Multiple Systems for Modal Cognition

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Background

Many of the high-level judgments that have interested cognitive scientists require an ability to represent and reason over sets of possibilities. That is, a capacity for *modal cognition*. Among other things, this is true of causal reasoning, moral judgments, predictions of others' actions and many aspects of language (Lewis, 2013; Kratzer, 2012; Pearl, 2009).

Despite the central importance of this capacity, surprisingly little work has directly investigated representations of modality in human adults, and even less has tried to connect this aspect of cognition with the high-level judgments that have been assumed to require it.

Previous research

To date, most of the empirical research that has investigated modal cognition in human adults has studied how people explicitly and reflectively represent and reason about specific possibilities. For example, there is now a substantial amount of research on how and when people engage in explicit counterfactual reasoning (see, Byrne, 2016 for a recent review), some research on how human adults deliberate as to whether a given event is impossible (Shtulman & Tong, 2013), and some research on the neural substrates recruited when adults engage in episodic counterfactual reasoning (Schacter, Benoit, De Brigard, & Szpunar, 2015). Much less work has looked at non-reflective modal reasoning (though see Gerstenberg et al., 2015).

Overview

Two studies investigate modal cognition in human adults. Study 1 distinguishes between two ways of representing possibilities by showing that reflective vs. speeded judgments of possibility are differentially impacted by norms. Study 2 provides evidence that non-reflective representations of possibility are recruited when making judgments of whether an agent was forced to act.

Study 1

~500 participants read a series of six different vignettes involving six different agents in various situations, e.g.:

Josh is on the way to the airport to catch a flight for a hunting safari in Africa. He leaves with plenty of time to make it there, but his car breaks down on the highway. Now Josh is sitting in his car near a busy intersection and knows he needs to get to the airport soon if he is going to catch his flight.

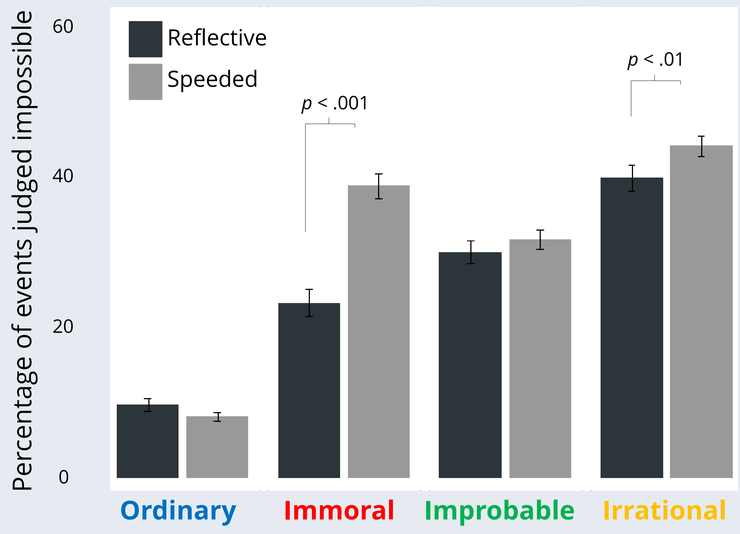
After reading the vignette, participants made judgments of the possibility of different kinds of events. These varied in whether they were ordinary, immoral, improbable, irrational, or impossible:

Is it possible or impossible for Josh to…
***Ordinary example**: hail a taxi at the intersection.*
***Immoral example**: sneak onto public transportation.*
***Improbable example**: get a stranger to drive him.*
***Irrational example**: sell car for ride to airport.*
***Impossible example**: teleport himself to the airport.*

Half of participants were instructed to answer as quickly and accurately as they could. They were given 1500ms to respond to each event. The other half of participants were asked to carefully reflect on the possibility of each event before responding, and only responses that were given after longer than 1500ms of reflection were analyzed. Participants completed 144 trials in total.

Results

We observed a significant interaction between the type of the event and whether the judgments of possibility were made reflectively or under speed, $p < .001$:



Study 2

~400 new participants read the vignettes from Study 1, which now continued, e.g.:

Josh calls his father who lives a few states away and tells him about his problem. Not really knowing how to help him, Josh's father makes a suggestion. His father says Josh could…

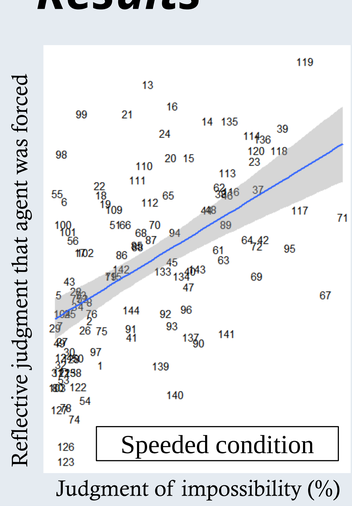
Participants saw one of the 144 events from Study 1. The vignette then continued, e.g.:

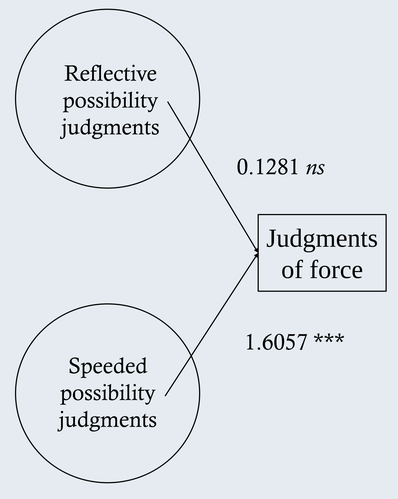
Josh ignores his father's suggestion and decides to book the next available flight, even though it is quite expensive.

Finally, participants answered a question about whether the agent was forced, e.g.:

<u>Was Josh forced to book the next available flight?</u>

Results





Discussion

These studies provide evidence that human adults have multiple ways of representing possibilities, and suggest that there may be multiple systems involved in modal cognition: one system that requires deliberative reflection and is not influenced by norms, and one that does not require deliberative reflection, but is sensitive to prescriptive norms. Intriguingly, we found that high-level judgments that have been posited to rely on modal cognition may preferentially recruit non-reflective representations of modality.