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The Functional Theory of Counterfactual Thinking: New Evidence, New Challenges, New Insights

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Abstract

Thinking about what might have been—counterfactual thinking—is a common feature of the mental landscape. Key questions about counterfactual thinking center on why and how they occur and what downstream cognitive and behavioral outcomes they engender. The functional theory of counterfactual thinking aims to answer these and other questions by drawing connections to goal cognition and by specifying distinct functions that counterfactuals may serve, including preparing for goal pursuit and regulating affect. Since the publication of our last theoretical statement (Epstude & Roese, 2008), numerous lines of empirical evidence support, or are rendered more readily understandable, when glimpsed through the lens of the functional theory. However, other lines of evidence have called into question the very basis of the theory. We integrate a broad range of findings spanning several psychological disciplines so as to present an updated version of the functional theory. We integrate findings from social psychology, cognitive neuroscience, developmental psychology, clinical psychology, and health psychology that support the claim that episodic counterfactual thoughts are geared mainly toward preparation and goal striving and are generally beneficial for individuals. Counterfactuals may influence behavior via either a content-specific pathway (in which the counterfactual insight informs behavior change) or a content-neutral pathway (in which the negative affect from the counterfactual motivates generic behavior change). Challenges to the functional theory of counterfactual thinking center on whether counterfactuals typically cohere to a structural form amenable to goal striving and whether behavioral consequences are mainly dysfunctional rather than functional. Integrating both supporting and challenging evidence, we offer a new theoretical synthesis intended to clarify the literature and guide future research in multiple disciplines of psychology.



1. INTRODUCTION

Never job backwards. What-might-have-been was a waste of time. Follow your fate, and be satisfied with it, and be glad not to be a second-hand motor salesman, or a yellow-press journalist, pickled in gin and nicotine, or a cripple—or dead.

Fleming (1957, p. 115)

So appear the inner thoughts of James Bond, gentleman spy and unflappable hero of the longest-running film franchise in history, as envisioned in Ian Fleming's classic spy novel *From Russia With Love*. James Bond is a man of action, skilled in weapons, hand-to-hand combat, and various other dark arts of the spy trade. He gets the job done, whether by meticulous planning or by instinct and reflex. As the above quotation reveals, Mr. Bond prefers never to look back with thoughts of what might have been, that is, with counterfactual thoughts. His eyes are always on the future. Perhaps he feels that the melancholy of missed opportunity or the self-recrimination inherent in regret is sign of personal weakness. In looking forward, he maybe believes that he becomes better equipped to ensure continued success. But is counterfactual thinking indeed at odds with success? We think not. The central tenet of the functional theory of counterfactual thinking is that the counterfactual thoughts that spring effortlessly to mind on a daily basis are, for the most, reflections of goals. Accordingly, patterns of counterfactual thinking are clarified through the lens of theory pertaining to goal cognition.

Counterfactual thinking refers to thoughts about what might have been, of how the past might have been different had some or another aspect been different (Byrne, 2005, 2016; Kahneman & Miller, 1986; Miller, Turnbull, & McFarland, 1990; Roese, 1997). The term counterfactual, first articulated by philosophers, is defined as a proposition that is contrary to fact, in that it specifies a situation or scenario that did not actually happen. Counterfactuals may be understood as instantiations of conditional propositions, containing an antecedent (if) and consequent (then). This conditional structure often lends itself to the expression of a causal inference, as in "If only I had studied, then I would have passed the exam" (i.e., studying is sufficient to achieve improved exam performance). Here, the antecedent action did not occur and the consequent outcome also did not happen, and in this way the counterfactual meets the definition of contrary to the facts. Nevertheless, counterfactuals may embody an underlying causal proposition that captures real world relations with some accuracy (studying does usually result in improved performance). In short, counterfactuals may contain causal insights of varying accuracy, a key point when connecting the counterfactual inference to subsequent actionable intentions.

Counterfactuals are inferences and thus have been conceived as cold cognition that nevertheless, depending on their content, evoke poignant emotions. Counterfactuals can focus on personally experienced episodes, or they can focus on historical or natural events far removed from personal

experience. Counterfactuals that are self-focused and specify how the past might have been better (upward counterfactuals) can evoke emotions such as regret, guilt, and shame, each of which now occupies a distinct literature. Counterfactuals that focus on how the past might have been worse (downward counterfactuals) can evoke relief and rejoicing. And counterfactuals that focus on historical events (e.g., What if the Berlin Wall had not fallen in 1989? What if President Kennedy had not been assassinated in 1963?) can give pause, luring further consideration, both anxious as well as curious. Counterfactuals are an essential part of the human experience and a signature example of the imagination and creativity that stand at the intersection of thinking and feeling.

Great works of literature, works that penetrate to the core of the human experience, sometimes instantiate the emotionality of counterfactual thinking. Consider first the musings of Winston Smith in George Orwell's classic novel, *1984*:

A deep tenderness, such as he had not felt for her before, suddenly took hold of him. He wished that they were a married couple of ten years' standing. He wished that he were walking through the streets as they were doing now, but openly and without fear, talking trivialities and buying odds and ends for the household.

Orwell (1949, p. 23)

In this dystopic story of the coldness of life under a totalitarian regime, Winston risks his life to pursue Julie, the first love he has ever known, a love that brings color to his otherwise gray existence. As this counterfactual reveals, he longs for a better life with Julie at his side. A similar longing for love underlies the following quotation from the great French novel, *Madame Bovary*:

If matters had fallen out differently, she wondered, might she not have met some other man? She tried to picture to herself the things that might have been—that different life, that unknown husband. He might have been handsome, intelligent, distinguished, attractive ...

Flaubert (1857/1950, p. 57)

We see in this passage the inner musings of the title character, focusing on great longing, which is to say, a life goal unmet. And in Mario Puzo's novel, *The Godfather*, singer Johnny Fontane (under the protection of his godfather, Vito Corleone) experiences highs and lows in his entertainment career, but none so low as the loss of his singing voice due to vocal cord lesions. Near the end of the novel, Fontane joyously regains his voice, but that joy is tempered by the melancholy of a long separation from his young daughters:

For a moment he had just one regret. If only his voice had come back to him while trying to sing for his daughters, how lovely that would have been. That would have been so lovely.

Puzo (1969, p. 381)

Different from the counterfactual-denying quotation of James Bond that opened this section, these three quotations of counterfactual musings speak to emotional urgency and deep-seated motives. From thirsting for a love free from government oppression, to craving a love that is rich and meaningful, to yearning a connection with estranged offspring, these counterfactuals speak of human desire, of wants, of needs. These counterfactuals speak of goals.

The foundational idea of the functional theory is that counterfactual thinking is illuminated through its connection to goal-directed cognition (Epstude & Roese, 2008, 2010, 2011; Roese, 1997). In short, counterfactual thoughts often reflect goals and the varying means to reach those goals. Imagining alternative pathways by which past goals might have been achieved provides insights that comprise blueprints for future action. The functional perspective is certainly not the only way to understand counterfactual thinking. However, the functional theory provides a considerable breadth in accounting for wide varieties of empirical patterns.

Pivotaly, the functional theory bridges disciplines by providing a common nomenclature and set of assumptions. Developed initially within the discipline of social psychology, these ideas have since become central to recent empirical contributions from cognitive neuroscience, developmental psychology, clinical psychology, and health psychology. In cognitive neuroscience, combining neuroimaging with tasks that engage counterfactual reasoning illuminates the brain networks underlying goal-directed action as modulated by reward circuitry. In developmental psychology, the emergence of adult sophistication in goal management from primitive consideration of alternatives reveals a succession of cognitive operations, the more sophisticated built upon a foundation of the more basic, progressing from simple goal consideration to complex conditional reasoning. In clinical and health psychology, the role of distorted causal assessment and ruminative tendencies can be illuminated by specification of dysfunctional variants of normally functional counterfactual thinking. Exciting new empirical discoveries from each of these areas suggest new nuances to the functional theory of counterfactual thinking.

At the same time, empirical challenges to the theory have emerged. One challenge centers on observations of structure and content of counterfactual

thoughts that seem unamenable to future improvement. Another is observations that counterfactual thinking may evoke deleterious rather than favorable consequences. These theoretical challenges tear at the heart of the theory, demanding a sober assessment of their deeper meaning along with reconsideration and reformulation of the theory. After presenting the various threads of new evidence, we reaffirm that (a) counterfactual thinking is a conscious reflection of deeper implicit processes that cross-connect covariation detection, causal inference, and goal cognition and (b) counterfactuals are useful in that they stimulate further thought that feeds into goal pursuit. We revise the functional theory with additional postulates centering on the delineation of (a) two steps underlying counterfactual effects on behavior: application vs deployment of accurate causal inference (which permit predictions as to when counterfactuals will and will not be beneficial) and (b) simple vs complex causal domains, such that beneficial effects of counterfactual thinking are more likely to be found in the latter than former domain. Before getting to these revisions, it is necessary first to state the theory and then to survey supportive as well as challenging findings.



2. STATEMENT OF THE THEORY

First and foremost, the functional theory recognizes counterfactual thinking as a signature example of mental simulation, defined as a mechanism for creating mental analogs to real world structures and events for the purpose of estimating prospects (Kahneman & Miller, 1986). Whereas counterfactual mental simulations are defined by their past tense (I might have had eggs for breakfast yesterday), other kinds of mental simulation include fictive imaginings in the present tense (My brother must be having breakfast by now) and expectancy visualizations in the future tense (Tomorrow I will enjoy pancakes for breakfast). Mental simulation shares with episodic memory a capacity for manipulating concrete, contextual details specific to the time and place of the focal episode (Hassabis & Maguire, 2007; Özbek, Bohn, & Berntsen, in press; Roese & Sherman, 2007; Suddendorf & Corballis, 2007; Szpunar, Spreng, & Schacter, 2014; Tulving, 2002).

As we further define counterfactual thinking with regard to related constructs, we make use of the distinction between episodic vs semantic memory (which distinguishes between autobiographical memory for specific events in time and place vs more general world knowledge), which has

recently proven useful in distinguishing among different kinds of mental simulation. From this vantage point, we can usefully distinguish episodic counterfactuals from semantic counterfactuals (De Brigard, Addis, Ford, Schacter, & Giovanello, 2013; De Brigard & Giovanello, 2012; Özbek et al., 2016; Schacter, Benoit, De Brigard, & Szpunar, 2015), such that the former focus on personally meaningful alternatives to events that were experienced first hand, whereas the latter focus on alternative constructions derived from general knowledge of history, society, and the natural world (e.g., Revlin, Cate, & Rouss, 2001). This distinction elegantly situates the sphere of influence of particular theories. The functional theory of counterfactual thinking for the most part describes the operation of episodic counterfactuals, whereas the mental models theory (Byrne, 2002; Johnson-Laird & Byrne, 2002; Thompson & Byrne, 2002), focusing on the cognitive underpinnings of basic reasoning processes, to a greater extent describes semantic counterfactual thinking. Accordingly, the research methods deployed in the service of the functional theory tend often to focus on personal experiences, either recalled or experienced first hand in the laboratory. These research methods uncover counterfactual thoughts that typically center on alternatives to one's own actions, or those actions of a person known by the individual. By contrast, the research methods that serve the mental models theory largely comprise impersonal scenarios and conditional statements drawing on general knowledge of the workings of the world (e.g., "If Kennedy had listened to his Hawk advisers, he would have engaged in a nuclear strike during the Cuban missile crisis," from Byrne, 2002, p. 428).

The functional theory of counterfactual thinking centers on the connection of episodic counterfactuals to goal-directed cognition and action. Simply put, episodic counterfactual thoughts are disciplined, not erratic flights of fancy. These types of counterfactual thoughts are constrained by reality and typically involve only minimal changes to actual events to suppose alternatives that are pragmatic and plausible (Seelau, Seelau, Wells, & Windschitl, 1995). Episodic counterfactuals usually embody goals and specify means by which goals may be achieved. They relate directly to planning and action implementation, which may in turn guide behavior. In essence, episodic counterfactuals are best understood in terms of their connection to behavior regulation. True, counterfactual thoughts also influence emotion, suggesting a linkage also to affect regulation. Nevertheless, the functional theory positions affect regulation as secondary to behavior regulation. The functional theory of counterfactual thinking embraces the following

postulates, covered in [Section 2](#). We state the theoretical ideas here in their purest essence, and then return to the question of their empirical support in [Section 3](#).

2.1 Counterfactuals Are About Goals

At the most general level, episodic counterfactual content is about goals. When we think “if only,” we are usually thinking about a way to get to an unrealized desire. In this section, the focus is on episodic counterfactual thinking, which we will shorten simply to counterfactuals. Regardless of whether counterfactuals specify common vs unusual ways to achieve a goal, they nevertheless cohere around goals. Therefore, it is essential to examine the goal central to a situation when examining the functional qualities of a counterfactual thought. Counterfactuals connect to behavior regulation in the form of a negative feedback loop comprising the current goal state of the individual, an ideal goal state, and actions that serve to reduce the discrepancy between the current and ideal state ([Carver & Scheier, 1996](#)). The greater the discrepancy, the greater the impetus to activity aimed at reducing the discrepancy.

2.2 Situational Need Evokes Counterfactual Thinking

Counterfactual thoughts are activated not at random, but systematically in response to goal blockage. Goal blockage represents a situational need for intervention that would restore goal progress and achieve goal success (e.g., [Lewin, 1935](#)). Stated differently, a perceived discrepancy between an actual and ideal goal state activates spontaneous counterfactual thinking. Although people can reason counterfactually with great facility when prompted, spontaneous counterfactual thoughts arise in response to the following, all of which constitute proxies, derivations, or immediate consequences of the construct of goal blockage: failure, perception of a problem, lack of goal progress, disconfirmed expectancy, and negative affect in response to a negative outcome. Correspondingly, spontaneous counterfactual thinking is less likely to occur in light of success, “situation normal,” goal progress, expectancy confirmation, and positive affect.

2.3 Counterfactual Thinking Impacts Behavior: Content-Specific Pathway

Generally speaking, counterfactuals influence behavior in a beneficial way in terms of performance improvement. However, this general statement carries

several qualifications, the most important of which are that performance benefits will be observed to a greater extent when (a) the causal inference underlying the counterfactual is accurate and effective and (b) there is opportunity for implementing the fruit of the causal inference. Thus, the functional theory does not predict uniform performance improvement as a consequence of any and all counterfactual thinking; rather, there are particular conditions and forms of counterfactual thinking that yield differing degrees of impact on performance.

Counterfactual thinking may impact behavior in relation to a specific problem at hand. The content-specific pathway embodies the transfer of informational content (i.e., information centering on an action-outcome causal linkage) from the counterfactual to behavioral intentions, which in turn evokes behavior aimed at reducing the discrepancy between the actual and ideal goal state. “This pathway is content specific in the sense that the particular information contained in the counterfactual (i.e., the lesson learned, or the belief in the causal effectiveness of a particular action) is funneled directly into a behavioral intention and, as a consequence, behavior” (Epstude & Roese, 2008, p. 171).

A key aspect of the content-specific pathway is causal inference. Roese (1997) identified causal inference as one of two key mechanisms (the other being a contrast effect) by which counterfactual thinking produces judgment and decision-making consequences. The counterfactual statement “If I had studied harder, I would have passed the exam” is essentially a statement of the causal impact of studying on exam performance. Causal inferences derive from implicit processing of covariation information and thus are unconscious precursors to the conscious form of counterfactual thoughts. As counterfactual thoughts tend to embrace a means-end linkage (studying and performance), their typical form embraces personal action followed by a desired goal outcome. More specifically, the causal meaning of a counterfactual conditional tends to isolate one particular causal antecedent as sufficient to have produced a desired, alternative outcome (Alicke, Buckingham, Zell, & Davis, 2008; Burrus & Roese, 2006; Mandel & Lehman, 1996; Petrocelli & Dowd, 2009; Roese, Hur, & Pennington, 1999; Roese & Maniar, 1997; Roese & Olson, 1996; Roese & Vohs, 2012; Spellman & Mandel, 1999).

Drawing on the causal inference contained in the counterfactual, a behavioral intention to implement the corresponding action is formed or facilitated, and this behavioral intention then feeds into corresponding behavior.

2.4 Counterfactual Thinking Impacts Behavior: Content-Neutral Pathway

Counterfactuals may also have broader consequences that extend beyond the problem that elicited them in the first place. The content-neutral pathway specifies the type of information processing translating across domains without transfer of the particulars of the insight contained in the counterfactual. That is, independent of the specific meaning contained by it, the counterfactual thought may activate mental procedures that carry over into subsequent judgments and behavior. For example, as we argued in our 2008 paper,

... in the content-specific pathway, apple-thoughts lead to apple behaviors ('I should have eaten an apple' results in subsequent apple consumption), whereas in the content-neutral pathway, apple-thoughts might lead to orange behavior (or turnip or squash or guava behavior).

