Voluntary actions are often defined as those actions that are not triggered by an external stimulus but are rather initiated endogenously, and are typically accompanied by the experience of intention. While prospectivist theories suggest that people have some conscious insight into their motor preparation process prior to action execution, retrospectivist theories propose that the experience of intention is entirely retrospectively reconstructed, based on whether an action was executed. To investigate the prospective and retrospective contributions to the experience of intention, we ran a real-time EEG experiment.

Twenty-three participants were tested. In the first phase of the task, participants performed self-paced pedal presses with their right foot. These data were used to train a classifier to discriminate movement preparation from non-preparatory brain activity. The Readiness Potential (RP) is a negative-going signal over the motor cortex that precedes self-paced voluntary actions and starts before the time at which participants report an intention to move. The RP was therefore our candidate prospective component of intention awareness. We excluded 6 participants who either did not show a RP before voluntary actions or for whom the classifier failed to use that signal for classification. In the second phase of the experiment, participants performed the same self-paced pedal press task with their right foot, but were now occasionally interrupted by either green GO or red NO-GO probes. Participants were instructed to press the pedal as fast as possible if they saw the GO cue and to refrain from moving in response to the NO-GO cue. Crucially, the probes were triggered by the algorithm trained in the first phase given either the presence or absence of a RP. After the cue, participants were prompted about conscious intention: “Were you about to move when you saw the probe?”. Awareness of intention reports were hence obtained in a 2 by 2 combination of prospective (presence/absence of an RP) and retrospective (presence/absence of an action) components.

Our results show participants more frequently reported conscious intention at the time of the probe when they had just pressed the pedal in response to a GO-probe, compared to when they did not move at all, following a NO-GO probe. This suggests a strong effect of retrospection on awareness of intention. We also found that in the GO condition only, reports of awareness of intention were more likely when the probe was

preceded by an RP than when it was not, as long as the action was executed within ~300 ms of the GO-probe. This suggests that awareness of intention in voluntary action also involves a prospective process that precedes action execution, but its availability for report is limited in time and facilitated by action.

Our results have important methodological and theoretical implications for the study of consciousness in the context of voluntary action control.