual exposure, that process is likely to rely on accessibility in memory. More specifically, when people initially encounter a stimulus, the mental representation of the stimulus in the form of a memory node may move into a state of high activation and becomes maximally active (an "A1 state"). In this initial state, there is maximal response to the stimulus. Over time the activation of the node decays into an "A2 state" in which the node is in a lower level of activation that generates less responding to the stimulus. Some priming models suggest this shift occurs as the stimulus becomes no longer surprising (Wagner, 1976). When activation has completely dissipated, the node moves to an inactive state (I) and there is no responding to the stimulus. Regardless of the number of additional exposures, the flow of this is always unidirectional, from A1 to A2 to I. Thus, once the node has moved from A1 to A2 from its initial exposure, additional exposures will only elicit the diminished A2 responding and the node must cycle through to its inactive state ("I") before additional exposures move it to A1. The amount of time the node is in the A2 state is then contingent on the short-term memory available to preserve activation in A2. Eating another food or attending to a different stimulus, like watching television, will move activation more quickly through A2 to I and diminish the amount of time that the node spends in the less responsive A2 state (for a more detailed review, see Epstein, Temple, Roemmich, & Bouton, 2009).

IV. SIMULATED ACHIEVEMENT AS SUBSTITUTE FOR REAL ACHIEVEMENT

Mentally simulating the achievement of a goal can serve as a substitute for its real achievement. Building on Freudian theory, Rapaport (1951) proposed that "fantasy thought may reduce drive sufficiently to permit the person to tolerate delayed gratification, thus avoiding fruitless impulsive actions" (Singer & Rowe, 1962, p. 446). Delaying gratification by imagining the future is useful when pursuing actual gratification would be difficult or problematic (Kappes, Schwörer, & Oettingen, 2012; Van Gelder, Hershfield, & Nordgren, 2013). If one's goal is to work out, stick up to the boss, or lose weight, however, imagined success can sometime derail or decrease actual success by serving as a substitute for real goal achievement. If women compare themselves to magazine imagery of thin models, they feel overweight. If instead, they imagine *being* the pictured model, positive affect is produced (Tiggemann, Polivy, & Hargreaves, 2009) that may counteract the push to embark on an unpleasant diet. Simulating the achievement of a desired behavior or outcome can make people feel better, and less likely to pursue goals that are difficult or costly to achieve.

Evidence. Research participants who mentally simulate easily achieving success on tasks are less likely to subsequently succeed at those tasks than are participants who imagine failing to perform the task, encountering problems, or something entirely different. In one study (Kappes & Oettingen, 2011), laboratory participants generated and wrote either positive fantasies (e.g., imagine everything during the week goes really well) or realistic descriptions about their upcoming week. Their week then unfolded without further intervention. Seven days later, participants who had generated positive fantasies reported that their actual week had been worse, that they felt less control, and that they had more difficulty managing time, suggesting that the success imagery generated several days before interfered with achieving actual success during the week. In a different paradigm, both defensive pessimists and strategic optimists performed worse on a dart-throwing task following mastery imagery (i.e., imagine flawless performance) compared to coping imagery (i.e., imagine correcting mistakes) or relaxation imagery (Spencer & Norem, 1996). The same pattern of results held in correlational studies in which the more people imagined succeeding rather than failing at goals like losing weight, starting a new relationship, or earning a high grade, the less successful they actually were, weeks or months later (Kappes, Oettingen, & Mayer, 2012; Oettingen & Mayer, 2002; Oettingen & Wadden, 1991; see also Langens & Schmalt, 2002; Sherman et al., 1981, Experiment 1). In short, mentally simulating success may sometimes be worse than not thinking about an upcoming task at all.[1]

Process. Two processes have been identified that may explain why imagined success decreases actual success: its influence on effort and planning. Mental simulations make people feel, to some extent, like that event *has* actually happened. Even psychologically healthy individuals can confuse imagination with reality. Imagining and describing experiences that never happened can produce convincing false memories of those experiences (Loftus & Pickrell, 1995), for instance.[2] Even when people readily acknowledge that their thoughts do not reflect reality—as when they explicitly recognize that they have not yet achieved a goal—simulations still affect judgment, emotions, and physiology (Nemeroff & Rozin, 2000).

