CHAPTER 13

Prospective Codes Fulfilled: A Potential Neural Mechanism of Will

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One of my few shortcomings is that I can't predict the future.

Lars Ulrich, Metallica

Lars Ulrich was right and wrong. He was right in the way we most often think about the future—as a long stretch of time during which multiply determined events occur. If we could predict this kind of future we would play the lottery every day and avoid embarrassing wardrobe malfunctions. This is clearly not the case. However, converging evidence from neuroscience reveals that our brains do predict the future and do so well, albeit on a much shorter time scale. Bayesian anticipation of likely events appears to be a general principle of brain function. That is, we use information about the probability of past events to predict future events, allowing for a more efficient use of neural resources. While research has begun to show that many systems in the brain code Bayesian predictions, very little work has examined the experiential consequences of this coding. Here we propose that prospective neural facilitation may be fundamental to the phenomenological experience of will.

THE FEELING OF WILL

The feeling of will is typically associated with having performed an intentional act. Slamming the door to make a point feels willed. Rushing to the airport to make a flight feels willed. Will is the kind of feeling one gets when actions are consciously purposeful. Wegner and Wheatley proposed that this feeling comes from three sources: priority, consistency, and exclusivity (Wegner & Wheatley, 1999). An action feels willed to the degree that one has a prior thought (priority) that is consistent with that action (consistency) and that appears to be the only possible cause of that action (exclusivity). Importantly, these sources of will need not be veridical to action, but can be manipulated independent of action as was illustrated by the following experiment.

The "I Spy" Study

In this experiment, two people sat across a table from each other with their hands on a large computer mouse. Unbeknownst to the actual subject, their partner was an employee (confederate) of the experiment posing as a participant. On the table, visible to both, was a computer monitor with a screen depicting a variety of objects taken from the children's book *I Spy*. The participant and the confederate were instructed to move the mouse together in sweeping circles and, by doing so, they moved a cursor around the screen. The pair were also instructed to stop moving the mouse approximately every 30 seconds. Finally, both were given headphones and told that they would hear different words, ostensibly as a mild distraction for the task. In reality, the headphones were critical to the experiment. The real subject heard words related to objects onscreen (e.g., "swan . . . monkey"). The confederate heard instructions to force stops on particular objects at particular times. These critical stops occurred at various time intervals after the participant heard a related word. For example, the confederate would force a stop on the swan exactly 5 seconds after the participant heard the word "swan" in their headphones. After each stop the pair rated how much they had intended to make that stop in comparison to their partner.

As the assumption of priority would predict, the amount of time between the preview and the forced act was important to the perception of will. If the preview occurred a few moments before the act, participants mistakenly perceived that they were responsible for (and had intended to perform) the act. If the preview occurred too far in advance (e.g., subjects heard "swan" 30 seconds before the confederate engineered a stop on the swan) or immediately after the stop, subjects did not attribute the act to themselves (see Fig. 13.1).

This study demonstrated that the feeling of will could be evoked by providing people with three bits of information: a preview thought, a consistent act, and the knowledge that the initiating event was exclusive to them. This suggests that will, as a phenomenological experience, can be attributed erroneously whenever stimuli mimic the natural sources of will. Since this study, several other paradigms have demonstrated that the feeling of will can be manipulated independently of action (Banks & Isham, 2009; Choi & Scholl, 2006; Lau, Rogers, & Passingham, 2007; Wegner, Fuller, & Sparrow, 2003; Wegner, Sparrow, & Winerman, 2004). Collectively, these manipulations of will demonstrate the flexibility of its interpretation. Consistent with this flexibility, the ostensible instigating event need not be a thought at all; actions can serve as previews for future actions.

The "Sequential Will" Study

In this study, subjects were asked to perform a series of action sequences. Importantly, each action in a sequence was performed without knowing which action would follow next. All subjects were given the same 24 initial actions (e.g., make a fist) but subsequent actions in each sequence differed across subjects. In any given sequence, the actions were either *unrelated* to each other (make fist, knock on the desk with the other hand), *disrupted* by an intervening action (make fist, tap left foot, knock on the desk with the fist), *delayed* (make fist, wait five seconds, knock on the desk with the fist), or *related* (make fist, knock on the desk with the fist). Each subject performed each of the 24 action sequences only once, and counterbalancing ensured that the sequence conditions were

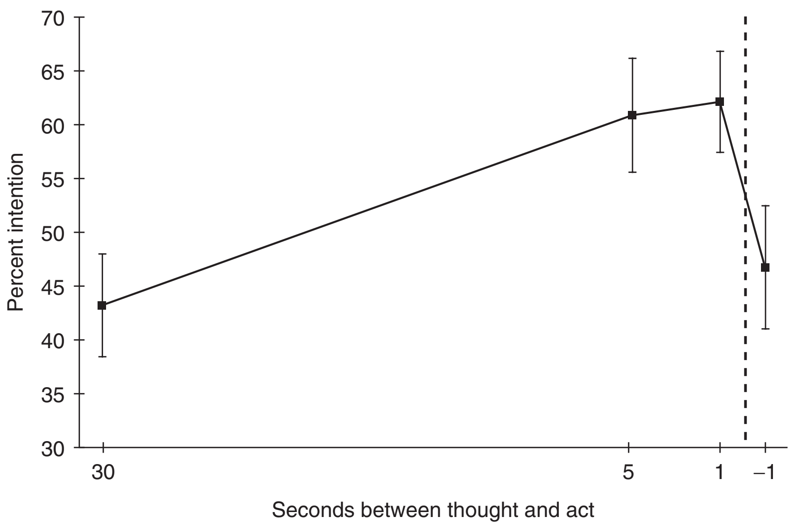

Figure 13.1 Mean percentage of intentionality perceived for forced stops (Wegner & Wheatley, 1999). 0 ("My partner intended the stop")–100% (I intended the stop").