Epstude and Roese (2008, p. 175)

The signature example is the counterfactual mindset, in which counterfactual thinking in one domain alters performance in another (Galinsky & Kray, 2004; Galinsky, Moskowitz, & Skurnik, 2000; Hirt, Kardes, & Markman, 2004; Kray & Galinsky, 2003; Kray, Galinsky, & Wong, 2006; for an overview of the mindset construct, see Wyer, Xu, & Shen, 2012). For example, in research by Galinsky and Moskowitz (2000), participants who had been drawn into generating a counterfactual about another person's chance of winning a prize at a rock concert (the initial domain) were subsequently more likely to achieve novel solutions in a very different domain (the Duncker candle problem from Glucksberg & Weisberg, 1966). At a more general motivational level, upward counterfactual thinking can feed into behavior change by way of a general strengthening of motivation (e.g., Markman, McMullen, & Elizaga, 2008; Markman, McMullen, Elizaga, & Mizoguchi, 2006).

2.5 Counterfactual Form Fits Function

The form of counterfactual thoughts may be characterized in various ways, chief among them direction, structure, and social focus. By direction, we mean the evaluative implication of whether the counterfactual embraces an alternative outcome that is superior to or more desirable than actuality (upward counterfactual) or inferior to or less desirable than actuality (downward counterfactual). By structure, we mean whether the counterfactual is

constructed via the addition of a new action, means, or element not present in actuality (additive counterfactual) vs the deletion of an action, means, or element that was in fact present in actuality. By focus, we mean whether the counterfactual's action, means, or element connects to oneself vs another person (in the attribution theory lexicon, this same conception differentiates internal vs external locus of causation; [Weiner, 1985](#)).

At a general level, each of these three kinds of form varies in terms of how useful it will be for goal progress, particularly in terms of the content-specific pathway, which involves specification of a means-end causal linkage that then informs a behavioral intention. In terms of direction, there is a general advantage for upward counterfactuals over downward counterfactuals for performance improvement, in that, by definition, an upward counterfactual specifies an improvement to the status quo, whereas a downward counterfactual specifies a deterioration to the status quo and thus points to ways to preserve rather than improve upon the status quo. Hence, all else being equal, the functional theory predicts that among spontaneous (vs prompted) counterfactual thoughts, the upward form will predominate over the downward form. In terms of structure, there is similarly a general advantage for performance improvement achieved by additive over subtractive counterfactuals, in that additive counterfactuals specify novel, creative solutions to build upon the status quo. Therefore, all else being equal, the functional theory predicts that among spontaneous (vs prompted) counterfactual thoughts, the additive form will predominate over the subtractive form ([Roese & Olson, 1993b](#)). Finally, in terms of social focus, it stands to reason that personal benefit derives primarily from modification to one's own behaviors, hence there is an advantage for the self-focused over the other-focused form that translates into the prediction that the former form will predominate over the latter form. Summarizing, the typical form of a spontaneous counterfactual thought is upward, additive, and self-focused.

To be sure, the above characterization of form fitting function is stated at a general, main effect level. The prediction is that when averaging across people, across domains, and across goals, there will be a main effect favoring upward over downward, additive over subtractive, and self-focused over other-focused counterfactuals. Importantly, this general pattern will shift as a function of moderators that alter the goal structure of the episode that evokes the spontaneous counterfactual. For example, sometimes individuals may have a strong goal to make themselves feel better, and, as a result, they

may be more likely to generate downward counterfactuals in order to achieve this goal (McMullen & Markman, 2000; White & Lehman, 2005). There may also be groups of individuals who are chronically driven by a need to feel good about themselves, such as narcissists, who may also be more likely to generate downward than upward counterfactuals (this testable hypothesis has not, to the best of our knowledge, been examined). Further, self-focus is more useful and hence more prevalent when attached to a desire to improve oneself, but other focus is more useful and hence more prevalent with a desire to self-handicap or evade blame (e.g., Catellani & Bertolotti, 2014; McCrea, 2008).

The situations (or episodes) that evoke counterfactual thoughts constitute another source of variation in the manner in which counterfactuals impact behavior. Some situations involve problems that are unidimensional, linear, and amenable to solutions achieved via analytic problem solving, whereas other domains are multidimensional, recursively interconnected, and amenable to more creative, divergent problem solving. We argue that the additive form of counterfactual is more useful for, and hence more prevalent than, the subtractive form for multidimensional as opposed to linear challenges.

Finally, goals differ. Although many goal conceptions exist, a particularly useful conception is regulatory focus theory (Higgins, 1997), which differentiates goal regulation in terms of focus on promotion (seeking gains vs nongains) vs prevention (seeking nonlosses vs losses). For a promotion goal, i.e., seeking improvements to the status quo, upward and additive counterfactuals will be more useful and hence more prevalent. For a prevention goal, i.e., preserving the status quo by thwarting deterioration, downward counterfactuals (which specify what not to do in order to keep things as they are) will be more useful and hence more prevalent than upward counterfactuals. Also, the additive counterfactual form, which involves a creative reconstruction of reality, is more useful, and hence more prevalent, for achieving promotion goals, whereas the subtractive form, which involves less creative deletion of aspects of the factual situation, is more useful, and hence more prevalent, for achieving prevention goals (Pennington & Roese, 2003; Roese et al., 1999, 2006). To summarize, counterfactual form fits function at a general main effect level, but guided by the concept of goal striving, this main effect is moderated by factors connecting to the individual, the situation, and the goal that comprise the specific episode that evokes the counterfactual thought.

2.6 Opportunity as Master Moderator

The theoretical conception of counterfactual thinking as serving particular goals has traditionally been parsed into behavior regulation vs affect regulation (e.g., [Markman & McMullen, 2003](#); [Roese & Olson, 1997](#)). The signature distinction is between the activation of upward counterfactuals, which connect to performance improvement, and downward counterfactuals, which connect to affect regulation. At a main effect level, upward counterfactuals predominate over downward counterfactuals, but there are many exceptions, fueling the quest to identify key moderators. Of these, we have in previous writings proposed that the master moderator is opportunity, such that greater opportunity unleashes the behavior regulation aspect of counterfactual thinking to a greater extent than the affect regulation aspect ([Epstude & Roese, 2008, 2011](#); see also [Roese & Olson, 2007](#)). When opportunity for corrective action presents itself, counterfactuals can inform subsequent behavior and enhance performance, via either the content-specific or content-neutral pathway. When opportunity is reduced, by contrast, counterfactuals afford little help in corrective action, and so instead affect regulation predominates over preparation, such that people generate thoughts that mainly serve to make them feel better (e.g., “it was lucky that things weren’t worse for me”).

By master moderator, we mean that a variety of more concretely defined moderator constructs may be understood as instantiations residing under one higher-order umbrella construct. By opportunity, we mean a chance or possibility to effect change in the status quo ([Roese & Olson, 2007](#); [Roese & Summerville, 2005](#); [Summerville, 2011a, 2011b](#)). Opportunity is defined with regard to the individual in the here and now, as a present-tense property of the person-situation status quo. Perceiving opportunity means believing that taking action will produce a change to the status quo. Without opportunity, the situation is sufficiently constrained that action produces little or no effect on the status quo. For example, a typical middle class adult has the opportunity to buy different types of cars depending on individual preferences, whereas the choice of home town is much more constrained by external circumstances. Most human beings have the opportunity to run in the face of danger, but zero opportunity to fly from danger. The key defining aspect of opportunity is: does the individual have both the capacity to take action *and* does the action have the causal property of being sufficient to effect a change?

Opportunity as an overarching concept may be glimpsed within various lower level constructs that have been examined in prior research, each of which embraces either personal capacity or effectance. Perceived control is a construct that connects to both capacity and effectance (Tykocinski & Steinberg, 2005). Event repeatability refers to whether there is the situational opportunity to take action in the near future (Markman, Gavanski, Sherman, & McMullen, 1993). Decision reversibility refers to whether a past decision may be subsequently changed (Bullens, Van Harreveld, & Förster, 2011). And individuals vary in their implicit beliefs as to whether human behavior is inherently malleable vs fixed (Dweck, 1996; see chapter “Implicit theories: Assumptions that shape social and moral cognition” by Plaks). All of these examples of specific constructs embody the essence of opportunity, and all are predicted to exert a moderating effect, such that the link from counterfactuals to behavior is stronger under higher opportunity.

2.7 Other Functions

The functional theory of counterfactual thinking asserts that multiple functions may be served by counterfactuals, and that the particular structural form or content of those counterfactuals will vary as a function of the activation of particular functions. A preparative function occupies the bulk of our attention in this chapter, yet previous writings articulated additional functions, chief among them an affective function. In other words, counterfactuals can sometimes take a downward form, in which a worse alternative is considered, which in turn (by way of a contrast effect) evokes more positive emotions (Roese, 1997, 1999; Roese & Olson, 1995a, 1995b, 1997; see also Allen, Greenlees, & Jones, 2014). Accordingly, under some circumstances, people may generate downward counterfactuals strategically in order to make themselves feel better. The key structural differentiator between a preparative and affective function is direction of comparison: upward counterfactuals are more useful for preparation, whereas downward counterfactuals are more useful for affect repair. In measures of spontaneous counterfactual thinking, downward counterfactuals occur rarely, thus lending weight to the assertion that counterfactuals embrace this affective function relatively rarely, i.e., under certain unusual circumstances, such as when a more tragic event very nearly happened (McMullen & Markman, 2000), or when affective self-enhancement motives are heightened or chronically activated (Rim & Summerville, 2014; White & Lehman, 2005).

Another way that the affective function might be served is by way of excuse making, which may, in part, reflect self-esteem maintenance, but also

self-presentation following failure (McCrea, 2008; Tyser, McCrea, & Knüpfner, 2012). For example, after a loss in the sport of baseball, one player might note that if only the pitcher had played better, the team would have won. In this case, the counterfactual takes the form of a self-serving attribution, in which blame is deflected away from the self and onto another person (Feeney, Gardiner, Johnston, Jones, & McEvoy, 2005; McCrea, 2007; Roesse & Olson, 1993a, 2007). The key structural differentiator here is self-focus (or internal vs external locus of causation): self-focused (upward) counterfactuals are more useful for the preparative function whereas other-focused (upward) counterfactuals can be affectively soothing. Because counterfactual thinking connects to goal cognition, the most active goal in the moment dictates which form of counterfactual is activated. If an achievement or performance goal is active, counterfactuals tend to be upward, self-focused, and beneficial for subsequent performance (McCrea, 2008), whereas if the goal is to make oneself feel better, counterfactuals may be upward and other-focused (Tyser et al., 2012) or downward and self-focused (White & Lehman, 2005). Interestingly, if the individual has the goal of presenting a favorable impression to others, claiming upward, other-focused counterfactuals will backfire. Audiences apparently appreciate and evaluate more positively individuals who accept blame by communicating upward, self-focused counterfactuals (Wong, 2010).

Are there other functions served by counterfactuals, beyond those of preparatory and affective? Undoubtedly there are, but we argue that these will likely be niche motives that are operative among a relatively small subpopulation and under relatively rare circumstances. In our view, there is a hierarchy of importance and hence frequency of operation, such that counterfactuals are largely preparative, sometimes affectively soothing, and occasionally aimed at excuse making.

2.8 Theoretical Precursors

In summarizing, the main postulates of the functional theory of counterfactual thinking, we pause to note the chief theoretical precursors to this conception. The idea of connecting structure to function has been essential to biology since at least the time of the ancient Greeks and forms the backbone of contemporary anatomy and physiology. The notion that social psychological processes have structural forms that may connect meaningfully to behavioral function appeared in Katz (1960), who linked attitudes (long a key construct in social psychology) to four distinct functions (instrumental,

ego-defensive, value-expressive, and knowledge). Katz's seminal contribution was to organize disparate attitude change findings systematically with regard to goals: "both attitude formation and attitude change must be understood in terms of the needs they serve and that, as these motivational processes differ, so too will the conditions and techniques for attitude change" (p. 167) and "recognition of the complex motivational sources of behavior can help to remedy the neglect in general theories which lack specification of conditions under which given types of attitude will change" (p. 168).

The functionalist idea of interplay between motivation and cognition was applied to counterfactual thinking and mental simulation by [Johnson and Sherman \(1990\)](#). Widely cited in subsequent papers on counterfactual thinking, this book chapter was more catalyst than detailed explication. Ranging over wide terrain of social cognition research (e.g., expectancies, stereotyping, reality monitoring, overconfidence, mood-congruent recall, etc.), the discussion of counterfactual thinking accounted for just 3 of 44 pages. The contribution to the functional theory was so brief that we may quote it here in its entirety: "Counterfactual thinking can prepare us for maintaining our beliefs in the future; for coping with an uncertain, unexpected, or stressful future; and for paving the way for changing in the future" (p. 509) and "The generation of counterfactuals gives us flexibility in thinking about possible futures and prepares us better for those futures ... Event simulation serves problem-solving and emotion-regulating functions for stressors by increasing the perceived validity of the imagined experiences, providing a framework for organizing experience, and providing a mechanism for mustering helpful emotions" (p. 510). The more formal and detailed statement of the functional theory of counterfactual thinking appeared in [Roese \(1997\)](#); see also [Roese & Olson, 1993a, 1995a, 1997](#)), with significant qualifications and additions appearing in [Markman and McMullen \(2003\)](#). The updated version that named the functional theory of counterfactual thinking in its title ([Epstude & Roese, 2008](#)) is the immediate precursor to the present paper.



3. CORE EVIDENCE

In this section, we begin our consideration of the principal evidence in support of the functional theory of counterfactual thinking. Included are research programs from social psychology, emphasizing those publications that have appeared since our 2008 paper. Further evidence is considered in [Section 4](#) (which centers on findings discrepant with the theory) and

Section 5 (which centers on evidence from disciplines other than social psychology). We begin with the core assertion, that counterfactuals are most often centered on goals.

3.1 Counterfactuals Are About Goals

Counterfactual thoughts that occur spontaneously on a daily basis center mainly on goals. They focus on what one personally could have done to have achieved the goal, or to have bypassed some obstacle so as to achieve a more desirable outcome. As such, most spontaneous counterfactuals are episodic (as opposed to focused on general world knowledge), personal (as opposed to focused on others), and upward (as opposed to downward).

One way to capture the connection of counterfactuals to goals centers on the broadest and biggest of all goals, those of life goals or core motives. What are the fundamental motives that drive human behavior? As a reasonable theoretical default, we draw on the classic contribution by Atkinson and McClelland (e.g., [McClelland, Atkinson, Clark, & Lowell, 1953](#)) to assume three core motives: the needs for achievement, affiliation, and power. By achievement, we mean personal advancement to greater degrees of mastery, understanding, and prosperity. By affiliation, we mean any and all interpersonal connections, be they dyadic, romantic, filial, community, tribal, or national. By power, we mean the personal asymmetric control over valued resources relative to other people. Beyond this classic specification, there are many other systems of carving up core motives, among them the [Maslow \(1943\)](#) pyramid of needs, its recent update by [Kenrick, Griskevicius, Neuberg, and Schaller \(2010\)](#), one based on social motives ([Stevens & Fiske, 1995](#)) and another centering on effectiveness ([Franks & Higgins, 2012](#)). For present purposes, the key question is whether counterfactual thoughts connect in a meaningful way to core motives.

Multiple motives drive human behavior in multifaceted ways, but there may be broader priorities among core motives. Studies of counterfactual thinking, and of life regrets in particular, offer us a back door research approach, i.e., getting at the question indirectly rather than simply asking people, “What matters most to you?” In assessing life regrets, the approach is to ask people: If you could live your life over, what would you do differently? For some, there is a ready answer to this question. Some people burn with red-hot regret (“I should have asked that girl out in high school;” “I should have tried to be an artist”), others have reconciled themselves with

their past (Maybe I should have moved to New York, but I'm fine here in St. Louis), but nearly everyone asked can give an answer. Regret is a counterfactual emotion that reflects an awareness of personal standards and that mistakes can be made. Morrison, Epstude, and Roese (2012) asked participants to report on the emotional intensity of their biggest life regrets. They found that the most intense life regrets reflect the core motive of affiliation, for example love regrets, friendship regrets, and regrets about not phoning mom last week. Regrets relating either to affiliation or achievement dominated over other kinds of life regrets, but affiliation regrets were felt more intensely than achievement regrets (see Towers, Williams, Hill, Philipp, & Flett (2016) for further supportive evidence). In probing this pattern further, Morrison et al. found that when people felt threatened by life circumstances that challenged their relationships, they reported more intense life regrets. In short, when people looked across their lives as a whole, and pondered which parts had something missing, what most bothered them were absences in social connection.