If simulation makes it feel or seem that success has been achieved, one may not devote effort to produce it. Indeed, imaginary idealized goal achievement reduces effort invested in pursuing the simulated outcome (Oettingen & Mayer, 2002). Because simulation evokes the physiological consequences of actual experiences, simulated success produces relaxation rather than energy. Thirsty participants who fantasized about imbibing a refreshing drink, for instance, exhibited a decrease in their systolic blood pressure (Kappes & Oettingen, 2011), an indicator of low energization (Wright, 1996). Energy underlies the investment of effort (Brehm & Self, 1989). This relaxation following fantasies of successful achievement, then, inhibits the effort required to achieve outcomes. As evidence, simulating future success reduces engagement more

[1] It may be more effective to simulate oneself coping with difficulty and mastering challenges (i.e., motivational general-mastery imagery) rather than oneself winning events or receiving prizes (i.e., motivational-specific imagery). The former is a strategy many successful athletes employ (Moritz, Hall, Martin, & Vadocz, 1996).

[2] Ordinary mistakes cross into pathological delusion via failures in so-called "reality testing;" delusional depressed and schizophrenic patients are found to use "inappropriately lax criteria in evaluating mental experiences" (Radaelli, Benedetti, Cavallaro, Colombo, & Smeraldi, 2013). Learning and refining these criteria is a normal part of child development (Subbotsky, 1993).

in more effortful tasks (e.g., requiring one hour rather than 5 minutes; Kappes, Sharma, & Oettingen, 2013). This is because less motivation is necessary to prompt easy actions. Little desire to eat chocolate is necessary to prompt chocolate eating when an open box is nearby (e.g., Kavanagh, et al., 2005).

Mentally simulating goal achievement also decreases actual achievement by thwarting effective planning. Simulating possible future obstacles and challenges provides the opportunity to make plans to overcome or avoid them (Taylor et al., 1998), which facilitates goal pursuit (Gollwitzer & Sheeran, 2006). Simulated success often omits obstacles and challenges, which hampers planning and impairs actually succeeding (Showers, 1992). Reducing planning can also increase anxiety about goal pursuit. Having a plan is reassuring and reduces anxiety about upcoming challenges. Simulating future success without considering obstacles or challenges may leave people unable to make the plans needed to decrease anxiety, letting that anxiety interfere with their subsequent goal-achievement efforts (Pham & Taylor, 1999; Showers, 1992).

INTEGRATION

In the four non-exhaustive cases we examine, mental simulation acts as a substitute for the corresponding experience: imagined evidence is a substitute for physical evidence, imagined practice is a substitute for physical practice, imagined consumption is a substitute for actual consumption, and imagined achievement is a substitute for actual achievement (see Table 1). These forms of mental simulation act as substitutes by having similar effects on perception, cognition, motivation, and action, as do the corresponding physical experiences.

Each of the simulation effects we examine is consistent with the effects of *the behavior that is simulated*. To discern whether a particular kind of mental stimulation would act as a substitute for an experience or induce an opposing effect, we suggest that the best indicator would be the effect of the corresponding real experience. For instance, just as actual initiation of goal pursuit stimulates further goal pursuit (e.g., a Zeigarnik effect), whereas actual goal completion turns off goal pursuit, the way goal-pursuit is simulated (e.g., initiated versus completed) should moderate the effects of simulation on subsequent real goal-pursuit. Simulated goal completion should reduce actual goal pursuit, whereas simulated initiation of goal pursuit should increase actual goal pursuit. Simulated tasting of an appetizing amount of food is likely to sensitize people to that food (increasing desire and consumption), whereas simulated eating-to-satiety satiates the desire for the food and decreases its subsequent consumption.

The duration of substitution effects of mental simulation is an open question. All four of the substitution effects we examine involve one or more memory processes (i.e., episodic, semantic, procedural). Their effects thus are likely to be stronger initially and dissipate without reactivation. The duration and durability of each mental substitution effect is presumably best predicted by the duration of the effect of the corresponding behavior. In the case of simulated evidence or practice effects, these effects should persist as long as the effects of the corresponding real evidence or physical practice persist in memory (Anderson, J. R. 1983). In the case of eating or achievement goals, these effects should persist as long as effects of comparable eating or achievement would persist—until sufficient time passes and interference occurs for people to find a consumed food appealing again, or contextual cues re-set motivation (e.g., Epstein et al., 2009; Garbinsky, Morewedge, & Shiv, 2014a; 2014b).

Mental simulation adheres to classic substitution effects as defined in economics, at least in three cases. Mental practice appears to be as efficacious for some skills as physical practice. Imagined consumption reduces subsequent actual food consumption, as would actually consuming a food. Imagined achievement appears to have similar physiological and demotivating effects as actual achievement. In these cases, mental simulation reduces the propensity or need to have the corresponding physical experience. In the case of imagined evidence and physical evidence, it is likely that imagined evidence reduces the motivation to search for physical evidence (instead of simply serving a supplementary role), but no data yet directly supports this prediction.

