counterfactuals could be imagined before any experienced difficulty, under ease or fluency.[1] But it would be erroneous to conclude that reactions can thus be predicted on the basis of content alone. For example, one potential irony is that difficulty or disfluency might occur precisely when thinking about alternatives is most needed, as when people are particularly motivated to understand what went wrong and wind up searching for many counterfactuals. This may leave people *less* able to learn from past mistakes, and unlikely to take steps to improve. Thus, only by considering metacognitive experiences along with the content of what people imagine can we fully understand imagination. In short, following through with Byrne's analogy, when fault lines in reality fissure, metacognitive processes may provide the seismic waves that ripple through the imagination to give meaning to the whole experience.

ACKNOWLEDGMENT

I thank the Imagination, Goals, and Affect (IGoA, or ego) laboratory group members at the University of North Carolina at Chapel Hill for their comments.

NOTE

1. Because people normally generate only a few counterfactuals when asked in experiments, there can be a similar natural confound between counterfactuals and ease of generation.

Imagination is only as rational as the purpose to which it is put

doi: 10.1017/S0140525X07002713

Andrew Shtulman

Department of Psychology, Occidental College, Los Angeles, CA 90041.
shtulman@oxy.edu **http://faculty.oxy.edu/shtulman/**

Abstract: Byrne's criteria for considering imagination rational do not accord with standard notions of rationality. A different criterion – that is, the correspondence between an inference strategy and its domain of application – is offered and illustrated with recent work on possibility judgment. This analysis suggests that, although imagination can be put to rational purposes, imagination itself should not be considered rational.

Byrne's (2005) book, despite its clarity of analysis and clarity of exposition, advances a claim that is far from clear: Imagination is rational. This claim is unclear because the word *rational* typically denotes conformity to some normative standard, yet, as Byrne herself notes, "There is no normative standard against which to judge whether an imaginative thought is best" (p. 209). Even if one adopts Byrne's view of rationality as the *capacity* to draw normatively valid conclusions (as opposed to the disposition to do so), one is still left with the problem of deciding what constitutes such a capacity in the domain of counterfactuals.

Byrne acknowledges this problem, but rather than confront it directly by explaining why the *content* of counterfactual inferences should be considered rational, she circumvents it by explaining why the *process* of counterfactual reasoning should be considered rational. Her argument proceeds as follows: (1) the process by which most individuals make deductive inferences (i.e., searching for counterexamples to an argument's conclusion among a set of possibilities consistent with the argument's premises) is capable of yielding normatively valid conclusions; (2) counterfactual reasoning shares many similarities with deductive reasoning; (3) therefore, if deductive reasoning is considered rational, then counterfactual reasoning should be considered rational as well.

The problem with this argument is that, without any independent measure of what constitutes a valid counterfactual inference, we have no reason to believe that the analogy between deductive reasoning and counterfactual reasoning is, itself, valid. After all, the literature on strategy development (e.g., Siegler 1996) has documented many instances in which failures of reasoning are attributable to the misapplication of domain-specific strategies. For instance, when children are first introduced to decimal notation, they often compare decimals on the basis of digit length rather than digit location, judging a decimal like .125 to be larger than a decimal like .25 because the former contains more digits than the latter (Moss & Case 1999; Smith et al. 2005). Although this strategy is reliably correct when applied to integers, it is not reliably correct when applied to decimals.

Is the application of deductive-reasoning strategies to counterfactual-reasoning problems as inappropriate as the application of integer-comparison strategies to decimal-comparison problems? Perhaps not, but Byrne provides no reason for us to believe otherwise. By focusing on processing similarities between deductive reasoning and counterfactual reasoning, Byrne overlooks potential dissimilarities in their application. One such dissimilarity is the nature of the space of possibilities over which each type of inference is drawn. That is, when reasoning about factual conditionals of the form "if A, then B," individuals are limited to a small, well-defined space of possibilities (i.e., A and B, A and not-B, not-A and B, not-A and not-B), but when reasoning about counterfactual conditionals, they are confronted with the space of all possible worlds (Lewis 1973; Stalnaker 2003). Thus, the absence of a counterexample specifies a normatively valid conclusion in the former space of possibilities but not the latter. Indeed, to conclude that reality is immutable because no changes to reality are conceivable is, in Dennett's words (1993), to "mistake a failure of imagination for an insight into necessity" (p. 48).

