# Causation Warps Our Perception of Time

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You push a button to call the elevator to your floor and you wait for what seems like forever, thinking it must be broken. When your friend pushes the button, the elevator appears within 10 seconds. “She must have the magic touch,” you say to yourself. This episode reflects what philosophers and psychological scientists call “temporal binding”: Events that occur close to one another in time and space are sometimes “bound” together and we perceive them as meaningful episodes.

New research published in Psychological Science, a journal of the Association for Psychological Science, suggests that binding may reveal important insights into how we experience time.

Research has shown that our perceptual system seems to pull causally-related events together – compared to two events that are thought to happen of their own accord, we perceive the first event as occurring later if we think it is the cause and we perceive the second event as occurring earlier if we think it is the outcome.

So how does this temporal binding occur?

Some researchers have hypothesized that our perceptual system binds events together if we perceive them to be the result of intentional action, and that temporal binding results from our ability to link our actions to their consequences. But psychological scientist Marc Buehner of Cardiff University, UK wondered whether temporal binding might be rooted in a more general capacity to understand causal relations.

“We already know that people are more likely to infer a causal relation if two things are close in time. It follows, via Bayesian calculus, that the reverse should also be true: If people know two things are causally related, they should expect them to be close in time,” Buehner says. “Time perception is inherently uncertain, so it makes sense for systematic biases in the form of temporal binding to kick in. If this is true, then it would suggest that temporal binding is a general phenomenon of which intentional action is just a special case.”

Buehner decided to test this hypothesis in two experiments using an event-anticipation paradigm. Participants in the experiments had to predict when a target light would flash. In the Baseline condition, the target flash was preceded by a signal light; in the Self-Causal condition, participants pressed a button to generate the target flash; in the Machine-Causal condition, a separate machine pressed the button to generate the target flash. According to the causal binding hypothesis, the Self-Causal and Machine-Causal conditions should lead participants to anticipate the target flash earlier relative to Baseline; according to intentional binding accounts, only participants in the Self-Causal condition would show early anticipation.

The results showed that Baseline predictions were significantly later relative to the predictions of

participants in both the Self-Causal and the Machine-Causal groups. The prediction time was not significantly different between the two causal groups, however. These findings suggest that intentionality is not a necessary condition for temporal binding to occur, confirming Buehner's hypothesis.

"Understanding the past gives us an advantage in predicting the future," says Buehner. "If we have a causal story of why things are happening, we are better prepared to expect what is to come. Merely knowing the past in the absence of causal understanding – such as in the Baseline condition – does not afford better preparedness."

"Causation instills a subjective time warp in people's minds," he observes.

Buehner believes that these findings may have practical implications for usability engineers and interface designers.

"People's perception of wait times and delays are becoming increasingly important. Here we can show that such perceptions are subject to systematic distortions depending on people's causal beliefs. For example, if people believe that they (or someone or something else) are in charge, the time appears to pass faster."

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