Researchers have generally focused on the processes underlying each of these mental simulation effects in isolation (cf., Barsalou, 2003; 2008). We hope the organization of these simulation effects under a superordinate category, by their overlap in output, may yield insight into overlaps in the processes driving them. At a basic level, it is worth examining whether these effects are all related to activation in the same core network of brain regions (Schacter et al., 2008), share similar cognitive properties, and align with regard to the metacognitive inferences they imply. It is also important to examine how they diverge. Memory and planning-related processes appear to be starting candidates for convergence at a cognitive level, whereas some of the simulation effects outlined here diverge with respect to their influence on motivation and goal pursuit. People set and pursue goals where success seems valuable and attainable (Atkinson & Birch, 1970; Bandura, 1997; Eccles & Wigfield, 2002). Simulation causes outcomes to seem more attainable, but can also cause those outcomes to appear less valuable, by making people feel like the outcomes have already happened.

Pragmatically, people seem to recognize the motivation-boosting effects of imagining success more than the motivation-dampening effects. For instance, the online companion to the best-selling book *The Secret* (http://www.thesecret.tv/all-stories/) compiles thousands of reader testimonials attributing their achievements to the power of positive mental imagery. This lopsided insight implies that oftentimes people may inadvertently, and ironically, sabotage their goal pursuit by imagining successful achievement. Just as people give themselves credit for their good intentions (Kruger & Gilovich, 2004), mentally simulating success may allow people to feel successful without effortfully pursuing their goals.

It is worth reiterating that substitution effects are not the only purpose or effect of mental simulation. Simulation is used to learn, to decide how to act, and avoid repeating mistakes of the past. Indeed, the mental practice we discuss is usually initiated for learning (i.e., improving performance). When appropriately guided, simulation may produce effects that counter substitution. Simulating how one would have gotten a better grade on a failed exam (e.g., study harder, get more sleep) may assist one in achieving better future grades, thereby increasing performance motivation in the future. Substitution effects are often unintended, but given their broad possible range of consequences, it is particularly valuable to examine them together in an overarching framework.

Whereas simulation is often utilized as a tool to help people increase engagement in an avoided behavior (e.g., phobia treatment, Rachman, 1967), efforts to decrease many unwanted behaviors rely on thought suppression or avoidance. To prevent cravings for food (Kemps & Tiggeman, 2007) or cigarettes (May, Andrade, Panabokke, & Kavanagh, 2010), people are guided to engage in tasks that impair mental imagery of the desired item. The findings we review in this paper suggests that behavioral change may be more nuanced, that simulating an undesired action may sometimes do more to prevent than produce it. Perhaps mental simulation offers an alternative route to the sublimation of undesirable goals for those who struggle to enact the reappraisals involved in mindfulness meditation (Hölzel, Lazar, Gard, Schuman-Olivier, Vago, & Ott, 2011). When simulation substitutes for the need to perform a behavior in reality, simulation could help reduce unhealthy and harmful behaviors, from helping dieters avoid unhealthy foods (Morewedge et al., 2010) to reducing the likelihood of pedophiles enacting their harmful urges (see Sheldon & Howitt, 2008). We hope that identifying the cases in which simulation serves as a substitute for experience serves as a useful first step in disentangling the common thread between these effects, and when they can be effectively implemented.

Table 1

Four Substitution Effects of Mental Simulations

	Mental Simulation			
	Evidence	Practice	Consumption	Achievement
Example	Simulate partner eating last piece of cake: *"Jane could eat my piece of cake."*	Simulate steps to make a new cake: *"…Next, I'll mix in flour."*	Simulate eating many bites of a piece of cake. *"I imagine vanilla and a granular texture…"*	Simulate obtaining cake at trendy, distant bakery: *"I'm going to treat myself with an M. Antoinette Cake."*
Substitution Effect	Imagined events seem more likely *"Jane is going to eat my piece of cake!"*	Mental practice improves task performance *"My cake turned out well!"*	Imagined consumption reduces actual consumption *"I no longer want to eat cake."*	Imagined goal achievement decreases effortful goal pursuit *"The line and trip aren't worth braving today."*
Underlying Process	(1) Increased cognitive accessibility. (2) Inferences drawn about why and how events occur.	Action planning facilitated by associating necessary action units.	Mental representation of the stimulus is activated and decays into a less responsive state.	(1) Feels like goal has been achieved: energy drops, effort decreases. (2) Impaired planning for obstacles.