Further evidence that counterfactuals connect importantly to the core motive of affiliation came from research on social closeness (Summerville & Buchanan, 2014), defined in terms of maintaining closeness to others by way of "repairing damaged social ties" (p. 464). According to these authors, publicly expressing a regret (i.e., an upward, self-focused counterfactual) essentially communicates the acceptance of blame as opposed to the deflection of blame onto others (as in the excuse-making function of counterfactuals). In Study 1 of this work, the public expression of regret in the form of Twitter messages (tweets) was content analyzed, which showed that tweet regrets tend more often than not to embrace social closeness by way of accepting self-blame (as opposed to excuse making); and in Study 3, participants explicitly drew a connection between their publicly expressed regrets and the goal of social closeness. A related finding is reported in the context of intergroup relations. Imhoff, Bilewicz, and Erb (2012) showed that regret for an ingroup atrocity is linked to intentions to engage in intergroup contact with the victim group. From the loftiest vistas of what motivates us to our most cherished ends, it is clear that counterfactuals connect to motivation. Counterfactuals are about goals.

When people speak of profoundly important goals, they often invoke meaning in life, which may be defined as belief in the coherence, significance, and purpose of life in general (Heine, Proulx, & Vohs, 2006; Heintzelman & King, 2014). The above findings regarding life regrets and affiliation goals may hold significance for questions of meaning in life.

Satisfying social relationships can imbue life with depth and clarity. By contrast, the loss of a loved one evokes the terror of a loss of meaning, solace for which is offered by various belief systems (e.g., religion) that serve to restore meaning. The mere consideration of a counterfactual fork in the road—what if my life had taken a different route (living in a different country, marrying a different person, engaging in a different occupation)—seems to evoke a greater sense of meaning (Ersner-Hershfield, Galinsky, Kray, & King, 2010; Kray et al., 2010; Seto, Hicks, Davis, & Smallman, 2015; Waytz, Hershfield, & Tamir, 2015). This type of manipulation also affects religiosity. When individuals consider alternatives to an event in their past, they report higher levels of religiosity than when just reporting factually on the same event (Buffone, Gabriel, & Poulin, 2016). In this way, counterfactuals connect to perhaps the loftiest of all goals, the quest for life's meaning and ultimate purpose.

Even with less lofty goals, counterfactuals are deeply connected. For example, a manipulation of the desirability of a counterfactual outcome makes that counterfactual seem more likely (Kanten & Teigen, 2015, Study 5). In other words, the desirability of an outcome, which drives goal formation and attainment, gears counterfactual thinking more toward implemental forward momentum, thus elevating the feasibility and attainability of the imagined counterfactual action. Relatedly, individual differences in focus on goals are associated with greater frequency of counterfactual thoughts. For example, the tendency to be a maximizer vs a satisficer (and, relatedly, variation in perfectionism) correlates with heightened feelings of regret (Ma & Roese, 2014; Schwartz et al., 2002; Sirois, Monforton, & Simpson, 2010). In addition, individual differences in assessment, that is, the tendency to examine and compare different means to attaining a specific goal, are positively related to generating more upward, self-focused counterfactual thoughts (Pierro et al., 2008). Thus, from the loftiest to the most mundane of goals, counterfactuals are involved. The connection of goals to counterfactuals is next considered in light of how the activation of counterfactuals is contingent upon variation in need states.

3.2 Evidence That Situational Need Evokes Counterfactual Thinking

Counterfactual thoughts are more numerous when they are most needed—when goals are blocked, or when outcomes fall short of what was desired. The finding that counterfactuals are generated spontaneously to a far

greater extent following negative than positive outcomes has been observed repeatedly. In our 2008 paper, we reviewed several studies demonstrating this point (Gilovich, 1983; Hur, 2001; McEleney & Byrne, 2006; Roese & Hur, 1997; Roese & Olson, 1997). Newer evidence continues to appear. For example, in coding open-ended responses at the trial-by-trial level of a multiple trial learning task, Petrocelli and Harris (2011) reported that nearly all observed instances of counterfactual thinking followed from losses rather than from wins. In a laboratory tasting task, selection of bad-tasting (vs good-tasting) drinks evoked more spontaneous counterfactual thoughts (Hafner, White, & Handley, 2012). Among children aged 8–11, spontaneous counterfactual thoughts in reaction stories told to them were more prevalent following negative as opposed to positive story outcomes (Gujardo, McNally, & Wright, 2016; see also German, 1999). Similarly, the greater the severity of trauma, the more numerous the counterfactual thoughts focusing on the events leading up to the traumatic experience (Dalglish, 2004; Davis, Lehman, Wortman, Silver, & Thompson, 1995). Very clearly, negative outcomes evoke greater counterfactual thinking than positive outcomes.

A need to reassess, retool, and regroup can be construed as a further instantiation of a situational need that evokes counterfactual thinking. Information about the decision process itself can be gleaned in part from information about an alternative outcome. For example, in considering various vacation options, an individual might make a decision and be satisfied with it, and yet still crave information about some other hotel she might have stayed in. Would it have been as good as the one chosen? Maybe it would have been better ... Such counterfactual information can be painful. A new, more concrete upward counterfactual (e.g., “I should have picked the other option”) can be realized through the acquisition of specific details as to what might have been. Individuals thus face a trade-off between wanting to know what might have been (which can be painful yet informative) vs keeping their head in the sand (which is painless yet uninformative). Several lines of evidence suggest that, all else being equal, people do seek out potentially painful information after a decision is made (Kruger & Evans, 2009). But as a further example that situational need is a determinant of counterfactual activation, several lines of evidence also indicate that negative decision outcome information and feelings of dissatisfaction with a decision evoke an even greater tendency to seek out counterfactual information (Shani, Tykocinski, & Zeelenberg, 2008; Shani & Zeelenberg, 2007; Summerville, 2011a).

3.3 Evidence That Counterfactual Thinking Impacts Behavior: Content-Specific Pathway

In our 2008 paper, we reviewed a variety of evidence that counterfactuals may impact behavior, involving such outcomes as laboratory anagram tasks (Markman et al., 2008; Reichert & Slate, 2000; Roese, 1994), academic performance (Nasco & Marsh, 1999), and landing an airplane in a flight simulator (Morris & Moore, 2000). Next, we consider evidence that has been published since our 2008 review.

Generally, speaking, three kinds of evidence are relevant: (a) counterfactuals influence behavioral intentions, (b) behavioral intentions influence behavior, and (c) counterfactuals influence behavior. The (b) connection involves a separate literature derived from the theory of reasoned action and the theory of planned behavior (Ajzen, 1991); we refer back to our 2008 paper for coverage of this literature. Accordingly, we focus here on recent evidence regarding links (a) and (c).

Turning first to evidence that counterfactuals influence behavioral intentions, early evidence took the form of manipulations of counterfactual thinking followed by generic intention ratings (Krishnamurthy & Sivaraman, 2002; Page & Colby, 2003; Roese, 1994). A more subtle technique rooted to sequential priming showed that the momentary consideration of a counterfactual proposition facilitates consideration of a corresponding behavioral intention (Smallman & Roese, 2009). Across multiple trials, counterfactual judgments facilitated (i.e., sped up reaction times of) intention judgments, relative to a no-judgment baseline and to a control judgment involving frequency estimation. Facilitation occurred only when the counterfactual and the intention focused on the same behavior, thus confirming a content-specific mechanism as opposed to a content-neutral one (in which case the mere recognition of a counterfactual might unleash a brief motivational burst that impacts both related and unrelated behavioral intentions). This (within-subject) sequential priming paradigm has proven useful for exploring further conditions regarding the link between counterfactuals and intentions.

Smallman and McCulloch (2012), using this same sequential priming paradigm, replicated the effect that counterfactuals facilitate behavioral intention judgments with corresponding content. However, they discovered that this facilitation effect was stronger when the counterfactual centered on an event from the recent as opposed to distant past. Connecting this finding to construal-level theory (Trope & Liberman, 2010), the insight

is that more recent events involve a lower level construal, entailing more contextual details but also greater emphasis on feasibility. Thus, the calculus of feasibility feeds into the process of translating counterfactuals into behavioral intentions, strengthening this link both when the counterfactual event is situated in the near rather than distant past, and when the behavioral intention specifies action in the near rather than distant future. By similar logic, [Smallman \(2013\)](#) used the same sequential priming paradigm to show that the counterfactual-intention facilitation is stronger when the relevant content was more detailed or involved a specific rather than general class of behavior. The basic pattern that counterfactuals facilitate the formation of behavioral intentions has been confirmed by several other researchers ([McCulloch & Smallman, 2014](#); [Walker, Smallman, Summerville, & Deska, 2016](#)).

The above findings document the link from counterfactuals to behavioral intentions. Further evidence documents the link from counterfactuals to performance. Among the more compelling domains in which to study counterfactual thinking is negotiation ([Galinsky, Seiden, Kim, & Medvec, 2002](#)). When two or more individuals bargain over limited resources, a mutually beneficial agreement is far from certain. Success at negotiation depends on skill, a command of the facts, and insight into the intentions of the other negotiator. In short, the task is multifaceted and amenable to multiple solutions, among them “log-rolling” (or an integrative solution) by which negotiators recognize that they can each give up a less valued objective to the other while keeping a more favored objective for themselves. In research by [Kray, Galinsky, and Markman \(2009\)](#), a manipulation of counterfactual content showed that additive counterfactuals resulted in superior subsequently negotiated outcomes (that embodied integrative solutions) compared to subtractive counterfactuals. In other words, focusing on what specific actions one might have taken to have achieved a better prior negotiated outcome (an additive counterfactual) resulted in enhanced performance in a subsequent negotiation, relative to focusing on a prior action that should not have been taken (a subtractive counterfactual). As we argued with regard to form following function in [Section 2.4](#), there is a general advantage for performance improvement achieved by additive over subtractive counterfactuals, in that additive counterfactuals specify novel, creative solutions that build upon the status quo, as opposed to the more simplistic subtractive counterfactuals that merely delete that which was already in fact performed.

Wong, Haselhuhn, and Kray (2012) showed that measured (rather than manipulated) upward (vs downward) counterfactuals predicted subsequent negotiation success. This finding reflects another example of the notion of form following function: There is an advantage for upward counterfactuals over downward counterfactuals for performance improvement, in that, by definition, an upward counterfactual specifies an improvement to the status quo, whereas a downward counterfactual specifies a deterioration to the status quo (and thus points to ways to preserve rather than improve upon the status quo). Dyczewski and Markman (2012) both measured and manipulated upward vs downward counterfactuals and found positive effects on motivation and performance on a subsequent laboratory task. However, their finding was highly contingent on beliefs about the attainability of the outcome, a moderating effect that supports our contention of the opportunity principle as master moderator, a point that we will revisit in a Section 3.6. To summarize, substantial new evidence links counterfactuals both to behavioral intentions and to performance.

3.4 Evidence That Counterfactual Thinking Impacts Behavior: Content-Neutral Pathway

A key assertion of the functional theory of counterfactual thinking is that counterfactuals may influence behavior by either of two pathways, a content-specific vs a content-neutral pathway. The content-neutral pathway involves the indirect effect of motives or mindsets that feed into behavior change regardless of the content of the counterfactual per se. In our 2008 paper, we reviewed evidence for a counterfactual mindset, in which counterfactuals activated in one domain can affect performance in a different domain (e.g., Galinsky & Kray, 2004; Kray et al., 2006; Markman, Lindberg, Kray, & Galinsky, 2007). New evidence broadens our understanding of the content-neutral pathway.

The key idea behind a counterfactual mindset is that the cognitive procedure of generating alternative ideas may be activated in the moment, and result in subsequent continued use of the procedure, which may then result in general judgment effects that seem more expansive and less constrained by a single, dominant solution. For example, the counterfactual mindset may shift judgments by individuals by way of reducing confirmation bias (Galinsky & Moskowitz, 2000; Kray & Galinsky, 2003), and it may shift judgments by groups by way of encouraging members to coordinate their discussion across disparate opinions (Galinsky & Kray, 2004; Liljenquist, Galinsky & Kray, 2004). Stated more comprehensively, the counterfactual mindset induces a

mental procedure that involves the consideration of associations across objects and patterns; as a result, such mindsets improve performance on tasks involving consideration of relations and associations, but impair performance on tasks involving novel idea generation (Kray et al., 2006).

Markman et al. (2007) suggested a conceptual separation of counterfactual mindsets into those stemming either from additive vs subtractive counterfactual thinking. As we noted previously, additive counterfactuals involve specification of a new antecedent that did not in fact occur, whereas subtractive counterfactuals involve the mental removal of an antecedent that was in fact present. These authors provided evidence that the previously observed effects, such that the counterfactual mindset induces procedures that encourage relational processing, are in fact restricted to the subtype of mindset rooted to the subtractive counterfactual. By contrast, the additive counterfactual mindset (which, in and of itself, involves creative generation of prior actions that could have occurred but had not, perhaps, been previously considered) promotes an expansive processing style that facilitates (rather than impairs) creativity and novel idea generation. Again, the defining feature of a counterfactual mindset (as it is for any mindset; see Wyer et al., 2012) is that it embodies the activation of a cognitive procedure that carries forward from one content domain to another. One may generate an “if only” thought about a game of tennis in the morning and then find that it influenced the purchase of a birthday present for a friend in the afternoon. A counterfactual mindset is emblematic of a content-neutral process.

We emphasize that the content-specific and content-neutral pathways are not mutually exclusive but rather complementary: Both may occur at the same time, and they may interact. Nevertheless, Myers, McCrea, and Tyser (2014) provided evidence for the content-neutral pathway by using a method that held constant the content of the counterfactuals while examining the role of affect in boosting task persistence. In Study 1 of their paper, participants solved anagrams that were divided into two blocks. Between blocks, counterfactual thinking was manipulated, but rather than having participants generate their own idiosyncratic content, some of the participants focused their attention on one, experimenter-provided counterfactual by writing it down three times, whereas those in the control condition were not exposed to a counterfactual. In addition, participants rated their current mood state. The counterfactual induction did not affect the corresponding action described by the counterfactual, so, in this experiment, the content-specific pathway was not operative. However, the

counterfactual induction did influence performance, but there was a catch. Inducing the participants to focus on a counterfactual resulted in performance improvement only for those reporting high negative mood after the counterfactual writing task. In Study 2, this same pattern was reported for the dependent variable of task persistence. The implication of this research is that the content-neutral pathway may require a motivational push from negative affect. When people feel bad, they work harder to alleviate the negative feelings. As these authors noted, “When individuals experience more negative affect as a result of counterfactual thinking, they should judge their performance as inadequate ... Effort on the task is increased, leading to more broad improvement” (p. 14; see also [Markman et al., 2008](#)).

Further evidence that upward counterfactual thinking can feed into behavior change by strengthening motivation comes from several studies. [Wong \(2007\)](#) experimentally manipulated exposure to upward vs downward counterfactuals created by others and found that the former (vs latter) increased motivation pertaining to a writing–revising task, and this motivation predicted subsequent performance. [Nasco and Marsh \(1999\)](#) showed that frequency of upward, self-focused counterfactuals predicted subsequent increases in perceived control and also superior academic performance. [McMullen, Markman, and Gavanski \(1995\)](#) reported an experimental manipulation wherein upward, self-focused counterfactuals evoked more perceived control than did downward, self-focused counterfactuals. Finally, self-efficacy is defined as the personal belief that one has the ability to recruit the necessary resources to meet a particular objective. [Tal-Or, Boninger, and Gleicher \(2004\)](#) manipulated the direction of counterfactual comparison, and found that generation of upward counterfactuals elevated self-efficacy relative to generation of downward counterfactuals. Thus, evidence supports the idea that counterfactuals can provide a motivational boost that then feeds into performance.

3.5 Evidence That Counterfactual Form Fits Function

At a general level, are counterfactuals suited to guiding future behavior? Benchmarking their detailed assessment of counterfactual content against similar content within prefactuals and memory for past episodes, [De Brigard and Giovanello \(2012\)](#) found that counterfactuals were unique in containing elaborative detail that built on the foundation of the evoking event. Such counterfactual-based generalization of knowledge exemplifies

learning from experience and results in performance improvement (Smallman, 2013; Zhang, Paik, & Pirolli, 2015).

Counterfactual content that is upward, additive, and self-focused is more useful, and hence likely to be more prevalent (in terms of spontaneous thoughts, for example as accessed via unprompted thought listing). Such evidence was reviewed in our 2008 paper, but newer evidence includes the following. First, upward counterfactuals outnumber downward counterfactuals at rates as high as 95% (Petrocelli, Seta, Seta, & Prince, 2012). De Brigard, Addis, et al. (2013) found that upward counterfactuals were judged as more vivid and more likely to have occurred than downward counterfactuals. Second, additive counterfactuals outnumber subtractive counterfactuals (Callander, Brown, Tata, & Regan, 2007; Petrocelli et al., 2012). Third, self-focused counterfactuals outnumber other-focused counterfactuals (McCrea, 2007, Study 1).