Consistent with this idea, most adults recognize, at least implicitly, that failures of imagination do not count as evidence of necessity (Shtulman & Carey 2007). That is, when asked to judge the possibility of events that violate physical laws, like walking through a wall or walking on water, most adults not only deny the possibility of such events, but also justify their judgments with *positive evidence* of the events' impossibility (e.g., "both walls and people are solid," "water doesn't have enough surface tension"). In other words, rather than appeal to the perceived absence of a counterexample (e.g., "there's no way a person could walk on water"), adults tend to provide principled reasons for why no such counterexamples exist.

In contrast to adults, preschool-aged children do not tend to provide principled reasons for their judgments. Instead, they appeal to their own failures of imagination, either explicitly (e.g., "it just doesn't seem possible") or implicitly, via the comparison of a seemingly impossible event to a possible one (e.g., "you can't walk across water but you could swim across"). Such appeals suggest that preschoolers reason about physical possibility similarly to how adults are purported to reason about counterfactuals: by searching for counterexamples to the status quo. If they can identify such a counterexample, they judge the event possible; if they cannot, they judge the event impossible. Although this strategy does, in fact, lead children to deny the possibility of events that violate physical laws, it also leads them to deny the possibility of events that, although difficult to imagine occurring, do not violate any physical laws, like making pickle-flavored ice cream or finding an alligator under the bed.

The point of this illustration is not to suggest that the process of searching for a counterexample is irrational but to suggest that this process is rational in some contexts (i.e., small, well-defined domains) and not in others (i.e., large, ill-defined domains), and that the appreciation of this fact is a normal developmental achievement. Moreover, by considering whether the *application* of an inference strategy is rational – as opposed to the strategy itself – one can better appreciate what constitutes a valid conclusion in the domain at hand and what does not. Admittedly, the aforementioned findings come from studies of

hypothetical reasoning, not counterfactual reasoning; yet they pertain to Byrne's claims in so far as reasoning about the mutability of particular events in the past is structurally similar to reasoning about the mutability of generic events, past or present. At the very least, this comparison points to the need for additional research on how individuals *justify* their counterfactual inferences, for such data are likely to shed light on how those inferences were made.

In sum, imagination can be put to rational purposes but it should not be considered inherently rational. Although Byrne's careful analysis of the similarity between counterfactual reasoning and deductive reasoning provides evidence of imagination's systematicity, it does not provide evidence of its rationality.

On the relation between counterfactual and causal reasoning

doi: 10.1017/S0140525X07002725

Barbara A. Spellman and Dieynaba G. Ndiaye

Department of Psychology, University of Virginia, Charlottesville, VA 22904-4400.

Spellman@virginia.edu Dgn2 h@virginia.edu
http://people.virginia.edu/~bas6g/

Abstract: We critique the distinction Byrne makes between strong causes and enabling conditions, and its implications, on both theoretical and empirical grounds. First, we believe that the difference is psychological, not logical. Second, we disagree that there is a strict "dichotomy between the focus of counterfactual and causal thoughts." Third, we disagree that it is easier for people to generate causes than counterfactuals.

Psychologists studying the relation between counterfactual and causal reasoning have long asked: Why, despite their similarity, do people give different answers to counterfactual versus causal questions? (See Spellman & Mandel [1999] for history.) For example, when completing "if only . . ." statements about Mr. Jones who was hit by a drunk driver while taking an unusual route home, most people focus on the unusual route, yet they identify the drunk driver as the cause of the accident (Mandel & Lehman 1996).