References

American Time Use Survey (2014). Retrieved from: http://www.bls.gov/tus/

Anderson, C. A. (1983). Imagination and expectation: The effect of imagining behavioral scripts on personal influences. *Journal of Personality and Social Psychology*, *45*(2), 293.

Anderson, J. R. (1983). A spreading activation theory of memory. *Journal of verbal learning and verbal behavior*, *22*(3), 261-295.

Atkinson, J. W., & Birch, D. (1970). *The dynamics of action.* Oxford, England: Wiley.

Bach, P., Allami, B. K., Tucker, M., & Ellis, R. (2014). Planning-related motor processes underlie mental practice and imitation learning. *Journal of Experimental Psychology: General*, *143*(3), 1277.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. Macmillan.

Barsalou, L. (2003). Situated simulation in the human conceptual system. *Language and Cognitive Processes*, *18*(5-6), 513–562.

Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology*, *59*, 617–645.

Bass, F. M., Pessemier, E. A., & Lehmann, D. R. (1972). An experimental study of relationships between attitudes, brand preference, and choice. *Behavioral Science*, *17*(6), 532-541.

Bone, P. F., & Ellen, P. S. (1992). The generation and consequences of communication-evoked imagery. *Journal of Consumer Research*, 93–104.

Brehm, J. W., & Self, E. A. (1989). The intensity of motivation. *Annual Review of Psychology*, *40*, 109–131.

Brown, G. P., Macleod, A. K., Tata, P., & Goddard, L. (2002). Worry and the simulation of future outcomes. *Anxiety, Stress & Coping*, *15*(1), 1–17.

Carroll, J. S. (1978). The effect of imagining an event on expectations for the event: An interpretation in terms of the availability heuristic. *Journal of Experimental Social Psychology*, *14*(1), 88–96.

Cohen, J., & Weimann, G. (2000). Cultivation revisited: Some genres have some effects on some viewers. *Communication Reports*, 13(2), 99–114.

Corbin, C. B. (1967). The effects of covert rehearsal on the development of a complex motor skill. *The Journal of General Psychology*, *76*(2), 143–150.

Decety, J. (1996). Do imagined and executed actions share the same neural substrate? *Cognitive Brain Research*, *3*(2), 87–93.

Dickson, P. R. (1982). The impact of enriching case and statistical information on consumer judgments. *Journal of Consumer Research*, 398–406.

Djordjevic, J., Zatorre, R. J., & Jones-Gotman, M. (2004). Odor-induced changes in taste perception. *Experimental Brain Research*, *159*(3), 405–408.

Djordjevic, J., Zatorre, R. J., Petrides, M., Boyle, J. A., & Jones-Gotman, M. (2005). Functional neuroimaging of odor imagery. *Neuroimage*, *24*(3), 791–801.

Driskell, J. E., Copper, C., & Moran, A. (1994). Does mental practice enhance performance? *Journal of Applied Psychology*, *79*(4), 481.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*, 109–132.

Effron, D. A., Cameron, J. S., & Monin, B. (2009). Endorsing Obama licenses favoring whites. *Journal of Experimental Social Psychology*, *45*(3), 590–593.

Egstrom, G. H. (1964). Effects of an emphasis on conceptualizing techniques during early learning of a gross motor skill. *Research Quarterly. American Association for Health, Physical Education and Recreation*, *35*(4), 472–481.

Elder, R. S., & Krishna, A. (2012). The "visual depiction effect" in advertising: Facilitating embodied mental simulation through product orientation. *Journal of Consumer Research*, *38*(6), 988–1003.

Epstein, L. H., Temple, J. L., Roemmich, J. N., & Bouton, M. E. (2009). Habituation as a determinant of human food intake. *Psychological Review, 116(2),* 384-407.

Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review*, *12*(2), 168-192.

Feltz, D. L., Landers, D. M., & Becker, B. J. (1988). A revised meta-analysis of the mental practice literature on motor skill learning. In D. Druckman & J. A. Swets (Eds.), *Enhancing human performance: Issues, theories, and techniques.* Washington, D. C.: National Academy Press.

Frank, C., Land, W. M., Popp, C., & Schack, T. (2014). Mental representation and mental practice: Experimental investigation on the functional links between motor memory and motor imagery. *PLoS ONE*, *9*(4), e95175. http://doi.org/10.1371/journal.pone.0095175

Garbinsky, E. N., Morewedge, C. K., & Shiv, B. (2014a). Interference of the end: Why recency bias in memory determines when a food is consumed again. *Psychological Science, 25(7),* 1466-1474.