An interesting question that stems from this latter observation is the aspect of personal control. According to Weiner's (1985) attribution theory, causal attributions may fall along three independent dimensions: locus, stability, and controllability. In this conception, whether an attribution is internal vs external is orthogonal to its controllability, such that for either the self or another person, an aspect might be highly controllable (e.g., task effort) or less controllable (e.g., intelligence). For a counterfactual to be informative about goal progress, and to be useful in terms of specifying causally efficacious action, the counterfactual should connect to both an internal and a controllable cause. As we shall see, there has been evidence both consistent and inconsistent with this point, and we return to these ideas as we consider challenges to the theory in Section 4.1.

In general, substantial evidence shows that counterfactuals not only focus on internal (or self-focused rather than other focused) antecedent actions, but also that these actions are personally controllable by the individual. For example, Hammell and Chan (2016) had their participants play popular console video games (e.g., archery using the Nintendo Wii console) in a laboratory setting. Counterfactual thinking was prompted and then coded by raters; counterfactuals focusing on controllable aspects outnumbered those focusing on uncontrollable aspects by a factor of two to one (but the underpowered statistical tests were nonsignificant). Similarly, Markman, Gavanski, Sherman, and McMullen (1995) used a gambling task in which participants played a computer-simulated "wheel of fortune" game, with their degree of control over the task experimentally manipulated to involve either controlling which of two wheels dictated their payoff or controlling

the stopping point of the wheel. The game was fixed so that outcomes were the same but would generate varying degrees of counterfactual thinking based on how close the wheel came to a large payoff. Counterfactual thinking was assessed via direct prompts, and these counterfactuals tended to focus on whatever aspect of the game the participants had (ostensible) control over. In studies involving hypothetical scenarios, participants tended to provide counterfactuals that centered on the scenario protagonist's unconstrained, controllable actions, as opposed to constrained aspects of the situation (Giroto, Legrenzi, & Rizzo, 1991; Mandel, 2003; Mandel & Lehman, 1996; McCloy & Byrne, 2000; McEleney & Byrne, 2006). Davis et al. (1995, Study 2) noted that the counterfactual thoughts generated in response to trauma overwhelmingly focus on personally controllable action (and hence involve significant self-blame; see also Davis, Lehman, Silver, Wortman, & Ellard, 1996).

At a more general level, it goes without saying that the observation of frequent reports of regret (according to one paper, regret is the second most commonly reported negative emotion: Saffrey, Summerville, & Roese, 2008) directly supports the contention that spontaneous counterfactual thinking is mostly upward (because regret, by definition, is a negative emotion predicated on an upward, self-focused counterfactual). The regret literature documents numerous incidents of reports of regret connecting to all manner of life concerns, large and small (Gilovich & Medvec, 1995; Morrison & Roese, 2011; Roese & Summerville, 2005; Zeelenberg & Pieters, 2007). However, as we shall see in a subsequent section, the question of whether upward counterfactuals mainly focus on personally controllable action has become a lightning rod for controversy concerning the very legitimacy of the functional theory of counterfactual thinking. We will return to evidence that challenges this linchpin of our theory.

3.6 Evidence That Opportunity Is the Master Moderator

Opportunity has been proposed as the master moderator that dictates whether or not counterfactual thinking results in performance benefits (Epstude & Roese, 2008; Roese & Olson, 2007; Roese & Summerville, 2005). When opportunity for corrective action presents itself, counterfactuals can inform subsequent behavior and enhance performance, via either the content-specific or content-neutral pathway. When opportunity is reduced, by contrast, counterfactuals afford little help in corrective action, and so instead the operative process centers on affect regulation rather

than preparation: people generate thoughts that mainly serve to make them feel better.

Under higher opportunity, the relative prevalence of those forms of counterfactual thinking conducive to behavior change is increased. For example, taking event repeatability as a form of opportunity, upward counterfactuals are more prevalent under high than low event repeatability (Markman et al., 1993). Taking personal control as a form of opportunity, upward counterfactuals are more prevalent under high than low control (Roese & Olson, 1995c; Tykocinski & Steinberg, 2005). If regret is understood to reflect upward, self-focused counterfactuals, then it is noteworthy that regret is greater for high than low opportunity actions (Roese & Summerville, 2005; Summerville, 2011a, 2011b). Taking a reversible decision as a form of opportunity, upward counterfactual thoughts are more prevalent following a reversible than irreversible decision (Hafner et al., 2012; see also Bullens et al., 2011; Bullens, Van Harreveld, Förster, & Van Der Pligt, 2013; Gilbert & Ebert, 2002).

On the flipside, reduced opportunity pushes people to toward affect regulation, for example in the form of self-serving biases (Roese & Olson, 2007). Intriguing new evidence for this pattern came from a pair of longitudinal studies assessing self-reports of perceived opportunity, reaction, and affective repair work (Bauer & Wrosch, 2011). These authors found that for those perceiving less opportunity, engaging in affect regulation by way of taking note of others who are worse off (a downward social comparison) corresponded with emotional well-being over time. Without those downward social comparisons, emotional well-being worsened.

Recent findings reveal a fuller picture of moderation of the processing sequence connecting counterfactual thinking to behavior. The focal behavior in one such research project was negotiation (Wong et al., 2012). The participants were business school students taking a course on negotiation, thus there was a clear vested interest in performance outcomes (business students are notoriously competitive), and the operational definition of opportunity took the form of individual differences in beliefs, specific to negotiation, as to whether people are inherently malleable in their actions. Drawing from Dweck and Leggett's (1988) conception of incremental vs entity implicit beliefs (see also Park & Kim, 2015; Plaks, this volume), Wong et al. developed a custom measure of implicit negotiation beliefs such that, on an individual difference level, participants varied in their expectation of malleability, and hence opportunity, within their negotiations. Individuals holding relatively more malleable beliefs generated more upward

counterfactuals in response to negotiation than did individuals holding fixed beliefs. Those upward counterfactuals also translated into superior subsequently negotiated outcomes. Stated differently, individual differences in perceived opportunity moderated the extent to which counterfactuals fed into improved performance.

Design-wise, research by [Dyczewski and Markman \(2012\)](#) was highly similar to [Wong et al. \(2012\)](#) in exploring moderation by opportunity from the foundation of [Dweck and Leggett's \(1988\)](#) conception of incremental vs entity implicit beliefs. Participants were university undergraduates, and the task at hand involved solving anagrams. Participants completed some anagrams, received false failure feedback, and then were induced to generate either upward or downward counterfactuals. They then completed more anagrams, and the difference between the first and second set of anagrams constituted a measure of performance improvement. Opportunity varied as an individual difference variable, and among those with greater opportunity beliefs (i.e., incremental theorists), generating upward (vs downward) counterfactuals resulted in greater motivation to improve and greater overt performance improvement.

Stepping back for a moment, we clarify our argument about opportunity to specify deeper details of what the construct entails. Essentially, the idea of future opportunity also implies having a more detailed representation of the specific event (i.e., lower level construal, [Trope & Liberman, 2010](#)). Individuals may then perceive the event as being more likely to occur or recur. Given a previous failure, individuals may also have quite specific aspects of the event activated from memory. An illustration of this idea comes from a research that examined the impact of opportunity on recollections of the past ([Si, Wyer, & Dai, 2016](#)). These researchers manipulated opportunity by having participants focus on a recent factual New Year's Eve experience and then explain why it was either likely or unlikely to recur (Study 2). The dependent variable centered on the subjective temporal distance from the past event, measured using a self-report scale with the endpoints "feels like yesterday" and "feels very far away." Greater opportunity (i.e., the event was likely to happen again) decreased the subjective temporal distance from the past event. Furthering this conception, [Van Boven, Kane, McGraw, and Dale \(2010\)](#) found that subjective temporal distance is reduced by the emotional intensity of the focal event. Putting these observations together, it seems that opportunity involves a lower level of construal that embraces focus on detail and feasibility, key ingredients for action preparation.

Summerville (2011b) added a further clarification to the opportunity principle in differentiating between past vs future opportunity. In research tracking regrets centering on choices of sorority among first-year university students, she found that when opportunity judgments centered on past circumstances (i.e., at the time a key decision was made), relatively lower perceived opportunity was associated with greater regret. In other words, this pattern is the reverse of what we have described as the opportunity principle, but it specifically centers on retrospective rather than prospective judgments of opportunity (Beike, Markman, & Karadogan, 2009). By contrast, when opportunity judgments were focused on the future, regrets were more intense and longer lasting under high opportunity. Summerville explained this pattern as instantiating a dynamic opportunity principle: “At first, we will feel the most regret when we cannot correct an outcome [because we cannot] meet our goals, but over time we will continue to regret those things related to the goals we can still meet” (p. 631).

Connecting these ideas to goal cognition, there is evidence that a goal that one commits to occupies the mind, that is to say, its accessibility is elevated (Klinger & Cox, 2004; see also Fishbach, Koo, & Finkelstein, 2014). If the individual perceives that there is opportunity to reach a goal even after an initial failure, they will remain motivated to pursue it. The closer the individual is to the goal (in terms of temporal distance) the greater the perceived likelihood of success, and the greater the resulting motivation (Peetz, Wilson, & Strahan, 2009). An upward counterfactual is part and parcel of this motivation. In cases when individuals are not very committed to a goal or when they perceive a low likelihood of success, downward counterfactuals may emerge. Koo and Fishbach (2014) demonstrated that goal commitment is indeed a crucial determinant of how individuals respond to information signaling difficulties in goal progress. Highly committed people can be motivated by information about the steps still necessary to pursue a goal. This research supports our assumption that when individuals commit to a goal, they are likely to stick to it (in part by generating upward counterfactuals) even as they confront obstacles to goal pursuit.

Although the opportunity principle has been discussed primarily in past studies of regret and counterfactual thinking (Epstude & Roese, 2008; Roese & Summerville, 2005), the principle is indeed broader, encompassing judgments that fall into general classes of self-serving judgment, cognitive dissonance reduction, and rationalization (or, as Gilbert termed it, the psychological immune system; Gilbert & Ebert, 2002). To put it simply, when do people blame others for failure vs self-blame? When do people alter

judgments to reduce dissonance vs sticking to original assumptions? When do people rationalize the past vs accept the facts as given? One answer to all of these questions is opportunity (Roesse & Olson, 2007): when future opportunity is open, people are less likely to deflect blame from self, less likely to engage in dissonance reduction practices, and less likely to rationalize, instead focusing on action deployment aimed at improving the situation at hand. For counterfactuals, this means when opportunity is open, upward counterfactuals predominate, which give insights to future improvement while tending also to bring more negative affect. By contrast, when opportunity to act is closed, people blame others self-servingly, reduce dissonance by changing this or that cognition, and rationalize. For counterfactuals, this means when opportunity is closed, downward counterfactuals predominate, which give weaker insights into improvement, but do tend to induce positive affect and hence are useful for affect regulation.

Taking the construct of opportunity to a higher level, another instantiation is social power, that is, the extent to which an individual holds more control over resources than do others (Keltner, Gruenfeld, & Anderson, 2003). Situationally activated feelings of power increased the tendency to generate self-focused counterfactual thoughts in regard to a failed dyadic task (Scholl & Sassenberg, 2014). By contrast, lower power, which was shown to covary with reduced feelings of control (and hence, as we argue, reduced opportunity) evoked fewer self-focused counterfactuals. Further, the ability to conjure imaginative ideas, as captured by the individual difference construct of fantasy proneness, might also be taken as the cognitive precursor of the capacity to see opportunity in one's future. In other words, greater imaginative aptitude may translate roughly into greater opportunity to conceptualize possibilities. Sure enough, individuals higher in fantasy proneness are more likely to generate spontaneous counterfactual thoughts (Bacon, Walsh, & Martin, 2013). Taking the construct of opportunity to its ultimate level, the belief in free will represents the panoramic conception of one's individual command over the environment via personal initiative (Baumeister & Monroe, 2014). By contrast, a belief in pure, religious determinism would seem to represent the ultimate in constraint. Few people believe in pure determinism, yet beliefs in the extent of free will do vary, and researchers have moved such beliefs about with experimental interventions (e.g., Vohs & Schooler, 2008). Alquist, Ainsworth, Baumeister, Daly, and Stillman (2015) showed that belief in free will, both manipulated and measured, resulted in greater prevalence of upward, additive, and self-focused counterfactuals. Building on this demonstration, Seto et al. (2015)

showed that individual differences in free will beliefs moderated the impact of counterfactual thinking on meaning in life (cf., [Kray et al., 2010](#)), such that a manipulation of counterfactual thinking centering on major life decisions increased perceptions of meaning for those high but not low in belief in free will. Alquist et al. concluded: “Belief in free will seems to foster a highly functional style of thinking. In this way, individuals and society as a whole may have benefitted from free will beliefs and the counterfactual simulations they stimulate” (p. 281).

It seems from the diverse evidence pulled together in this section that there is substantial support for the main tenets of the functional theory of counterfactual thinking, in particular the assertions that: counterfactual content is goal-centered, situational need evokes counterfactual thinking, counterfactual thinking impacts behavior by way of both a content-specific and content-neutral pathway, and opportunity moderates the effect of counterfactual thinking on behavior. But despite this impressive body of evidence, seismic challenges threaten the heart of the functional theory of counterfactual thinking. Next, we consider this evidence in detail.



4. CHALLENGES TO THE THEORY

The functional theory of counterfactual thinking provides an organizing framework by which wide-ranging findings spanning several disciplines of psychology sharpen into focus. However, not all evidence is compatible with the theory, and indeed some evidence presents sufficiently pointed challenges that the ultimate value of the theory may be questioned. Two lines of challenge are detailed next, one centering on the structural envelope of counterfactual thoughts and the other centering on the link from counterfactual thinking to performance benefits.

4.1 Structural Envelope of Counterfactual Thoughts

In terms of the argument that structure fits function, counterfactual form that is upward, additive, and self-focused is more useful, and hence more likely to be more prevalent at a main effect level (as opposed to counterfactuals that are downward, subtractive, and other-focused). Such patterns are accentuated when the situation at hand involves opportunity. A different way of expressing these ideas is that goal-directed episodic counterfactuals are likely to focus on the means for fulfilling the relevant goal. These means will be presumed (by the individual) to be causally effective and also feasible, i.e., the individual is capable of carrying them out at the appropriate time and

place. Feasibility connects to controllability, and it seems straightforward that for counterfactuals to engender performance improvement, they must center on actions (or situations) that are controllable by the individual. Using the framework of [Weiner's \(1985\)](#) attribution theory, the prediction is that episodic counterfactuals will tend to focus on antecedent elements that are internal, unstable, and controllable (as opposed to external, stable, and uncontrollable). Various lines of evidence show that episodic counterfactual thoughts gravitate toward personally controllable actions that are means to a desired end ([Davis et al., 1995](#); [Giroto et al., 1991](#); [Mandel, 2003](#); [Mandel & Lehman, 1996](#); [Markman et al., 1995](#); [Markman & Miller, 2006](#); [McCloy & Byrne, 2000](#); [McEleney & Byrne, 2006](#); [Roese & Olson, 1995c](#)). Despite this established evidence, newer evidence suggests the contrary that counterfactuals rarely center on personally controllable action. Although direct evidence has yet to appear, one theoretical possibility suggested by this work is that the dominant function of counterfactuals is not preparatory (as we have argued), but rather excuse making (see discussion of other functions in [Section 2.7](#)) and thus self-presentational in terms of centering on the deflection of blame away from the self and onto others.

[Giroto, Ferrante, Pighin, and Gonzalez \(2007\)](#) described a set of experiments that each manipulated whether participants were experiencers or observers; the lab tasks typically involved a blind choice of which task to pursue, a task involving a difficult math puzzle, and bogus failure feedback. The dependent variable was counterfactual thinking, prompted to focus on the upward direction of comparison. These authors concluded in their discussion that participants' counterfactuals "alter uncontrollable events (e.g., 'if I had had a calculator') ... rather than controllable ones" (p. 515), although direct statistical comparisons to support this claim were absent here but presented instead in subsequent papers that we describe below (see also [Pighin, Byrne, Ferrante, Gonzalez, & Giroto, 2011](#)).

More challenging in terms of the structural envelope of counterfactual thoughts was evidence reported by [Ferrante, Giroto, Stragà, and Walsh \(2013\)](#), by way of a paradigm involving an anagram task with accurate feedback, after which participants provided upward counterfactuals in response to a prompt. Coding the counterfactuals as controllable (e.g., mention of concentration, attention, reasoning tactics, etc.) vs uncontrollable (e.g., state, traits, abilities, situational aspects, etc.) by an independent rater revealed a weaker preponderance of counterfactuals focusing on controllable means (25%) than might be expected. A second study, which added the feature that participants had a choice over whether the task was easy or difficult (only

choosers of the difficult task, a minority, were analyzed), resulted in a somewhat higher preponderance of counterfactuals focusing on controllable means (43%), presumably because task choice offered an additional controllable target for participants to focus on. A further paper by [Ferrante, Stragà, Walsh, and Giroto \(2016\)](#) reported a similar laboratory task in which the yield of controllable (vs uncontrollable) counterfactuals was again 25%. Intriguingly, in that same paper, a study of marathon runners reflecting on their performance revealed a very different rate of 68% of counterfactuals focusing on personally controllable actions. In a third paper by [Mercier et al. \(2017\)](#), using laboratory tasks involving word search or syllogisms, the rate of counterfactuals that centered on controllable action hovered between 9% and 35%. An aspect of all three of these papers has been to benchmark the rate of controllable counterfactuals against the rate of controllable pre-factuals (i.e., future-focused if-then contingencies, [Epstude, Scholl, & Roese, 2016](#)); the general finding was that the latter are more likely to focus on controllable actions than the former.