In the chapter "Causal Relations and Counterfactuals," Byrne (2005) argues that people provide different answers because they focus on different things: in counterfactual reasoning they focus on "enabling" conditions, whereas in causal reasoning they focus on "strong causes." Imagine a dry forest floor and then a lightning strike resulting in a huge forest fire. People are likely to say, "if only there were not so many dry leaves," and "the lightning caused the fire," but not "the dry leaves caused the fire." Byrne argues that strong causes (lightning) are consistent with two possibilities: (1) lightning and fire, and (2) no lightning and no fire – however, people mentally represent only the first possibility. Enabling conditions (dry leaves) are consistent with three possibilities: (1) dry leaves and fire, (2) no dry leaves and no fire, and (3) dry leaves and no fire – however, people mentally represent two possibilities (or only the first, but the second comes "readily"). People, Byrne argues, use those representations to distinguish causes from enablers and, as a result, answer counterfactual questions with enablers and causal questions with strong causes.

We have trouble with some of the assumptions and assumed consequences of that characterization on both theoretical and empirical grounds. First, we believe that the difference between enablers and causes is psychological, not logical. Second, we do not believe that there is a strict "dichotomy between the focus of counterfactual and causal thoughts" (Byrne 2005, p. 100). Third, Byrne argues that as a result of the difference in representation, it is easier for people to generate causes than counterfactuals; we disagree.

Enablers versus causes. At first the dried-leaves-and-lightning example seems obvious: of course dried leaves constitute an enabler, whereas lightning is a cause. But on deeper reflection the logic is not so clear. Dried leaves would not lead to a conflagration without lightning; however, neither would lightning without dried leaves. Their logical status is equivalent: each is necessary but neither is sufficient.

Similarly, consider a lightning-torn stretch of wetlands. Despite countless lightning strikes, there was never a fire until the year's masses of dry leaves blew in. Now it seems natural to argue that leaves caused the fire, whereas lightning was an enabler. Again, calling one a cause and one an enabler is a psychological, not a logical, judgment, and to explain differences in counterfactual and causal judgments by saying that people represent causes and enablers differently is to finesse the importance of various factors (e.g., context) that get people to treat logically equivalent events as psychologically different. (See Einhorn & Hogarth 1986 and McGill 1989, for other context effects.) It is unclear how the mental representation of possibilities accounts for such context effects and informs people about which is the cause and which is the enabler; it seems that people must already know which is which based on the context before they represent the events. Byrne does mention alternative information sources (covariation, mechanisms, abnormality), but her argument implies that the mental representation of possibilities provides a better account of how people distinguish strong causes from enablers.

Not quite a "dichotomy". Second, it is inaccurate to characterize people's answers to causal and counterfactual questions as a strict "dichotomy." In some studies, the most prevalent answers are the same (e.g., Wells & Gavanski 1989, Experiment 1). Plus, differences in how counterfactual and causal reasoning are measured may contribute to belief in the dichotomy. Our participants read about a woman driving home from work. She stops at a red light and fiddles with the radio so that when the light turns green she hesitates before accelerating, delaying the cars behind her. Last in line is a school bus, which enters the intersection just as an irate man drives through the red light from the other direction hitting the bus and injuring many children.

Participants who listed counterfactuals focused on the hesitating woman; participants who rated causes focused on the irate man. These results replicate the "dichotomy." However, there is a confound: researchers usually measure counterfactuals with listings but causes with ratings. What if both are measured with ratings? Other participants saw 12 story events previously listed by earlier participants and rated each on either whether they agreed the event was an "undoing counterfactual" or whether it was causal. The irate man was rated as both most causal and most changeable (Spellman & Ndiaye 2007).

Thus, counterfactual and causal judgments are far from dichotomous; rather, depending on how questions are asked and answers are measured, they may focus on the same events.

Generating causes and counterfactuals. Byrne argues that because strong causes are represented by one possibility and enablers by two, and because "it is easier to think about one possibility than about several" (Byrne 2005, p. 119), it should be easier for people to generate causes than counterfactuals. McEleney and Byrne (2000) had participants imagine they had moved to a new town to start a new job and read about various events that happened to them. When asked what they would have written in their diaries, participants spontaneously generated *more* causal than counterfactual thoughts. In contrast, our participants read about a man who had been abused by his father, joined the army, learned to use explosives, then blew up his fathers' company's warehouse. Participants listed *fewer* causes ($M = 5.7$) than counterfactuals ($M = 7.7$) (Spellman & Ndiaye 2007). We have no problem