Garbinsky, E. N., Morewedge, C. K., & Shiv, B. (2014b). Does liking or wanting determine repeat consumption delay? *Appetite*, *7(1),* 59-65.

Gollwitzer, P. M., & Oettingen, G. (2012). Goal pursuit. In R. M. Ryan (Ed.), *The Oxford Handbook of Human Motivation* (pp. 208–231). New York: Oxford University Press.

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, *38*, 69–119.

Gregory, W. L., Cialdini, R. B., & Carpenter, K. M. (1982). Self-relevant scenarios as mediators of likelihood estimates and compliance: Does imagining make it so? *Journal of Personality and Social Psychology*, *43*(1), 89.

Hall, C. (2001). Imagery in sport and exercise. In R. Singer, H. Hausenblas, & C. Janelle (Eds.), *Handbook of Sport Psychology* (pp. 529 – 549). New York, NY: John Wiley & Sons, Inc.

Hamilton, R. W., Thompson, D. V., Arens, Z. G., Blanchard, S. J., Häubl, G., Kannan, P. K., Kahn, U., Lehmann, D. R., Meloy, M. G., Roese, N. J., & Thomas, M. (2014). Consumer substitution decisions: an integrative framework. *Marketing Letters*, *25*(3), 305-317.

Hardy, L., & Callow, N. (1999). Efficacy of external and internal visual imagery perspectives for the enhancement of performance on tasks in which form is important. *Journal of Sport & Exercise Psychology*, 95–112.

Heckhausen, H. (1991). *Motivation and action*. Springer Science & Business Media.

Hinshaw, K. E. (1991). The effects of mental practice on motor skill performance: Critical evaluation and meta-analysis. *Imagination, Cognition and Personality*, *11*, 3–35.

Hoch, S. J. (1984). Availability and interference in predictive judgment. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10*, 649-662.

Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science*, *6*(6), 537-559.

Huh, Y. E., Vosgerau, J., & Morewedge, C. K. (2016a). More similar but less satisfying: Comparing the efficacy of within- and cross-category substitutes for food. *Psychological Science*.

Huh, Y. E., Vosgerau, J., & Morewedge, C. K. (2016b). Selectivity in sensitization: Consuming a food motivates consumption of its complements. *Journal of Marketing Research*.

Inesi, M. E., Botti, S., Dubois, D., Rucker, D. D., & Galinsky, A. D. (2011). Power and choice their dynamic interplay in quenching the thirst for personal control. *Psychological Science*, *22*(8), 1042–1048.

Jeannerod, M. (1994). Motor representations and reality. *Behavioral and Brain Sciences*, *17*(02), 229–245.

Jeannerod, M. (2001). Neural simulation of action: a unifying mechanism for motor cognition. *Neuroimage*, *14*(1), S103–S109.

Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological review*, *88*(1), 67-85.

Jones, E. E., & Nisbett, R. E. (1971). The actor and the observer: Divergent perceptions of the causes of behavior. In E.E. Jones, D. E. Kanouse, H. H. Kelly, R.E. Nisbett, S. Valins, & B. Weiner, (Eds.), *Attribution: Perceiving the causes of behavior* (pp. 79-94). New York: General Learning Press.

Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and* *biases: The psychology of intuitive judgment* (pp. 49-81). New York: Cambridge University Press.

Kahneman, D., & Tversky, A. (1982). The psychology of preferences. *Scientific American*, *246*(1), 160–173.

Kappes, H. B., & Oettingen, G. (2011). Positive fantasies about idealized futures sap energy. *Journal of Experimental Social Psychology*, *47*(4), 719–729.

Kappes, H. B., Oettingen, G., & Mayer, D. (2012). Positive fantasies predict low academic achievement in disadvantaged students. *European Journal of Social Psychology*, *42*(1), 53–64.

Kappes, H. B., Schwörer, B., & Oettingen, G. (2012) Needs instigate positive fantasies of idealized futures. *European Journal of Social Psychology*, *42*, 299-307.

Kappes, H. B., Sharma, E., & Oettingen, G. (2013). Positive fantasies dampen charitable giving when many resources are demanded. *Journal of Consumer Psychology*, *23*(1), 128–135.

Kavanagh, D. J., Andrade, J., & May, J. (2005). Imaginary relish and exquisite torture: the elaborated intrusion theory of desire. *Psychological Review*, *112*(2), 446.