An intriguing puzzle across the above studies is the variability in the proportion of counterfactuals that are controllable, from a low of 9% ([Mercier et al., 2017](#), Study 1b) to a high of 68% (Study 2 in [Ferrante et al., 2016](#)). Obviously, this variability begs explanation, a point to which we shall return subsequently. For the moment, we acknowledge the stark challenge to the functional theory: How can counterfactuals be functional for the self if they do not focus on actions that are directly controllable by the self? We return to this challenge in [Section 6](#). Before then, we find that matters grow worse. A different line of evidence brings a further challenge to the functional theory of counterfactual thinking.

4.2 Link From Counterfactuals to Performance Benefit

In addition to the challenge in terms of the structural envelope of counterfactual thoughts, there is another challenge to the functional theory, centering on the link from counterfactual thinking to performance benefit. In several publications, Petrocelli and colleagues have proffered evidence in which counterfactuals are associated not only with benefit but also rather with diminished performance. This evidence now spans at least four paradigms, each distinct yet all sharing the common element that there is a single decision rule that is not immediately obvious. These paradigms are: bogus stock choice, general knowledge quiz, the Monty Hall problem, and coin flips. We consider each in turn.

In the first paradigm, described in [Petrocelli, Seta, and Seta \(2013, Study 1\)](#), participants engaged in a multiple trial learning task involving bogus stock performance (participants were asked to imagine that they were a stock broker with several years of experience). Within each of a maximum of 30 trials, participants could pick one of two stocks on the basis of graphical evidence of past performance, followed by feedback and further trials. The actual decision rule was simple: superior performance alternated between the two options across trials. If the participant chose correctly on six successive trials, the task ended. For each trial, participants were asked to type some of their prechoice thoughts into a text box; these open-ended responses were later coded for counterfactual content. Importantly, for this learning task, there is only one thing to be learned; that is, there is one useful counterfactual/causal inference, which centers on the alternation rule. Once the rule is learned, the one meaningful counterfactual is “I should have picked the stock according to the alternation rule,” etc., and any other counterfactuals that come to mind will be irrelevant and even detrimental to task performance. The key result was that the more counterfactuals generated, the worse the performance. The number of additive (vs subtractive) counterfactuals did not predict task performance. This result is correlational, and so Study 2 from this paper examined causal direction by manipulating explicit focus on counterfactuals within the same stock-picking paradigm. This counterfactual manipulation did not have an effect on task performance; however, the measured rather than manipulated association between counterfactuals and poorer performance was replicated. Thus, it seems, counterfactuals can coincide with a deleterious effect on learning from experience, and further, a direct manipulation of counterfactual thinking does not invariably spur success.

The second paradigm involved a sequence of general knowledge questions divided into a practice test vs a main test. [Petrocelli et al. \(2012\)](#) again used both correlational and experimental methods for assessing the link from counterfactuals to performance. Task materials derived from standard college admission test exam questions covering English, math, reading, and science. Participants completed the practice test, then received detailed feedback on each of the 16 items that comprised it. At the same time, they were prompted for thoughts (an open-ended measure of counterfactual thinking) in response to each question item. Before the main test, participants were afforded the opportunity to review relevant topics from a study guide. The key-dependent measure was performance on the main test. Importantly, for this general knowledge task there is no obvious

counterfactual that usefully specifies a causally efficacious inference. One might say, “If only I knew the answer” or “If only I were smarter” or “If only I had gotten different questions” but none of these are causally effective. The key mediating behavior under examination in this research was the time taken to peruse the study guide that was made available after the practice test. However, looking at the study guide was not an option for the pretest, hence counterfactuals about the pretest performance cannot translate into intentions to study more next time. Accordingly, the counterfactuals that can be generated here were, for task-specific reasons, less likely to tap into a useful causal inference. As in the previously mentioned stock-picking studies, here again the result was that more counterfactual thinking was associated with weaker performance. Study 2 from this paper introduced an experimental manipulation of counterfactual thinking, and unlike the result for the stock-picking study, here counterfactuals that were prompted experimentally caused weaker performance relative to control participants. Overall, this research further shows that counterfactuals can have a dysfunctional effect on task performance.

The third paradigm to show a dysfunctional effect of counterfactuals on performance involves the Monty Hall problem (Petrocelli & Harris, 2011), a commonly used decision puzzle noteworthy for its resistance to common sense solution (Krauss & Wang, 2003). The Monty Hall problem takes its name from the old television game show called *Let's Make a Deal*, hosted for many years by Monty Hall and involving a choice of one of three doors behind which are prizes of varying value. The specifics of the problem are well described by others (Gilovich, Medvec, & Chen, 1995; Granberg & Brown, 1995; Petrocelli & Harris, 2011), so we need not reiterate them here. Suffice it to say that the Monty Hall problem involves probabilistic judgment with an optimal rule that is difficult to grasp, making it an ideal task in which to observe learning across multiple trials. In the Petrocelli and Harris research, participants worked through 60 trials worth of Monty Hall choices, and after each they gave thought listings that were the basis for measurement of counterfactual thinking. In each trial, participants could win or lose on the basis of their dichotomous choice. Importantly, success on the task is probabilistic but depends on recognizing that one of two options results in better performance on average, an insight that can be learned over trials. Accordingly, there is one causal insight that counterfactuals may embody that may affect success overall. The result, as in the studies discussed previously in this section,

was that counterfactual thinking was negatively associated with task performance. Moreover, participants misrecalled their past reactions in a systematic manner that was fueled by their counterfactual thoughts. In Study 2 of this package, a direct manipulation of counterfactual thinking did not influence performance. Interestingly, a follow-up paper (Petrocelli, 2013) showed that experienced physicians perform no better than college undergrads at the 60-trial Monty Hall task, but this study did not include a measure of counterfactual thinking. Drawing from Monty Hall, then, it again seems that counterfactuals can have a dysfunctional effect on task performance.

The final paradigm involves coin flips (Petrocelli, Rubin, & Stevens, 2016). Participants watched videos of a coin being flipped several times. Most people would readily begin with the default assumption that the coin was fair; however, the coin flip was biased to land on one side about 2/3 of the time. The dependent measure was thus the learning that the coin was biased. Greater frequency of counterfactual thoughts (assessed via self-report ratings) predicted reduced learning of the actual coin flip pattern. In this and the previous papers, a mechanism is suggested that counterfactual thinking sometimes involves the misrecollection of past experience, confusing what could have happened with what should have happened. The resulting inaccurate understanding of contingency might then create an inaccurate causal inference, which then guides behavior that hampers rather than assists performance (Petrocelli & Crysel, 2009). The essential issues raised by this research are how often and under what circumstances will counterfactual thinking involve, on the one hand, misrecollection and, on the other, inaccurate causal inference.

We have now reviewed two lines of research, focusing on the structural envelope of counterfactual thoughts and on the link from counterfactuals to performance that challenge the core ideas of the functional theory of counterfactual thinking. Generalizing from these results, one may conclude that the functional theory has been disproven. Yet, we have also reviewed evidence from the mainstream of social psychology that offers significant support for the theory. As a way of shedding new light on what can only be described as a sobering controversy, we draw on evidence from studies of counterfactual thinking in the disciplines of cognitive neuroscience, developmental psychology, clinical psychology, and health psychology. Might the evidence from these disciplines illuminate these challenges?



5. NEW EVIDENCE FROM OTHER DISCIPLINES OF PSYCHOLOGY

In this section, we take a detour from the consideration of challenges to the functional theory so as to explore evidence from other disciplines of psychology. We begin with cognitive neuroscience.

5.1 Cognitive Neuroscience

What is the neuroanatomical basis of counterfactual thinking? This question fascinates cognitive theorists because counterfactuals are an ideal test specimen among various sorts of mental constructs. They are clearly defined, simple to operationalize, yet also complex in their connection to other such specimens as memory, imagination, and emotion. Moreover, counterfactuals are essential to judgment and decision making. Observing the neuroanatomical concomitants of the creation and elaboration of counterfactuals represents a fascinating window into a key feature of human thinking, one that may even be key to distinguishing human from nonhuman cognition.

Before engaging with cognitive neuroscience research, we briefly review the logic underlying the methods involved. The basic approach is to correlate brain structure with function and to aggregate findings into a brain map of multiple cognitive functions. Within a particular study, participants may perform one or another reasoning or judgment task (e.g., solving multiplication problems, scanning for faces in a matrix of everyday objects, etc.) while at the same time a measurement is taken of differential activation in various locations of the brain. The flipside of an activation method is a deactivation method, in which damage to a specific brain location may be correlated with deficits in one or another reasoning or judgment task. Drawing conclusions from convergent findings in activation plus deactivation methods have been the hallmark of animal research for many decades, in which similar techniques (e.g., electrodes inserted directly into the brain) may be used to achieve both ends (an electrode can measure activation at a specific brain site, but with a stronger current, it can also create a lesion that deactivates, permanently, the functional capabilities of that site). Clearly, animal studies cannot provide much insight into episodic counterfactual thinking, and direct electrode insertion methods cannot ethically be performed on humans. Nevertheless, the corresponding logic for humans is to measure activation (usually with functional magnetic resonance imaging,

or fMRI) and to track deactivation (either resulting from permanent brain injury or from temporary transcranial magnetic stimulation, or TMS). In fMRI, the measure of activation is changes in blood flow to specific brain regions over a matter of seconds, which is assumed to correspond to demand for energy in the form of oxygenated blood: more resource-demanding cognitive activity requires greater momentary intake of oxygenated blood. TMS, by contrast, involves the temporary blockage of neuronal firing (which operates via changes in electrical gradient) by way of a localized, pulsed magnetic discharge. Whereas fMRI has been widely used to understand counterfactual thinking, TMS has not. Yet given the persuasive logic of combining activation and deactivation studies to converge on neuroanatomic conclusions, we expect many such studies to appear in the literature shortly.

In a typical fMRI study of counterfactual thinking, the participant will lay flat on their back inside a large magnetic resonance scanner, often located in a hospital for diagnostic use. Stimuli are provided visually, and the task for participants is either to recall, state, or read an episodic counterfactual or to reason about or state agreement with a semantic counterfactual. The moment of judgment is recorded by a response on a button box, and this moment in time is locked with the fMRI brain scan. A control task must be used, one that is presumed not to involve the content or process of the counterfactual judgment. Scans of differential degree of oxygenated blood within a tightly defined brain region as a function of the counterfactual task and the control task are then averaged over trials, and the result a difference score that reveals how much more blood was needed by this one particular region during the completion of the counterfactual judgment. The counterfactual judgment tasks used in this research must be brief and time locked (to afford measurement by the scanner), which limits the sorts of judgments that can be used by this method. Also, mean responses must usually be averaged over several dozen trials so as to overcome the considerable random error in the measurement process (e.g., any minor head movement can render a trial worthless).

With fMRI, the last 10 years have seen tighter specification of a network of brain structures that underlie representation of counterfactual thoughts. It is useful to step backward to consider the status of thinking immediately prior to this fruitful period of work. In [Epstude and Roese \(2008\)](#), we noted the importance of the orbitofrontal cortex to counterfactual thinking, as demonstrated by several papers available to us at that time (e.g., [Camille et al., 2004](#); [Coricelli, Camille, Pradat-Diehl, Duhamel, & Sirigu, 2005](#)).

The orbitofrontal region is one subregion of the prefrontal cortex, and it is generally accepted that this area involves comparison and calibration of reward-related outcomes, particularly in regards to planning for subsequent action. Newer work has confirmed the role of the orbitofrontal cortex in self-focused, upward counterfactuals, and this evidence includes both imaging studies (Canessa et al., 2009; Chandrasekhar, Capra, Moore, Noussair, & Berns, 2008; Chua, Gonzalez, Taylor, Welsh, & Liberzon, 2009; Nicolle, Bach, Frith, & Dolan, 2011) and lesion studies (Beldarrain, Garcia-Monco, Astigarraga, Gonzalez, & Grafman, 2005; Levens et al., 2014). Another way of conceptualizing the role of the prefrontal region is that it involves error detection (and correction), that is, recognizing when a mistake has been made or nonoptimal reward value has been realized and then formulating adaptive plans. Obviously, these are specifications of goal-related cognition. Within this conceptualization, the missed reward value of upward counterfactuals has been associated with activation in the posterior medial prefrontal cortex (Danielmeier, Eichele, Forstmann, Tittgemeyer, & Ullsperger, 2011), whereas the expected value after loss is associated with ventromedial prefrontal cortex activation (Tobia et al., 2014).

After counterfactual thinking in a simple choice task, the recognition of another option having produced a more rewarding outcome may be followed by switching to that new choice path (often a riskier path). This aspect of translation of counterfactuals into action has been captured at the cortical level, specifically in the frontopolar cortex, the prefrontal region that is dorsal to the orbitofrontal cortex. Boorman, Behrens, Woolrich, and Rushworth (2009) examined brain activation during a series of choices made under uncertainty that could bring monetary reward (e.g., selecting a computer-presented box that would later be revealed to contain or not contain a reward). Participants could learn over time which options would be more likely to bring a reward. As participants learned to favor one or another option (i.e., learned reward value), fMRI tracking showed activation in the frontopolar cortex. By contrast, activation in the ventromedial prefrontal cortex corresponded with the potential reward value that was revealed to participants on each trial. This research thus offered a specification of the brain structures underlying the connection of counterfactuals to goal pursuit.

Imaging studies can shed new light on older puzzles. For example, it has been debated as to whether generating multiple counterfactuals occurs spontaneously for a given outcome, i.e., what weight people give to other counterfactuals beyond the most salient, focal alternative (Lin, Huang, &

Zeelenberg, 2006; Tsiros, 1998). In behavioral studies, it is generally observed that, in response to a prompt, people can generate two or three alternatives with little difficulty. But although people have the capacity to generate multiple counterfactuals in response to failure, there appears to be a privileged status of the best alternative in such relatively simple decision situations, i.e., the most superior of the various upward counterfactual possibilities. In an fMRI study involving choices of objects with shifting reward values (that participants could learn over time), it was the single best unchosen option that corresponded to activation in the lateral frontopolar cortex (Boorman, Behrens, & Rushworth, 2011).

In an influential conception, Knutson, Rick, Wimmer, Prelec, and Loewenstein (2007) specified the bidirectional circuitry between the prefrontal cortex and the nucleus accumbens as pivotal for decision making. The nucleus accumbens is the region that in an earlier era was considered to be the pleasure center, i.e., a region associated with the pure reward value (and attendant emotion of pleasure) associated with positive outcomes. That is, the nucleus accumbens was observed to be active during the experience of primary rewards such as eating food, but also secondary rewards such as receiving money. Newer work suggests that the nucleus accumbens is associated more with anticipated rather than experienced reward (Berridge & Kringelbach, 2015; Henderson & Norris, 2013). Interestingly, a key aspect of upward counterfactuals is the negative emotional consequence, which some have observed as deactivation in the nucleus accumbens, or its larger subsuming structure, the ventral striatum (Nicolle, Bach, Driver, & Dolan, 2010). An important piece of evidence consistent with the functional theory of counterfactual thinking is that ventral striatal activation not only covaries with the magnitude of the value of the upward counterfactual outcome, but this activation also predicts subsequent behavior change (Büchel, Brassens, Yacubian, Kalisch, & Sommer, 2011). That is, in a gambling task conducted during fMRI scanning, across multiple trials, participants made sequential choices and then on each trial discovered how much money they won, but also how much they could have won, had they made a different choice. When participants missed out (and thus presumably generated an upward counterfactual focusing on how much they had missed out), their subsequent gambles became riskier, a behavioral turn that correlated with striatal activation. Thus, nucleus accumbens and ventral striatum are limbic structures that are associated with reward value, and their coactivation with counterfactual thinking corresponds to participants' recognition of the value of losses and missed gains.

Finally, the insula has been associated with opportunity cost of pain of payment. When you decide to give up \$5 to get some ice cream, the momentary feeling of loss of the \$5 may involve insula activation. For example, in an fMRI study involving purchase decisions, these three brain regions predicted purchase above and beyond the role of self-reported shopping preferences (Knutson et al., 2007). However, insula activation has not been associated with the missed opportunity value of upward counterfactual thinking. By contrast, the amygdala, important in the interplay of emotion and memory formation, has been shown to be associated with upward counterfactuals. This pattern has not been widely noted, but complicating such observations is that the amygdala is sensitive to both positive and negative emotional experience, with no distinct anatomical separation of sensitivity by valence (Redondo et al., 2014).

