Humans perceive time somewhere in between reality and our expectations

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Series of red beeps. Credit: University of Birmingham

New research, using a Bayesian inference model of audio and visual stimuli, has shown how our perception of time lies mid-way between reality and our expectations.

90 participants were tested across four experiments, and asked to report on the timing of the last event in a regular sequence of beeps or flashes.

The findings, published in *Scientific Reports*, displayed that participants anticipated future occurrences of the stimuli in line with the regular pattern, but the perceived accuracy of their response differed from reality when the stimuli was either accelerated or delayed.

If the timing was regular, participants were able to anticipate the stimulus. However, when the final stimulus was delivered early, the participants perceived that it had occurred 'only slightly earlier' than expected, around halfway between their predicted response and the reality.

Similarly, when the final stimulus was delivered late, the participants had a similar perception of halfway between their prediction and the reality.

The researchers, from the universities of Birmingham and Sussex, believe their findings suggest that humans do not perceive time as it really is – rather as a mid-way between reality and their expectations. These findings suggest that the brain continuously updates the probability of encountering future stimuli based on prior experiences.

Dr Max Di Luca, from the University of Birmingham, explained, "Our brain relies on past events to predict what will happen next. These predictions are essential to survival because they allow us to react faster to the environment around us and plan what actions to perform."

"Our perceptions are also affected by these predictions; they are the result of the combination of our expectations and actual sensory information. We don't perceive the world as it really is, or as we expect it to be, but somewhere in between."

"Imaging a bad musician playing a cover version of one of your favourite songs. You have an expectation of which notes to expect and when to expect them. Even when poorly performed, your expectations will help

'soften the blow' and make it sound relatively better. However, if you were listening to them play a song you had never heard before, you would have no real expectations and so every mistimed note would be evident."

Dr Darren Rhodes, now at the University of Sussex, added, "We are not passive watchers. We use what we know about the world to inform us about when something is likely to happen. If our predictions are slightly wrong, we perceive the world somewhere in between expectation and reality. We hear, see and feel what we think we should be experiencing, not what is really happening out there."

"The conclusions that that can be drawn from this research can be applied to several technological domains" says Dr Di Luca.

"Knowing how the brain predicts the world can be used to teach robots how to behave and think in a way similar to humans, for example," says Dr Rhodes, who is working at a European-funded project on the interaction between neuroscience and robotics.

More information: Massimiliano Di Luca et al. Optimal Perceived Timing: Integrating Sensory Information with Dynamically Updated Expectations, *Scientific Reports* (2016). DOI: 10.1038/srep28563

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