Kemps, E., & Tiggemann, M. (2007). Modality-specific imagery reduces cravings for food: an application of the elaborated intrusion theory of desire to food craving. *Journal of Experimental Psychology: Applied*, *13*(2), 95.

Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science*, *330*(6006), 932–932.

Koehler, D. J. (1991). Explanation, imagination, and confidence in judgment. *Psychological Bulletin*, *110*(3), 499–519.

Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukophadhyay, T., & Scherlis, W. (1998). Internet paradox: A social technology that reduces social involvement and psychological well-being? *American psychologist*, *53*(9), 1017.

Krishna, A., & Schwarz, N. (2014). Sensory marketing, embodiment, and grounded cognition: Implications for consumer behavior. *Journal of Consumer Psychology*, *24(2),* 158-298.

Krishna, A., Morrin, M., & Sayin, E. (2014). Smellizing cookies and salivating: A focus on olfactory imagery. *Journal of Consumer Research*, *41(1),* 18-34.

Kruger, J., & Gilovich, T. (2004). Actions, intentions, and self-assessment: The road to self-enhancement is paved with good intentions. *Personality and Social Psychology Bulletin*, *30*(3), 328–339.

Kruglanski, A. W., Shah, J. Y., Fishbach, A., Friedman, R., Chun, W. Y., & Sleeth-Keppler, D. (2002). A theory of goal systems. *Advances in Experimental Social Psychology*, *34*, 331–378.

Kumar, A., Killingsworth, M. A., & Gilovich, T. (2014). Waiting for merlot: Anticipatory consumption of experiential and material purchases. *Psychological Science*, *25*(10), 1924-1931.

Langens, T. A., & Schmalt, H.-D. (2002). Emotional consequences of positive daydreaming: The moderating role of fear of failure. *Personality and Social Psychology Bulletin*, *28*(12), 1725–1735.

Larson, J., Redden, J. P., & Elder, R. (2013). Satiation from sensory simulation: Evaluating foods decreases enjoyment of similar foods. *Journal of Consumer Psychology, 24(2),* 188-194.

Libby, L. K., & Eibach, R. P. (2011). Visual perspective in mental imagery: A representational tool that functions in judgment, emotion, and self-insight. *Advances in Experimental Social Psychology*, *44*, 185.

Libby, L. K., Shaeffer, E. M., Eibach, R. P., & Slemmer, J. A. (2007). Picture yourself at the polls visual perspective in mental imagery affects self-perception and behavior. *Psychological Science*, *18*(3), 199–203.

Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals*, *25*(12), 720–725.

Longoni, C., Gollwitzer, P. M., & Oettingen, G. (2014). A green paradox: Validating green choices has ironic effects on behavior, cognition, and perception. *Journal of Experimental Social Psychology*, *50*, 158–165.

Markman, K. D., Klein, W. M., & Suhr, J. A. (Eds.). (2009). *Handbook of imagination and mental simulation*. New York: Psychology Press.

Markman, K. D., & McMullen, M. N. (2003). A reflection and evaluation model of comparative thinking. *Personality and Social Psychology Review*, *7*(3), 244–267.

MacInnis, D. J., & Price, L. L. (1987). The role of imagery in information processing: Review and extensions. *Journal of Consumer Research*, *13,* 473-491.

May, J., Andrade, J., Panabokke, N., & Kavanagh, D. (2010). Visuospatial tasks suppress craving for cigarettes. *Behaviour Research and Therapy*, *48*(6), 476–485.

McSweeney, F. K., & Swindell, S. (1999). General-process theories of motivation revisited: The role of habituation. *Psychological Bulletin*, *125*(4), 437.

Meister, I. G., Krings, T., Foltys, H., Boroojerdi, B., Müller, M., Töpper, R., & Thron, A. (2004). Playing piano in the mind—an fMRI study on music imagery and performance in pianists. *Cognitive Brain Research*, *19*(3), 219–228.

Monin, B., & Miller, D. T. (2001). Moral credentials and the expression of prejudice. *Journal of Personality and Social Psychology*, *81*(1), 33.

Morewedge, C. K. (2013). It was a most unusual time: How memory bias engenders nostalgic preferences. *Journal of Behavioral Decision Making, 26(4),* 319-326.

Morewedge, C. K., & Buechel, E. C. (2013). Motivated underpinnings of the impact bias in affective forecasts. *Emotion, 13(6),* 1023-1029.

Morewedge, C. K., Gilbert, D. T., & Wilson, T. D. (2005). The least likely of times: How remembering the past biases forecasts of the future. *Psychological Science, 16(8),* 626-630.