Summarizing thus far the contributions from cognitive neuroscience, whereas upward counterfactual thinking is associated uniquely with orbitofrontal and medial prefrontal cortex activation, the relation of counterfactual thinking to nucleus accumbens/striatal deactivation is nonspecific, with this region being associated with reward and approach responses more generally speaking (Coricelli, Dolan, & Sirigu, 2007).

With the advent of functional imaging has come the increasing realization that mapping of brain structure to function involves networks of interconnectivity among distributed neural structures. How many discrete networks comprise the brain? The answer depends on the level of analysis, of course, but at the broadest level, Yeo et al. (2011) used a comprehensive, large-sample cluster analysis of functional imaging data to specify seven networks. These seven networks were: (1) the visual network, (2) the somatomotor network, (3) the ventral attention network (the so-called “what pathway,” involved with identification of perceptual stimuli), which is defined against the (4) dorsal attention network (the “where pathway,” involved in spatial specification of perceptual stimuli; Goodale & Milner, 1992), (5) the limbic network (involved in reward and related emotional processing and including the nucleus accumbens), (6) the frontoparietal network (engaged when the individual is attending to demanding tasks), and finally (7) the default network (engaged when the individual focuses not on an external task but rather internally, as in self-reflection, daydreaming, or also, importantly, when recalling past episodes or imagining future prospects).

Building against this seven-network framework, several theorists have postulated a core network that both shares aspects of yet is distinct from

the default network (Benoit & Schacter, 2015; Schacter, Addis, & Buckner, 2007; Van Hoeck, Watson, & Barbey, 2015). The core network is engaged when people conduct mental simulations, and this includes counterfactual and prefactual simulation. Moreover, the core network further shares network components that are activated during episodic recall. The core network includes elements of the prefrontal cortex, elements of the hippocampus, the posterior cingulate/retrosplenial cortex, the inferior parietal lobe, and the lateral temporal cortex (Addis, Wong, & Schacter, 2007; Benoit & Schacter, 2015; Coricelli et al., 2007; Schacter et al., 2007, 2012, 2015).

Van Hoeck et al. (2013) showed that counterfactual thinking involves activation in this core network, including unique activation in the left prefrontal cortex, bilateral inferior parietal lobe, right temporal pole, left middle temporal gyrus, and left cerebellum. This study was particularly informative in its use of a counterfactual task in which participants constructed self-relevant episodic counterfactuals while in the scanner (but similar results are obtained with semantic counterfactuals; Van Hoeck et al., 2014). Again, the brain regions associated with counterfactuals connect clearly to those regions involving action control.

The core network includes regions relatively more active during simulation as opposed to memory, the key insight here being that simulation more than memory is action-oriented, as specified by the functional theory of counterfactual thinking. In short, counterfactual simulations involve greater cortical activation relative to that of memory that embraces preparation for future action, including the left dorsolateral prefrontal cortex, the posterior inferior parietal lobe, and aspects of the frontoparietal network (described above as involved when the individual is actively involved in task demands, including planning for reaction; Benoit & Schacter, 2015). Oversimplifying for the sake of clarity, counterfactual simulations involve joint activation of multiple brain networks that interconnect memory and action readiness.

The recognition of a core network feeds the realization that there is striking functional similarity between episodic memory, episodic counterfactuals, and episodic simulation of future events. However, it would be a mistake to equate counterfactuals with all kinds of mental simulation. We suggest that there is strict conceptual separation between counterfactuals and other simulations with regard to a representation of their truth value. Counterfactuals are false by definition—they did not happen in the past, and even if they could have happened, they clearly did not. Most people,

most of the time, have no difficulty keeping separate past events that happened vs could have happened. One is real, the other is false. In this sense, counterfactuals are similar to lies, which are messages aimed at deceiving others but that are well understood by the deceiver to be false (Briazu, Walsh, Deepröse, & Ganis, 2017). At the same time, the causal relation expressed by the counterfactual may well be accurate and may even become more convincing with the passage of time.

Intriguing evidence for the divergence in representations of counterfactuals vs future event simulations came from a paradigm involving the experimental manipulation of repetition of simulation. Spanning multiple events, on a within-subject basis, these hypothetical events were simulated 1 vs 4 times. Repetition increase the perceived plausibility of future event simulations (Szpunar & Schacter, 2013), whereas it decreased the perceived plausibility of episodic counterfactual simulations (and this reduction occurred equivalently for upward and downward counterfactuals; De Brigard, Szpunar, & Schacter, 2013). A key question in making sense of such findings is the definition of “plausibility” in the minds of research participants. In both experiments cited above, participants made a 7-point rating of plausibility, but apparently the word plausibility was not defined for participants, leaving them to their own subjective interpretations. We argue that repetition does not reduce the plausibility of the causal relation expressed by the counterfactual. If a student thinks repeatedly, “If only I had studied more, I would have passed the exam,” the student is indeed likely to reaffirm and reify the causal relation between studying and passing. With repeated thought, the student will naturally conclude that studying “works.” When it comes to the repetition effect on plausibility in the above studies, however, we assume that it reflects participants’ understanding of the likelihood of occurrence. That is, it becomes increasingly clear with repetition that the event described within the counterfactual did not in fact occur, whereas for repetition of future event simulation, the possibility that it may still happen is underscored.

Summarizing, whereas episodic simulations in general embrace brain regions involved in action, counterfactuals are different from future simulations in that increased scrutiny increases the recognition that, in fact, they did not occur. In short, people know on a deeply intuitive level that counterfactuals are not true, yet counterfactuals may nonetheless contain kernels of insight that are potentially useful. Source confusion regarding counterfactuals may occur, but we think only occasionally. That is, misrecollection of a counterfactual as factual is rare in healthy adults, but it may appear with

age-related deterioration in episodic memory (cf., De Brigard et al., 2016), among those suffering from schizophrenia (Contreras et al., 2016), and sometimes in healthy adults challenged by cognitively resource-demanding tasks (Petrocelli & Crysel, 2009). Repetition, as the above results show, works against this sort of misrecollection.

One key feature of counterfactuals, which is often taken for granted and thus rarely explored systematically, is the fact that they are based on comparison processes. Counterfactual thinking involves comparing a mentally simulated outcome to an actual outcome. The comparison process, and indeed the terminology of upward vs downward counterfactuals, draws from an earlier literature on social comparison, i.e., comparing oneself to other individuals (Festinger, 1954; Suls & Wheeler, 2000; Summerville & Roese, 2008). Recent years have seen progress in the study of social comparisons, with a focus on the brain regions involved; the same brain regions appear to underlie both counterfactual and social comparison processes (Kedia, Mussweiler, & Linden, 2014). For example, when comparing celebrities in terms of psychological or physical characteristics, activation occurs in the medial prefrontal cortex, the orbitofrontal cortex, and the nucleus accumbens (Lindner, Hundhammer, Ciaramidaro, Linden, & Mussweiler, 2008). Some research on comparison processes also suggests a general reduction of cognitive effort once comparison processes have taken place (e.g., Mussweiler & Epstude, 2009). Consistent with this view, research using EEG demonstrated an increase in alpha wave activity during comparison processes (Keil, Mussweiler, & Epstude, 2006). Little is known about similar potential effects in the counterfactual domain. It is a task for future research to study the time course of counterfactual processing, as well as the extent of cognitive effort involved.

5.2 Developmental Psychology

The timing at which specific cognitive abilities come online as children grow older is central to developmental research. At what age do children see episodic alternatives to their own actions? At what age can children make inferences about emotions on the basis of counterfactuals, such as in anticipating regret? And at what age do children show adult-like reasoning skills in assessing semantic counterfactuals? Developmental research suggests that these three facets emerge at different ages, and we have arranged them in their temporal sequence. We suggest that each new capability builds upon the platform of the previous cognitive landmark, from (1) episodic

counterfactual thinking and the emotional experience of regret, to (2) inferring and anticipating emotion on the basis of episodic counterfactual judgments, and to (3) reasoning with semantic counterfactuals.

Episodic counterfactual thinking, involving the child's own actions and experiences, appears to be present by age 6, although early forms of counterfactual thoughts, in terms of grasping the notion of "almost," can emerge as early as age 3 (Beck & Guthrie, 2011; Harris, German, & Mills, 1996). Beck, Robinson, Carroll, and Apperly (2006) used a play-oriented paradigm to examine episodic experiences of children. Children were tasked with ensuring that a toy mouse landed safely after sliding down a tubular slide. One of the slides had two exits. The exit could be controlled by adjustable gates. The key finding was that children are able to understand relatively simple counterfactual situations by age 4. Further, the raw emotional corollary of episodic counterfactuals, namely felt regret in response to one's own decisions, is also present by this age (Burns, Riggs, & Beck, 2012; Weisberg & Beck, 2010, 2012). However, when the situation becomes more complex, with multiple possibilities or longer causal chains to consider, children up to age 6 experience difficulty. Thus, it seems a fair conclusion based on current evidence that episodic counterfactual thinking is largely intact by age 6 (Beck & Crilly, 2009; Beck, Riggs, & Gorniak, 2009, 2010).

Episodic counterfactuals connect to goals and performance, as specified by the functional theory of counterfactual thinking. Key evidence on the appearance of this effect came from O'Connor, McCormack, Beck, and Feeney (2015), who used a paradigm in which children chose between two boxes containing valued tokens or stickers. The researchers varied whether children chose a box themselves vs had a box randomly assigned to them. The obtained box contained a less valued prize, whereas the unobtained prize was always of much greater value. Children were asked about their affective response before and after learning about the content of the nonchosen box. On the next day, children participated in the same task again and had the option to adjust their decision from the first day. Results indicate that being actively involved in making the suboptimal decision evoked upward, self-focused counterfactuals (i.e., regret) starting at around age 6. Pivotaly, these same children (starting at around age 6) took the opportunity to adjust their behavior on the second day, specifically as a result of experiencing regret. Thus, this experiment indicated counterfactual-fueled performance improvement, although in this circumstance we cannot be sure whether the effect was content-specific or

content-neutral (or both; see also O'Connor, McCormack, & Feeney, 2014). That regret is experienced at around age 6 is also supported by evidence from risky decision tasks (McCormack, O'Connor, Beck, & Feeney, 2016).

Emotional insights from counterfactuals, such as anticipating regret in others (as opposed to experiencing it first hand in oneself), seems to be a more challenging task for children, as it does not become accurate until age 8 (Beck & Crilly, 2009; Guttentag & Ferrell, 2004). Using another version of the box selection paradigm, McCormack and Feeney (2015) showed that only around the age of 8 are children able to anticipate both regret and relief. Guttentag and Ferrell (2008) asked children to rate different story characters' feelings in response to an event. Some of the stories involved descriptions of negative events that occurred after a typical vs atypical course of events (e.g., having a cycling accident after taking the usual vs an unusual route). At age 5, children had great difficulty in making affective forecasts: they predicted no difference in affective response for characters involved in typical vs atypical events, whereas by age 9 children did indeed predict that affective reactions would be more intense for atypical than typical events, which is the same effect that has been observed with adults (e.g., Kahneman & Tversky, 1982).

Semantic counterfactual thinking becomes adult-like at around age 12. For example, Wimmer and Perner (1983) looked at children's understanding of false beliefs. Children heard a story about "Maxi," who hides chocolate in a specific cupboard. Later and unknown to Maxi, the mother puts the chocolate into a different cupboard. The question then is whether the child can correctly answer where Maxi will look for the chocolate, that is, by taking the perspective of what Maxi can possibly know. Only by the age of 4 or five are children able to answer the respective questions correctly. Such a false belief task can be modified in different ways to study counterfactual thinking (see also Drayton, Turley-Ames, & Guajardo, 2011; Guajardo, Parker, & Turley-Ames, 2009; Guajardo & Turley-Ames, 2004). Rafetseder, Cristi-Vargas, and Perner (2010) adjusted the task in that the focal object (sweets) was hidden in a usual vs unusual location. Also, the location was manipulated to be either within reach of both actors in the story (i.e., a smaller and a taller child) or only within reach for one of the actors (just the taller child). These authors found that children around age 6 had little difficulty in answering simple memory questions (e.g., "Where was the chocolate actually located?") or questions that required simple mental simulations (e.g., "Where would the sweets be found by the child tall

enough to reach them?”). The counterfactual questions referred to an imagined alternative to what was stated as a fact (e.g., “What if the shorter, rather than taller, child had found the sweets?”). Children at age 6 experienced difficulty in producing the correct answer for this counterfactual question. In further studies in a comparable paradigm, it was found that only at the age of 12 did children show counterfactual reasoning that was truly comparable to adults (Rafetseder, Schwitalla, & Perner, 2013). Semantic counterfactual thinking may, however, be amplified at earlier ages by giving children conceptual tools to aid in their expression (e.g., Beck, Carroll, Brunson, & Gryg, 2011).

Overall, developmental research holds up an ontogenetic mirror to the observation that counterfactual thinking is primarily about goals. Specifically, episodic counterfactual thinking emerges as a product of goal cognition, and infants of only a few months hold goals (e.g., to eat, to approach or grab interesting objects, etc.). As verbal ability develops, so too do the lexical descriptors for recognition of “almost” and “might have been.” Each new cognitive capability builds upon the platform of the previous cognitive landmark, from (1) episodic counterfactual thinking and the emotional experience of regret (age 6), to (2) inferring and anticipating emotion on the basis of episodic counterfactual judgments (age 8), to (3) reasoning with semantic counterfactuals (age 12). By age 8, counterfactual thoughts emerge spontaneously in response to blocked goals (Guajardo, McNally, & Wright, 2016). Each stage, progressing from episodic to semantic counterfactual reasoning ability, trends from a platform of goal cognition. Overall, new insights from developmental psychology provide substantial support for the functional theory of counterfactual thinking.

5.3 Clinical Psychology

In our 2008 paper, we proposed a framework to relate counterfactual thinking to mental health by way of the functional perspective. In particular, we drew a broad distinction between an excess vs deficit in counterfactual thinking, positioning healthy psychological functioning at the midpoint of a spectrum of activation of counterfactual thinking. Thus, counterfactual dysfunction is distinctive either in terms of its excess (as in depression and posttraumatic stress syndrome) or its deficit (as in schizophrenia). We reiterate:

If the principal consequences of (upward) counterfactual thinking are problem-solving insights and negative affect (stemming from the contrast between

factuality and a better alternative), then excessive counterfactual thinking may be associated with excessive problem-focused cognitions (e.g., worry, anxiety) and excessive negative affect (e.g., dysphoria, depression). By contrast, a deficit of counterfactual thinking would be associated with a deficit of problem-focused cognition (e.g., underachievement, work difficulty, social dysfunction), along with an absence of negative affect.

Epstude and Roese (2008, p. 182)

As discussed below, the 10 years of evidence accumulated since we penned those words have largely justified the ideas. A point worth clarifying in the above phrasing is schizophrenia is commonly associated not so much with absence of negative affect, but more tellingly with flat affect, which means either emotional unresponsiveness or inappropriate emotional displays.

We now add a further clarification that broadens the connection of the functional theory to psychopathology. We have already distinguished between the activation of counterfactual thinking in terms of excess vs deficit; another of way stating the distinction is hyperactivation vs hypoactivation. In parallel fashion, we may use the same to distinguish the deployment stage, that is, the connection of counterfactuals to behavior, usually by way of the content-specific pathway. If one has a counterfactual in mind, even if it is highly useful, it will do nothing for behavior if it is not successfully deployed in the service of reaching a goal. Although we do not suggest a case of an excess of deployment (which is, frankly, difficult to conceptualize), it makes good sense to distinguish between normal deployment vs a reduction or even absence of deployment. Thus, we may distinguish among those having frequent counterfactual thoughts for whom counterfactuals are deployed vs hypodeployed, and as we shall see, this added distinction helps to make sense of a variety of findings in psychopathology that have appeared since our 2008 paper.

Turning first to depression, our 2008 paper noted several demonstrations of an association between depression and hyperactivation of counterfactual thinking, especially of the upward rather than downward form (e.g., [Davis et al., 1995](#); [Lecci, Okun, & Karoly, 1994](#); [Monroe, Skowronski, MacDonald, & Wood, 2005](#); [Wrosch, Bauer, Miller, & Lupien, 2007](#)). For example, among breast cancer patients, depression was associated with more frequent upward but not downward counterfactuals ([Gilbar & Hevroni, 2007](#)). In a representative sample of adult Americans, depression was associated with more intense regrets (which embody upward, self-focused counterfactuals), especially among individuals with a tendency

toward repetitive thought or rumination (Roese et al., 2009). Such evidence exemplifies the notion that depression involves hyperactivation of upward, self-focused counterfactual thinking.

