

# Effecting re-representation: revising false beliefs and fostering creativity

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## Introduction

Perhaps the greatest challenge to successful learning and problem solving is when learners initially represent the novel problem or concept in a way that conflicts with the proper solution or content to be learned. For example, naïve conceptions of *force* often lead to failure to show any learning gains from lessons on Newton’s laws of motion (e.g., Muller, Sharma, & Reiman, 2008), and knowledge of typical functions prevent using familiar artifacts in novel ways to solve otherwise simple problems (Adamson, 1952). Further, rampant society-wide misconceptions, such as the belief that vaccines cause autism, or deny the causal role of humans in global warming, are having disastrous effects on public health and environmental policy. On the flip side, overcoming the constraints of an initial representation can spark creative innovation. For example, the Dyson vacuum cleaner is famously based on the re-conception of the vacuum mechanism via an analogy to saw mills.

The goal of this symposium is to present a variety of methods to effect successful re-representation across several domains. We bring together empirical work addressing processes of re-representation in the domains of moral reasoning, causal learning, and negotiation in business. We hope communicating these methods will help grow the group of researchers both trying to improve our basic knowledge of re-representational processes, and solve these real-world problems.

Z. Horne, D. Powell & J. Hummel will present on the effects of revising so called “toxic beliefs”— beliefs that constrain the understanding of entire domains, preventing the learning of new information. M. Goldwater presents a novel approach to overcoming stubborn causal misattributions by teaching learners to categorize disparate phenomena via their shared causal structure. Categorizing phenomena aids learners to discard misattributed causal relations inconsistent with the category’s causal model. J. Loewenstein presents a line of studies on when and why

negotiators redefine what is under discussion to form creative agreements. Our likelihood of redefining problems appears to be partly a matter of how tightly we are clinging to our existing definitions. R. Goldstone, an expert in the reciprocity between perceptual learning and higher-level cognition, will serve as a discussant, integrating the presentations, making connections between the processes of reinterpreting situations and perceptually re-parsing objects in new ways, and presenting future challenges.

## Toxic beliefs

Zachary Horne, Derek Powell, and John Hummel

In the medical, moral, and political domains, people are often deeply entrenched in their beliefs, resistant to any new information. Educational efforts—for instance, pro-vaccine messaging which emphasizes the safety of vaccines—can sometimes fail (e.g., Nyhan et al., 2014; also see Horne, Powell, Hummel, & Holyoak, 2015 for a recent success). Here, we investigate a potential cause of such failures, a class of beliefs we call *toxic beliefs*— which are a kind of over-hypothesis (e.g., Jern et al., 2014) that inform how reasoners interpret evidence in the belief’s domain.

To consider an intuitive though controversial example, certain religious beliefs may be considered toxic (in the functional sense just defined). Imagine that some event, say a new archaeological find, would normatively constitute evidence against the hypothesis that God exists (henceforth, evidence E1 and hypothesis H1). However, now imagine that the reasoner also holds the belief that all people of faith will often have their religious convictions tested by secular society (call this H2). This belief affects how reasoners interpret evidence like E1. Rather than viewing E1 as direct evidence against H1, E1 might instead provide further support for H2 in turn *strengthening* H1. Thus, we call H2 a toxic belief because the belief that the faithful will be challenged allows any evidence *against* the existence of God be reinterpreted as evidence *for* the existence of God.

Here we present a line of research applying these ideas to medical denialism – crudely, the idea that modern medicine

provides ineffective treatments and simply supports corporate interests. We argue that medical denialism is a kind of toxic belief that can lead reasoners to be negatively affected by positive medical information and health education. We then discuss avenues to encouraging rational belief revision by altering or undermining toxic beliefs.

### **Discarding causal misattributions with abstract causal knowledge**

Micah B. Goldwater

Once a causal relation is attributed between two variables, it stubbornly persists in learners' causal models despite novel evidence to the contrary—evidence that would have prevented the misattribution in the first place. Taylor and Ahn (2012) refer to this as “causal imprinting.” Their work concerned learners first attributing a causal relation between two correlated variables, and then being presented with evidence that the correlation can be explained with a third variable that is the common cause of both. That is, the first two co-occur *because* this third variable causes them to. Taylor and Ahn presented several experiments that show that this stubborn causal imprinting is not due simply to memory limitations, or total failure to update their representations. Subjects did learn that the third variable caused the other two, but these causal relations were simply added to their causal model; they did not replace the original causal (mis-)attribution. On the other hand, when subjects learned about all three variables to start with, they only represented the two correct causal relations.

In a separate line of research, Goldwater and Gentner (2015) taught subjects to classify descriptions of natural and social phenomena via their underlying causal structure, such as a common-cause system (wherein multiple effects have a single common-cause). The current work presents evidence that the learning intervention of Goldwater and Gentner can overcome causal imprinting. That is, subjects with an abstract representation of a “common-cause system” were capable of recognizing how that structure applied to the co-occurrence data from Taylor and Ahn, encouraging learners to discard the causal misattribution. This research is novel both because it shows how causal category learning is applied to the interpretation of co-occurrence data, and argues for learning at the category-level as a method to revise false beliefs about individual exemplars.

### **Redefining negotiation problems to form creative agreements**

Jeffrey Loewenstein

Negotiations, disputes, and other social conflicts sometimes result in creative solutions that make everyone better off for having had the run-in. The pioneering Mary Parker Follett (1940) championed it as “constructive conflict.” The question is when and why multiple people coming together to generate a decision end up redefining

their understandings and producing creative agreements rather than settling for meager divisions and souring their relationships.

My colleagues and I are finding that one's stance towards the problem and the other parties appear to matter. Unsurprisingly, when parties are unable to reach their goals and so are confronted by an impasse they are more likely to redefine the problem and generate creative agreements. But it is not just flexibility but goal commitment and flexibility together that foster redefining the problem and generating creative agreements. Further, focusing on higher-order goals rather than lower-order goals fosters generating creative agreements.

In addition, considering not just one's own ambiguous information but also the ambiguous information offered by others is important. This is challenging because those others might just be trying to use their influence to gain acceptance of lopsided proposals. Nonetheless, seeking to learn from the current experience rather than maximize current performance fosters generating creative agreements. Seeking to ask questions of others rather than seeking to talk about one's own information fosters generating creative agreements. Not trust in others but respect for others fosters attending to and making use of others' information and then appreciating and accepting their creative proposals.

Taken together, these findings indicate that redefining negotiation problems to produce creative agreements is strongly influenced by the broader goals and approach people adopt towards the negotiation problem and their counterparts.

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