Morewedge, C. K., & Hershfield, H. (In press). Consumer prediction: Forecasted utility, psychological distance, and their intersection. In M. I. Norton, D. Rucker, and C. Lamberton (Eds.), *Cambridge Handbook of Consumer Psychology.* New York, NY: Cambridge University Press.

Morewedge, C. K., Huh, Y. E., & Vosgerau, J. (2010). Thought for food: Imagined consumption reduces actual consumption. *Science*, *303,* 1530-1533.

Morewedge, C. K., & Kahneman, D. (2010). Associative processes in intuitive judgment. *Trends in Cognitive Sciences, 14,* 435-440.

Morewedge, C. K., & Todorov, A. (2012). The least likely act: Overweighting atypical past behavior in behavioral predictions. *Social Psychological and Personality Science*, *3*(6), 760–766.

Moritz, S. E., Hall, C. R., Martin, K. A., & Vadocz, E. (1996). What are confident athletes imaging? An examination of image content. *The Sport Psychologist, 10*, 171-179.

Mulder, T., Zijlstra, S., Zijlstra, W., & Hochstenbach, J. (2004). The role of motor imagery in learning a totally novel movement. *Experimental Brain Research*, *154*(2), 211–217.

Munzert, J., Lorey, B., & Zentgraf, K. (2009). Cognitive motor processes: the role of motor imagery in the study of motor representations. *Brain Research Reviews, 60*(2), 306–326.

Murphy, S.M., Nordin, S. M., & Cumming, J. (2006). Imagery in Sport, Exercise and Dance. In T. Horn (Ed.), *Advances in sport psychology* (3rd ed. pp 297-324). Champaign, IL: Human Kinetics.

Nemeroff, C., & Rozin, P. (2000). The makings of the magical mind: The nature and function of sympathetic magical thinking. In K. S. Rosengren, C. N. Johnson, & P. L. Harris (Eds.), *Imagining the impossible: Magical, scientific and religious thinking in children* (pp. 1-34). Cambridge, UK: Cambridge University Press.

Nussbaum, S., Liberman, N., & Trope, Y. (2006). Predicting the near and distant future. *Journal of Experimental Psychology: General*, 135, 152–161.

Oettingen, G., & Mayer, D. (2002). The motivating function of thinking about the future: expectations versus fantasies. *Journal of Personality and Social Psychology*, *83*(5), 1198.

Oettingen, G., & Wadden, T. A. (1991). Expectation, fantasy, and weight loss: Is the impact of positive thinking always positive? *Cognitive Therapy and Research*, *15*(2), 167–175.

Perry, H. M. (1939). The relative efficiency of actual and imaginary practice for five selected tasks. *Archives of Psychology, 34*, 5-75.

Pham, L. B., & Taylor, S. E. (1999). From thought to action: Effects of process-versus outcome-based mental simulations on performance. *Personality and Social Psychology Bulletin*, *25*(2), 250–260.

Rachman, S. (1967). Systematic desensitization. *Psychological Bulletin*, *67*(2), 93.

Radaelli, D., Benedetti, F., Cavallaro, R., Colombo, C., & Smeraldi, E. (2013). The reality monitoring deficit as a common neuropsychological correlate of schizophrenic and affective psychosis. *Behavioral Sciences*, *3*(2), 244–252.

Richardson, A. (1967a). Mental practice: a review and discussion part I. *Research Quarterly. American Association for Health, Physical Education and Recreation*, *38*(1), 95–107.

Richardson, A. (1967b). Mental practice: a review and discussion part II. *Research Quarterly. American Association for Health, Physical Education and Recreation*, *38*(2), 263–273.

Risen, J. L., & Gilovich, T. (2008). Why people are reluctant to tempt fate. *Journal of Personality and Social Psychology*, *95*(2), 293-307.

Sackett, R. S. (1934). The influence of symbolic rehearsal upon the retention of a maze habit. *The Journal of General Psychology*, *10*(2), 376–398.

Sanders, C. W., Sadoski, M., Bramson, R., Wiprud, R., & Van Walsum, K. (2004). Comparing the effects of physical practice and mental imagery rehearsal on learning basic surgical skills by medical students. *American Journal of Obstetrics and Gynecology*, *191*(5), 1811–1814.

Schacter, D. L., Addis, D. R., & Buckner, R. L. (2008). Episodic simulation of future events. *Annals of the New York Academy of Sciences*, *1124*(1), 39–60.