Newer evidence coincides with these observations of hyperactivation. Among women breast cancer patients who had undergone mastectomy surgery, depression was associated with regret (Sheehan, Sherman, Lam, & Boyages, 2007; see also Zhong et al., 2013). Among those at risk for suicide, depression was again associated with regret (Bruine de Bruin, Dombrovski, Parker, & Szanto, 2016). In a meta-analysis of 42 effect sizes, Broomhall et al. (2016) reported a moderate positive relation between depression and upward counterfactual thinking (see also Howlett & Paulus, 2013). Despite the persuasiveness of this metaanalytic conclusion, not all evidence is consistent with hyperactivation: A study by Chase et al. (2010) found hypoactivation, in that depression corresponded with lower, not higher, self-reported regret. The procedure for assessing this relation involved a multiple trial gambling task for which participants got feedback on missed opportunities and provided affective self-reports on a per-trial basis, so this particular method may perhaps not be ideal for capturing the broader life regrets that are typically found in depressed individuals. This study also reported that regret scores correlated with apathy ratings, suggesting that depressed patients simply did not care about the hypothetical gambles they were forced to make.

Evidence also points to hypodeployment of upward counterfactuals by depressed individuals. Further, the counterfactual thoughts generated by depressed (vs nondepressed) individuals tend to be less useful for guiding future behavior (Markman & Miller, 2006). Among those suffering from recurrent pregnancy miscarriage (Callander et al., 2007), upward counterfactual thinking was frequent but unrelated to future plans and search for meaning. Using a laboratory thought induction of counterfactual (vs control) ideation in response to school performance, depressed students showed no correlation between intentions to improve and their subsequent behavior, whereas among nondepressed participants, this correlation was indeed evident (Quelhas, Power, Juhos, & Senos, 2008). Thus, the content-specific pathway was absent among depressed people, but verified for nondepressed people. Finally, in a sample of Israelis who had been victimized by a terrorist attack, counterfactual thinking was prevalent and linked to distress (Gilbar, Plivazky, & Gil, 2010), but was predictive of emotion focused rather than problem-focused

coping. In other words, counterfactual thinking among these traumatized individuals was less likely to connect to direct action. We hesitate to draw firm conclusions from this finding, because there are so many factors that differentiate between the circumstances of those living with and without threat of terrorism.

Schizophrenia is a profound disorder of basic thought processes (Fusar-Poli et al., 2007; Shad, Tamminga, Cullum, Haas, & Keshavan, 2006). In our 2008 paper, we noted the seminal work that documented an impairment of counterfactual thinking among those with schizophrenia (Hooker, Roese, & Park, 2000). One of the tools developed for that initial study was the counterfactual inference test (CIT), a 4-item measure which took robust counterfactual effects from 1980s era research and plugged them into true-false questions; many healthy respondents will answer all questions correctly and achieve a score of four, whereas those with impaired counterfactual thinking will much lower: Schizophrenia patients averaged a CIT score of 1.3, compared to case-matched controls who scored 2.3, and undergraduate students who scored 3.5. Contreras et al. (2016) replicated this CIT result and found further support among other measures. Interestingly, the same research team (Albacete et al., 2016) noted that blood relatives of schizophrenia patients score somewhat better on tests of counterfactual thinking than the latter, but worse than healthy control participants, underscoring the heritability of schizophrenia. This research collectively suggests that schizophrenia is associated with hypoactivation of counterfactual thinking, which may contribute to the impairment in social functioning suffered by people with schizophrenia. Similar hypoactivation of counterfactuals occurs in individuals with other neurodegenerative disorders, such as Parkinson's (McNamara, Durso, Brown, & Lynch, 2003) and Huntington's (Solca et al., 2015).

In addition to hypoactivation of counterfactual thinking in schizophrenia, there is the further observation of hypodeployment of counterfactuals. Whereas Brandstätter, Lengfelder, and Gollwitzer (2001, Study 2) demonstrated that the link from behavioral intentions to behavior is intact among people with schizophrenia, a subsequent study by Roese, Park, Smallman, and Gibson (2008) showed that it is the link from counterfactuals to behavioral intentions that is disordered. This finding points to a volatile effect of counterfactuals on behavior in schizophrenic patients. A sequential priming task that tracked the facilitation by counterfactual inferences of behavioral intentions showed no effect, where that

same effect was significant among healthy individuals. As we noted in our 2008 paper:

This research revealed that the link between counterfactuals and intentions is indeed broken for people with schizophrenia. If this link had been intact, the finding might have suggested the straightforward efficacy of a counterfactual therapy designed to increase counterfactual thoughts oriented toward everyday social interactions. Unfortunately, these results indicated instead that such an intervention would be futile. If counterfactual thoughts do not influence intentions, performance improvement is unlikely to result.

Epstude and Roese (2008, p. 183)

Trauma and its most recognized psychological aftermath, posttraumatic stress disorder (PTSD), are related to depression in terms of feelings of distress and anxiety. Research has established the link between trauma and hyperactivation of upward counterfactual thinking (Blix et al., 2016; Branscombe, Wohl, Owen, Allison, & N'gbala, 2003; Dalgleish, 2004; Gilbar et al., 2010). A key aspect of PTSD is ruminative or repetitive thinking, and we previously noted that counterfactuals that are repetitive are particularly predictive of general distress (Roese et al., 2009). Psychometric development in self-report scales has clarified that counterfactual thinking is one of several components of rumination (Brinker & Dozois, 2009; Tanner, Voon, Hasking, & Martin, 2013; see Watkins, 2008, for a general review of the repetitive thought construct). Using the newer measurement instrument, Mitchell, Contractor, Dranger, and Shea (2016) noted that counterfactual thinking uniquely predicts the aspects of intrusive thoughts and behavioral avoidance among PTSD sufferers (while controlling for depressive symptoms). This evidence constitutes further instantiation of the idea that pathology in counterfactual thinking can combine hyperactivation with hypodeployment.

Proximity to a terrifying event may sometimes be traumatizing, sometimes not. In the absence of PTSD, different forms of counterfactual thinking may occur. Teigen and Jensen (2011) surveyed Norwegians who had closely witnessed the disaster of the December 2004 Tsunami that hit Thailand, because they had been vacationing there. The predominant reaction was largely one of relief and not regret, and downward counterfactuals ("it could have been so much worse for me or my family," etc., scored from spontaneous mentions in interviews) outnumbered upward counterfactuals by a factor of 10 to 1. As in other research (Blix et al., 2016; McMullen & Markman, 2000), the conclusion here is that close-calls can directly evoke counterfactuals, and although connected to goals in the broader sense (here, the goal of survival), there is no connection of such counterfactuals to subsequent action.

5.4 Health Psychology

We have already outlined earlier that, in many situations, individuals form counterfactuals that are linked to their own behavior. Although our main argument is that counterfactuals are largely beneficial, the functional theory certainly recognizes that there are instances when counterfactuals have dysfunctional consequences, and thus a key question is which moderators account for functional vs dysfunctional consequences. As one example of dysfunction noted already, trauma can evoke self-focused counterfactuals, as with parents who have lost a child and torment themselves with “if only” recriminations even though an outside observer might hold them blameless (Davis et al., 1995). When it comes to medical conditions that affect the individual personally, the extent to which the current state is seen as avoidable (and therefore, under our definition, a state of opportunity) predicts the degree to which individuals blame themselves (Davis et al., 1996).

Recent research underscores the benefits of counterfactual thinking in health-related domains. Epstude and Jonas (2015) examined a sample of men who tested positive for the human immunodeficiency virus (HIV); their infections had been obtained through unprotected intercourse. Counterfactual thoughts were common, in which participants reported ways that they might have avoided becoming infected. As predicted by the functional theory, counterfactual thoughts that “undid” their infection predicted intentions to use condoms in the future. At the same time, the upward counterfactual thoughts reported by participants were detrimental to their emotional well-being. With this severe health threat, the preparative function of counterfactual thinking was indeed dominant over any affect-regulating properties of counterfactuals.

Given the prominence of counterfactual thinking among those suffering a health threat, the issue is raised as to whether counterfactuals may be utilized as an intervention designed to increase beneficial behaviors. Such an intervention may backfire, in that counterfactuals may sometimes be associated with weaker rather than stronger health-benefiting behaviors. For example, in research conducted among those at high risk of contracting a sexually transmitted disease (sex party attendees), Jonas and Epstude (2016) found that participants reported a substantial number of counterfactuals focusing on past sexual practice, but these were linked to a decrease in the intentions to use a condom. Examining the goals operating in this situation revealed health preservation was less important to participants than purely hedonistic goals (e.g., how to have more sexual interactions during the party).

Ramos et al. (2016) tested how counterfactual thoughts would affect attitudes toward abuse of medication intended for attention-deficit hyperactivity disorder (ADHD). Among college students, many feel it perfectly acceptable to use ADHD medication (such as Adderall) as a study aid; the medical community considers this an abuse of the medication. When college undergrads were presented with a scenario containing a negative outcome stemming from ADHD abuse (having to go to the hospital due to side effects), and at the same time were prompted to consider counterfactual alternatives to the outcome, attitudes toward ADHD medication became more positive. That is, in emphasizing a counterfactual outcome, the authors found that even with a positive goal in hand (e.g., getting good grades), counterfactuals may strengthen intentions for suboptimal behaviors in order to reach that goal. The takeaway from these two lines of research is that a clear understanding of the goal operative in a particular situation clarifies the functional role of counterfactual thinking. With the Jonas and Epstude findings, we see that counterfactuals connecting to a vice (vs virtuous) goal can result in problematic outcomes, and with the Ramos et al. findings, we see that even if one has a more virtuous goal, counterfactuals may strengthen intentions to focus on less virtuous means to reach that goal. Together, these findings further emphasize that counterfactual thoughts do not invariably trigger performance-facilitating behaviors, a point to which we will return in [Section 6](#).

To summarize, the functional theory of counterfactual thinking provides a framework for understanding the place of counterfactuals within various kinds of psychopathology. Far from a random or indistinct pattern, the preponderance vs absence of counterfactual thinking coheres around a spectrum in which the normal functioning of counterfactuals with regard to goal-directed behavior sits at the center, with greater extremes of each pole represented by either excess or absence of counterfactuals (i.e., hyperactivation vs hypoactivation). Orthogonally, counterfactuals may be deployed to further behavioral goals, or not. Putting these points together, dysfunction may come from too many (e.g., depression, trauma), too few (e.g., schizophrenia), or inadequately deployed counterfactuals (e.g., schizophrenia).



6. SYNTHESIS AND REVISED THEORY

Counterfactual thinking involves reflections and elaborations on pasts that never were. For the most part, these musings focus on alternatives to events stored in episodic memory and connect to goals such that the counterfactual specifies how a desired end state might have been achieved. This

depiction forms the heart of the functional theory of counterfactual thinking, and in previous sections we have reviewed new evidence relevant to the theory, first in terms of core evidence deriving primarily from the social psychology literature, and then from related literatures in cognitive neuroscience, developmental psychology, clinical psychology, and health psychology. Altogether, we have profiled over 100 empirical papers inspired by and/or significantly illuminated by the functional theory of counterfactual thinking. At the same time, we also confronted significant empirical challenges. How might we reconcile these conflicting bodies of evidence? In this section, we pull together the various strands of evidence to create a new synthesis and revision of the theory, one which we hope may prove useful in guiding future research.

6.1 Synthesizing Insights From Other Disciplines of Psychology

Neuroimaging research has blazed an exciting trail of new research that underscores the usefulness of the functional theory of counterfactual thinking. The new evidence favoring the theory can be concisely summarized as follows: the brain structures active during counterfactual thinking overlap with those active during goal-oriented cognition.

To briefly reiterate the picture, one line of work shows that the orbitofrontal cortex is active during self-focused, upward counterfactuals (Canessa et al., 2009; Chandrasekhar et al., 2008; Chua et al., 2009; Levens et al., 2014; Nicolle et al., 2011). The orbitofrontal region is a component of the larger prefrontal region, which involves specific sites active in error detection, i.e., recognizing when a mistake has been made and then formulating plans for corrective action. The missed reward value of upward counterfactuals associates with activation in the posterior medial prefrontal cortex (Danielmeier et al., 2011). Further, the recognition of an upward counterfactual connects to behavior change: Boorman et al. (2009) showed that fMRI-tracked activation in the frontopolar cortex corresponds uniquely with the relative increase in reward value contained in switching to an unchosen alternative. Another key observation is that ventral striatal activation not only covaries with the magnitude of the value of the upward counterfactual outcome, but this activation also predicts subsequent behavior change (Büchel et al., 2011). Finally, and perhaps most significantly, the recent specification of the core network (Benoit & Schacter, 2015; Van Hoeck et al., 2015), engaged when people conduct mental simulations, represents a significant theoretical advance in that it is now understood to be a

network of cortical structures that overlap with those active in error detection, planning, and action control (Addis et al., 2007; Coricelli et al., 2007; De Brigard, Addis, et al., 2013; Schacter et al., 2015; Van Hoeck et al., 2014, 2013). Taken together, these strands of neurocognitive research offer strong support for the functional theory of counterfactual thinking by specifying the neuroanatomical underpinnings of the counterfactual–behavior link.

As informed by cognitive neuroscience research, there is an interesting tension associated with the conceptual distinction between counterfactual thinking and other forms of mental simulation, such as the imagination of future or prefactual events. On the one hand, all mental simulations share the aspect of connection to a core network of cortical structures that are active during such thought processes. We know also that the basic toolkit of mental simulation involves the dissection and reassembly of episodic memories, which depends on a similar cortical network. Of the structures involved across counterfactual, future simulation, and episodic recall, there is overlap but not a one-to-one mapping, indicating that these are distinct mental operations that share a family resemblance. At the same time, key differences have been observed. For example, experimental manipulations of thought frequency have revealed an intriguing divergence, such that repeated future event simulation increases their perceived plausibility (Szpunar & Schacter, 2013), whereas the same manipulation decreases the perceived plausibility of counterfactual simulations (De Brigard, Szpunar, & Schacter, 2013; see also Stanley, Stewart, & De Brigard, 2016). As we noted previously, we may interpret participants' subjective self-reports of plausibility as reflecting perceived likelihood of occurrence. Thus, repetition has the effect of making it increasingly clear to participants that the counterfactual did not, in fact, occur, whereas for future event simulation, repetition reminds them that the event in question will still occur. However, these plausibility judgments apparently do not reflect confidence in causal insight, which we suggest increases with repetition for any type of mental simulation.

We believe that this work on the effect of repetition on perceived plausibility can shed some light on research that has challenged the functional theory by revealing instances in which counterfactual thinking hampers rather than helps performance (e.g., Petrocelli & Harris, 2011; Petrocelli et al., 2013, 2012). One reason why such an effect may occur, as argued by these authors, is that counterfactuals can cause the misrecollection of prior instances, thus resulting in inaccurate causal inference (Petrocelli & Crysel, 2009; Petrocelli et al., 2016; see also Shidlovski, Schul, & Mayo, 2014). The key issues raised by these findings are how

often and under what circumstances will counterfactual thinking involve, on the one hand, misrecollection and, on the other hand, inaccurate causal inference?

We argue that episodic counterfactual thoughts tend to be evoked in direct response to a particular outcome, and the counterfactual form tends to be constrained by reality such that usually only one detail is altered. Yet, for most people and most of the time, there is a clear recognition that the counterfactual is false. It could have happened, yet it clearly did not happen. It is possible that there is a “falsity tag” on counterfactual thoughts, a conceptual associative linkage in memory that marks the counterfactual as having factually not occurred (although, as we have noted, the underlying causal inference may well be accurate). Drawing repeated attention to the counterfactual serves to strengthen the associative link between the counterfactual and its falsity tag, thus underscoring its status as having never happened. Future event simulations, including prefactuals and intentions, are typically not benchmarked against an evoking factual event. Rather, they focus on some particular episode that may happen, but perhaps with important details left out. Repeated attention then fuels further elaboration of detail, enhancing judgments of plausibility (or, as the case may be, likelihood). At the end of the day, counterfactuals are useful because they stimulate further thought that can feed into goal pursuit. Although we recognize that misrecollection can occur, we reiterate our earlier claim that it is rare among healthy adults.

Insights from developmental psychology echo the above ideas. The progression of development of cognitive abilities seems to mirror a progression from early awakening of basic goals, followed by successively more sophisticated mental articulation of episodes. Episodic counterfactual thinking emerges as a product of goal cognition, and three landmark stages emerge as follows: (1) episodic counterfactual thinking and the emotional experience of regret (age 6), then (2) inferring and anticipating emotion on the basis of episodic counterfactual judgments (age 8), and then (3) reasoning with semantic counterfactuals (age 12). Each stage, progressing from episodic to semantic counterfactual reasoning ability, springs from a platform of goal cognition. The development stages of cognition provide nuanced new support for the functional theory of counterfactual thinking.

In clinical and health psychology, the role of distorted causal assessment and ruminative tendencies can be illuminated by specification of dysfunctional variants of normally functional counterfactual thinking. Thus, in depression and trauma, we see a hyperactivation of upward episodic counterfactual thinking (Blix et al., 2016; Chase et al., 2010; Feng et al., 2015;

Gilbar et al., 2010; Howlett & Paulus, 2013; Roese et al., 2009). By contrast, in schizophrenia, Parkinson's, and Huntington's disorders, we see a hypoactivation of counterfactual thinking, which accompanies deficits in daily functioning (Contreras et al., 2016; McNamara et al., 2003; Roese et al., 2008; Solca et al., 2015). When counterfactuals are either activated or deployed in a manner distinctly different from healthy individuals, problematic social functioning appears. Further, depending on whether counterfactuals heighten or reduce performance-facilitating intentions, different sorts of outcomes for the individual may obtain (Epstude & Jonas, 2015; Jonas & Epstude, 2016; Ramos et al., 2016). But the question remains, what can account for variability in whether counterfactuals take a form that is conducive to benefit, and whether the counterfactual actually does bring about performance improvement? We next revise the functional theory of counterfactual thinking with additional postulates that address these questions.

6.2 Two Steps Necessary for the Content-Specific Pathway

We proceed with a revised version of the functional theory that clarifies the connection of counterfactual thinking to goals and behavior. First and foremost, we propose that counterfactual thinking is a conscious reflection of deeper implicit processes that cross-connect covariation detection, causal inference, and goal cognition. Counterfactuals of an episodic nature may be easily discussed in everyday language and thus easily shared with others. However, the consciously verbalizable form of a counterfactual insight is a derivation of an implicit process that drives causal inference. Now, some causal inferences are accurate and some are inaccurate, and the literature is replete with examples of biased and faulty causal reasoning. Nevertheless, a great many causal inferences are accurate and reflect computations of contingencies gleaned from observations of covariation over time. The counterfactuals that reach our conscious thoughts and our tongues are surface reflections of these implicit reasoning dynamics. The point is that our crude self-report measurements of counterfactuals do not guarantee a faithful assessment of those underlying processes. Further, experimental attempts to manipulate counterfactual thinking must by necessity aim for the conscious, verbalizable form of counterfactuals, yet may leave untouched the underlying process. Similar to medicine that treats a symptom rather than the underlying cause, such counterfactual manipulations may only scratch at the surface and leave untouched the deeper mechanics of causal reasoning.

Stated differently, in attempting experimentally to activate or prompt counterfactual thinking, there is no guarantee that an accurate causal inference will be formed and successfully deployed. This characterization helps to explain, in part, the variation in results of experimental manipulations of counterfactual thinking, some of which have resulted in performance benefits (Dyczewski & Markman, 2012; Markman et al., 2008; Morris & Moore, 2000; Myers et al., 2014; Reichert & Slate, 2000; Roese, 1994), whereas others have resulted in performance decrements (Petrocelli et al., 2012) or no effect at all (Petrocelli & Harris, 2011; Petrocelli et al., 2013).

Formalizing these ideas, there are at least two critical steps that are necessary for a counterfactual to have a content-specific effect on behavior: causal inference accuracy and deployment of the inference in the service of subsequent action. By causal inference accuracy, we mean whether or not the counterfactual specifies a causal relation that maps onto an objective reading of causal contingency. By deployment, we mean whether or not the insight contained in the counterfactual is used or ignored. When landing an aircraft (as in Morris & Moore, 2000), pilots have the goal to land safely. The outcome in question may vary in success (how closely the aircraft matches an ideal glide path), but the dichotomous outcome of safe landing vs crash is perhaps the more succinct specification of the operative goal. There are multiple causal contingencies involved that spell the difference between a safe vs a crash landing. If one performs the correct, time-tested actions, there will be a safe landing. Neglect those actions, or introduce new and unreasonable actions, and there will be a crash landing. For a novice pilot attempting a landing in a computer flight simulator, the absence of deep expertise means that any number of causal principles might be deployed to facilitate or hinder landing. For example, lowering the aircraft's flaps has the causal effect of increasing lift from the wings, essential when reducing speed for landing. Lowering flaps, therefore, has the causal effect of facilitating a safe landing. Neglecting to lower flaps increases the risk of a crash. Similarly, rate of descent can be monitored and adjusted to maintain an ideal glide path; too great a rate of descent will increase the risk of a crash. Learning represents the successive acquisition of each of these causal contingencies, and expertise results from the collective understanding of the multiple causal contingencies. For a novice pilot to note explicitly, "I would have made a better landing if I had remembered to lower my flaps" means that the novice pilot has learned one causal contingency that maps onto empirical fact. For another novice pilot to note, "If I only I had turned the volume up on my 80s rock music playlist, I would have made a better landing" is clearly an example of

an inaccurate causal contingency. Deploying that causal contingency in a subsequent landing attempt will have zero impact on performance.

In this example of attempting to land an aircraft, the goal to land safely has a clearly identifiable outcome. However, in many other situations, goals are perhaps less clear, with outcomes that are not dichotomous. For example, receipt of negative feedback at work may motivate various sorts of future behaviors. Individuals may try to adjust their performance (under the goal of being a good employee), or they may decide to leave the company (under the goal of exerting control of one's career). Both actions may be deemed "accurate" in the sense that the actions have a causal effect on producing the respective goals, but this of course means taking into account the fact that different goals are operative. The key point is that the causal inference formed by an individual must be considered in light of the goal that underlies the inference process. In our previous paper, we used the term "pragmatic accuracy" to describe this idea (Epstude & Roese, 2008). In short, accuracy must be considered in terms of both the situation and the currently active goals.

To summarize, there are two clear steps that are necessary for counterfactuals to improve performance:

Causal inference accuracy. The counterfactual must embody a valid antecedent-consequence linkage. There are many ways that causal inferences might be accurate (e.g., via balanced acquisition of covariation information), and there are many ways that causal inferences might be inaccurate (e.g., biased by being at odds with real-life demands), but for a counterfactual to have a positive impact on performance, it must be accurate.

Deployment. The insight derived from the counterfactual can be used to guide behavior, or ignored. It is necessary for the counterfactual to be deployed as a guide for subsequent behavior (i.e., by feeding into pre-factuals or behavioral intentions) in order to have a positive impact on performance.

In general, we assume that the vast majority of self-focused upward counterfactuals meet the two criteria. The specification of the two steps instantiates the theoretical differentiation between activation and application, a notion that has illuminated the circumstances under which stereotypes can result in prejudiced behavior (e.g., Gilbert & Hixon, 1991) or when knowledge of personal bias or outside influence will be used to recalibrate judgment (e.g., Wegener & Petty, 1997). The specification of these two steps helps to resolve the discrepant findings provided by Petrocelli and

his colleagues, in the sense that the first step of causal insight accuracy was not achieved. The various paradigms used by Petrocelli share one key feature: they all involve a simple causal situation, one that is marked by a single causal contingency. For example, in the stock-picking task, there is single rule that guides the outcome. If participants learn it, they succeed, and if they do not, they underperform. Each participant can only learn the rule once. Similarly, in the Monty Hall problem, there is also a single rule, which past research has shown to be remarkably difficult to learn. In these cases, it is clear that measurement of counterfactuals picks up a blend of accurate and inaccurate causal inferences. If on balance the causal inferences are correct, we may see a positive effect of counterfactuals on performance. But if the causal inferences are largely inaccurate, we will see a negative effect of counterfactuals on performance. Of course, even if counterfactuals are largely accurate within a given research paradigm, there is still no guarantee that the insight will be deployed in the service of subsequent behavior.

6.3 Simple vs Complex Domains

The further challenge coming from work by Petrocelli is the manipulation of counterfactual thoughts. Here, we must probe deeper into the underlying meaning of a counterfactual thought induction manipulation. As we stated previously, counterfactuals are conscious, verbal reflections of a deeper, implicit process. The counterfactual induction cannot be more than an imprecise, ham-fisted bludgeon that pushes the surface level thought structure around while having lesser effect on the underlying process. In short, there is no guarantee that a counterfactual induction will push people to form a more accurate causal inference. That is to say, there is no guarantee that a counterfactual induction, which targets the surface level of verbal responding, will extend deeper to unleash implicit processes of covariation detection. Moreover, and this is the key point, when an experimental induction of counterfactual thinking is deployed in a unicausal domain, it is more likely to lead to distraction and error than accuracy. Take, for example, a participant in the study with the stock-picking problem (Petrocelli et al., 2013). Perhaps some participants accurately surmised the decision rule and used it to their advantage. Next comes a counterfactual induction of what the participant might have done differently. The resulting thought would be to consider a second or third causal contingency that is present, but not accurate. In this case, the counterfactual induction has pushed counterfactual thinking in an inaccurate direction, which is the only direction possible with a simple,

single-cause domain (once you have learned the one correct answer, every other answer you come up with will be wrong). By contrast, in a more complex multicausal situation, such as in the flight simulator example, the counterfactual induction has at least a fighting chance of locating a second or third causal contingency that is also accurate. As a result, we formalize this reasoning in a second refinement of the theory.

The content-specific pathway by which counterfactuals may influence behavior is more likely to produce performance benefit within multi-causal than uni-causal domains.

We argue that this specification of moderation by domain, in terms of whether the environment in which the individual operates is characterized as simple vs complex, explains the discrepancy in results between those that have shown a beneficial effect of counterfactuals on performance (Dyczewski & Markman, 2012; Markman et al., 2008; Morris & Moore, 2000; Myers et al., 2014; Reichert & Slate, 2000; Roese, 1994; Wong, 2010) vs a null effect or performance decrement (Petrocelli & Harris, 2011; Petrocelli et al., 2013, 2012). When the domain is simple and unicausal, measuring spontaneous counterfactuals may tap variability in causal accuracy, which may or may not connect to performance. When the domain is simple, the manipulation of counterfactuals will have an effect that is deleterious to performance. By contrast, when the domain is complex and multicausal, again spontaneous counterfactuals will vary in causal accuracy, and measurement specific enough that it captures accuracy will show a relation to performance. But more important, when a counterfactual induction is used in a complex domain, the manipulation will push individuals to further conscious deliberation, which may well allow them to pick up on additional causal contingencies that will prove accurate and useful (content-specific pathway). By contrast, the content-neutral pathway can enhance performance independently of whether the domain is unicausal vs multicausal.

This same reasoning regarding simple vs complex domains helps us to understand the discrepant results reported by Ferrante et al. (2013, 2016) and Mercier et al. (2017). Recall that their key observation was that the proportion of counterfactual thoughts generated by their participants that focused on personally controllable actions was small, hovering around 25%, but with notable variability across studies. The functional theory of counterfactual thinking offers the principle of form follows function, which means that the content of counterfactuals tends, on average, toward a form that is amenable for subsequent goal pursuit. For example, counterfactuals are more useful if they are upward than downward and more useful if they focus on internal rather than other-focused actions. We have already

reviewed a range of evidence that suggests that counterfactual form indeed follows function, and so how can we best understand the discrepant findings reported by the above authors? We argue that a first clue is to be found in the variability in proportion of counterfactuals that are controllable across their studies. In laboratory studies involving word puzzle decisions, proportions become larger when participants are given a further choice as to whether their task was easy or difficult (43%, Ferrante et al., 2013, Study 2) and becomes larger still among marathon runners asked to reflect on their training and performance in an activity about which they are clearly passionate (68%, Ferrante et al., 2016, Study 2). We argue that a determinant of this variability in whether counterfactuals specify controllable actions is the degree to which the domain itself is one that is largely self-initiated and complex vs experimenter-initiated and simple. In the latter case, participants are thrown into a peculiar laboratory situation at the behest of experimenters who control the strings. Little wonder that participants' counterfactuals that undo a negative laboratory outcome focus on the peculiarity of the situation. By contrast, when participants self-initiate a more complex activity with multiple facets under their control (e.g., running a marathon, landing an aircraft, performing on stage), we expect that failure-evoked counterfactuals will focus largely (and by largely we mean a two-thirds majority) on personally controllable actions (using Weiner's framework, the counterfactuals will tend to be internal, unstable, and controllable).

Stepping back and gazing from a high vantage point across the various research threads constituting (a) the core evidence for the theory from social psychology, (b) the challenges to the theory in terms of new evidence on the structural envelope of counterfactual thoughts and on cases in which the link from counterfactuals to performance is one of deterioration rather than benefit, and (c) the various evidence from other disciplines of psychology, we see a general picture that is largely supportive of the functional theory of counterfactual thinking. Nevertheless, the new evidence has pushed us to reconsider and then reconceptualize aspects of the theory. It is our hope that these revised theoretical ideas will prove useful in guiding another decade or more of basic research into counterfactual thinking.



7. CODA

Counterfactual thinking is a common part of the mental landscape (Summerville & Roese, 2008). Yet no more vivid instantiation of the

observation that counterfactuals are about goals can be had than the depiction of counterfactual worlds in fiction (Roese & Morrison, 2009). Stories of alternative history have been a staple genre for decades, and the last year has seen three entertainment properties reach new audiences with their thought-provoking portrayals of what might have been. Originally written in 1962, Philip K. Dick's novel, *The Man in the High Castle*, is one of innumerable stories premised on an alternative ending to the Second World War. Dick is the same author whose bizarrely paranoid fiction inspired such films as *Blade Runner* and *Total Recall*. Set in an alternative version of the 1960s, *Castle* tells the story of an America partitioned between two conquering powers, Imperial Japan on the West Coast and Nazi Germany on the East. The novel inspired a television drama that premiered in 2015 and has to date run to two seasons. Clearly, the world portrayed in *Castle* is a dystopic nightmare, yet with rays of hope that speak to a larger motivation of freedom, dignity, and democracy.

11/22/63 is a television drama adapted from King's (2011) novel. In both television and book, we meet Jake Epping, who uses an accidentally discovered time portal to travel back in time from today to the early 1960s with the goal of preventing the assassination of President John F. Kennedy. Jake is persuaded by the discoverer of the time portal that the world would have been a better place had Kennedy lived:

... What about Vietnam? Johnson was the one who started all the insane escalation. Kennedy was a cold warrior, no doubt about it, but Johnson took it to the next level. ... Kennedy might have changed his mind. Johnson and Nixon were incapable of that. Thanks to them, we lost almost sixty thousand American soldiers in Nam. The Vietnamese, North and South, lost millions. Is the butcher's bill that high if Kennedy doesn't die in Dallas?

King (2011, p. 62)

The motivation here is clear, to save millions of lives, to make the world a better place. Would the world have been better off had Kennedy lived? The novel delivers an answer in a chilling denouement which we shall not spoil, but it is safe to say that the key value proffered by time machines is the ability to fix mistakes, right wrongs, make things better. Time machines are tools for realizing the goals inherent in counterfactuals.

Star Trek is the third entertainment property to hit new heights as it celebrated in September 2016 its 50th anniversary of the first air date. By far the most successful television property in history, *Star Trek* spans hundreds of television episodes and dozens of films, with a new television series

planned for 2017 (*Star Trek: Discovery*). Yet with all these stories told, there is one that stands out from the original series, a beloved story involving time travel and historical counterfactuals. *The City on the Edge of Forever*, first aired in April 1967, is a classic *Star Trek* tale built from the “what-if” possibility of a Nazi victory in the Second World War. After the discovery of an alien time portal, the starship Enterprise’s doctor, Leonard McCoy, accidentally travels back in time to 1930s America. In an instant, all in the present have changed, because back in the past McCoy had somehow changed history. As the tale unfolds, we learn the details of what he did: a butterfly effect, or rippling chain reaction from a single act, results in the United States delaying its entry in the Second World War, allowing Germany to develop the atomic bomb first, and thus to win the war. To set things right, Captain Kirk and Mr. Spock must also travel back in time to undo whatever McCoy did to alter history. Kirk and Spock piece together the mystery and learn that restoring history to its proper course pivots on a single life-or-death choice. Kirk must decide whether to save the life of the woman he has come to love or to let her die “as she was meant to” and thus return history to its normal course. Kirk’s decision stuns McCoy, who is unaware of the big picture: “Do you know what you just did?” “He knows, Doctor,” says Spock, “He knows.”

Regardless of whether counterfactual fiction hinges on a different outcome to the Second World War, a different version of the Kennedy presidency, or some other fork in the historical road, the underlying theme of all such fiction centers on goals and the struggles to fulfill them. If the counterfactual world is worse than our own, the trials and tribulations of those fictional characters are all the more poignant. They, like all of us, yearn for a better place, and counterfactuals are mental simulations that wield imagination to give color and form to those yearnings. Unfulfilled goals drive counterfactual thinking, and counterfactual thinking embraces goal-focused content. We think it not quite accurate to specify a single process direction of causation, because counterfactuals and goals wrap forward and then back into each other, a Möbius strip of cognition.

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