Schooler, J. W., Smallwood, J., Christoff, K., Handy, T. C., Reichle, E. D., & Sayette, M. A. (2011). Meta-awareness, perceptual decoupling and the wandering mind. *Trends in Cognitive Sciences*, *15*(7), 319-326.

Shearer, D. A., Thomson, R., Mellalieu, S. D., & Shearer, C. R. (2007). The relationship between imagery type and collective efficacy in elite and non elite athletes. *Journal of Sports Science & Medicine*, *6*(2), 180.

Sheldon, K., & Howitt, D. (2008). Sexual fantasy in paedophile offenders: Can any model explain satisfactorily new findings from a study of Internet and contact sexual offenders? *Legal and Criminological Psychology*, *13*(1), 137–158.

Sherman, S. J., Cialdini, R. B., Schwartzman, D. F., & Reynolds, K. D. (1985). Imagining can heighten or lower the perceived likelihood of contracting a disease the mediating effect of ease of imagery. *Personality and Social Psychology Bulletin*, *11*(1), 118–127.

Sherman, S. J., Skov, R. B., Hervitz, E. F., & Stock, C. B. (1981). The effects of explaining hypothetical future events: From possibility to probability to actuality and beyond. *Journal of Experimental Social Psychology*, *17*(2), 142–158.

Showers, C. (1992). The motivational and emotional consequences of considering positive or negative possibilities for an upcoming event. *Journal of Personality and Social Psychology*, *63*(3), 474.

Simmons, W. K., Martin, A., & Barsalou, L. W. (2005). Pictures of appetizing foods activate gustatory cortices for taste and reward. *Cerebral Cortex*, *15*(10), 1602–1608.

Singer, J. L., & Rowe, R. (1962). An experimental study of some relationships between daydreaming and anxiety. *Journal of Consulting Psychology*, *26*(5), 446.

Spencer, S. M., & Norem, J. K. (1996). Reflection and distraction: Defensive pessimism, strategic optimism, and performance. *Personality and Social Psychology Bulletin*, *22*(4), 354–365.

Suddendorf, T., & Busby, J. (2005). Making decisions with the future in mind: Developmental and comparative identification of mental time travel. *Learning and Motivation, 36,* 110–125.

Subbotsky, E. (1993). *Foundations of the mind: Children's understanding of reality.* Cambridge, Massachusetts, Harvard University Press.

Szpunar, K. K., Spreng, R. N., & Schacter, D. L. (2014). A taxonomy of prospection: Introducing an organizational framework for future-oriented cognition. *Proceedings of the National Academy of Sciences*, *111*(52), 18414–18421.

Taylor, S. E., Pham, L. B., Rivkin, I. D., & Armor, D. A. (1998). Harnessing the imagination: mental simulation, self-regulation, and coping. *American Psychologist*, *53*(4), 429.

Taylor, S. E., & Schneider, S. K. (1989). Coping and the simulation of events. *Social Cognition*, *7*, 174–194.

Tiggemann, M., Polivy, J., & Hargreaves, D. (2009). The processing of thin ideals in fashion magazines: A source of social comparison or fantasy? *Journal of Social and Clinical Psychology*, *28*(1), 73–93.

Tucker, M., & Ellis, R. (1998). On the relations between seen objects and components of potential actions. *Journal of Experimental Psychology: Human Perception and Performance*, *24*(3), 830.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207–232.

Van Gelder, J.-L., Hershfield, H. E., & Nordgren, L. F. (2013). Vividness of the future self predicts delinquency. *Psychological Science*, *24*(6), 974–980.

Vasquez, N. A., & Buehler, R. (2007). Seeing future success: Does imagery perspective influence achievement motivation? *Personality and Social Psychology Bulletin*, *33*(10), 1392–1405.

Viscusi, W. K. (1985). A Bayesian perspective on biases in risk perception. *Economics Letters*, *17*(1), 59–62.

Wagner, A. R. (1976). Priming in STM: An information-processing mechanism for self-generated or retrieval-generated depression in performance. In T. J. Tighe & R. N. Leaton (Eds.), *Habituation: Perspectives from child development, animal behavior, and neuropsychology* (pp. 95-128). Hillsdale, NJ: Lawrence Erlbaum Associates.

Wicklund, R. A., & Gollwitzer, P. M. (1982). *Symbolic self-completion*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Wright, R. A. (1998). Ability perception and cardiovascular response to behavioral challenge. In M. Kofka, G. Weary, & G. Sedek (Eds.), *Personal control in action: Cognitive and motivational mechanisms* (pp. 197–232). New York: Guilford.