balanced across subjects. Immediately after each sequence was performed, subjects were asked to rate the first action, last action, or entire action sequence for how much they felt that they had performed it willfully vs. mechanically. Willfully was described as feeling "like the action was coming from you . . . like you are consciously initiating your actions, as an active participant." Mechanically was described as "operating on autopilot, responding mindlessly to what is being asked of you without being engaged or consciously involved." The empirical question was whether the first actions would be misremembered as more or less willful depending on the relatedness of the subsequent actions.

As predicted, the ratings of the first action differed significantly depending on the subsequent actions. Specifically, actions followed immediately by a related sequence were rated as having felt more willfully authored compared to actions followed by disrupted or unrelated sequences. Importantly, these first actions could not have differed at the *time* they were performed because participants did not know what the next action would be (and thus whether it would be related). The experience of will for the first action was revised by subsequent actions. Uncharacteristically, William James was incorrect when he stated that: "The willing terminates with the prevalence of the idea; and whether the act then follows or not is a matter quite immaterial" (James, 1890). In all of these experiments, illusory versions of priority, consistency, and exclusivity evoked an illusory feeling of will. The cognitive mechanism underlying this illusion is unclear, but there are at least two possibilities.

Explaining Illusory Will

Retrospective Inference

The most intuitive explanation of these effects is retrospective inference: participants deduced the intentionality of their actions after the fact. This explanation suggests that people are essentially outside observers of their own behavior, a conclusion that squares with many findings in social psychology. The seminal paper by Nisbett and Wilson (1977), "Telling More Than We Can Know," provides several illustrations in which people fabricated reasons for their behavior when they were ignorant of the true cause. For example, mall shoppers were asked to select the best pantyhose among four alternatives. All four pantyhose samples were identical but people overwhelming chose the right-most pair. Shoppers appeared to have no knowledge of this position effect, and instead claimed that their choices were based on more normative reasons such as the superiority of the weave. Indeed, when asked directly about whether they were influenced by position, the shoppers "denied it, usually with a worried glance at the interviewer suggesting that they felt either that they had misunderstood the question or were dealing with a madman" (Nisbett & Wilson, 1977). The shoppers observed their behavior and retrospectively inferred the most plausible, albeit incorrect, reason.

In the case of the I Spy study, retrospective inference might sound something like this: "I was the only one who heard the word 'swan,' then we stopped on the swan, . . . I suppose I must have been the one responsible for the stop." Despite presenting this reasoning as a quote, it should be noted that retrospective inference does not necessarily imply conscious awareness. This explanation simply suggests that a deduction was made retrospectively that led the participant to tag the event as willed. As the participant could not foresee the impending action in either the I Spy or Sequential Will study, it seems strange to argue that the creation of will was anything *but* retrospective. However, Patrick Haggard has suggested that a second phenomenon may be at play that is not retrospective at all (Haggard & Clark, 2003; Haggard, 2005; Moore & Haggard, 2008).

Neural Prospection

Haggard and colleagues refer to the alternative phenomenon as neural prediction. Broadly speaking, a neural prediction is the brain's preparatory activity for a predicted action or event. In the domain of motor control, neural predictions allow the brain to evaluate the success of a motor plan by predicting the visual, motor, and proprioceptive feedback associated with an action (Blakemore, Wolpert, & Frith, 2002). Haggard posited that conscious intention may be an immediate consequence of these predictive processes. That is, the feeling of agency may arise in a feed-forward, constructive manner rather than, or perhaps as well as, via retrospective inference. Haggard et al. (2003, 2008) convincingly demonstrated that the experience of action is tied to the preparation and perceived realization of a specific motor prediction. Although this research has focused on the neural prediction of a specific motor plan, there is reason to believe that the phenomenon of neural prediction, broadly construed, is a general mechanism of brain function.

The broad view of this idea may be more consistent with the term "neural prospection" than "neural prediction." "Neural prediction" and "predictive coding" commonly refer to the mapping between a cause (motor command) and its specific sensory effect (e.g., visual or proprioceptive feedback; Kilner, Friston, & Frith, 2007). In contrast, neural *prospection* refers to mental forecasting: "the capacity to imagine, simulate, or pre-experience episodes in the future" (Schacter & Addis, 2007).

In contrast to neural prediction, neural prospection is likely to be a general mechanism across multiple sensory systems and operate at larger time-scales. Simply put, it is the sensitization of neural pathways based on recent experience. What we experience at Time 1 readies our brains to process related experiences at Time 2. Recently, there has been a shift in neuroscience to consider the brain as a predictive machine. In the (very) big picture, this conceptualization is long overdue.

THE PROACTIVE BRAIN

Several million years of evolution honed the brain to be an incessant forecaster. Predators, weather, and social hierarchies could yield unfavorable conditions rapidly; thus an efficient predictive system was essential to not being eaten, rained on, or socially outcast. Moreover, survival prioritized the overestimation of cause-effect relationships rather than veridical accuracy: better to falsely impute the presence of a snake from the sound of rustling leaves than process the sound veridically and miss the potential implications. In short, natural selection ensured that the brain generates continuous predictions in order to selectively amplify potential biologically relevant information within streams of fleeting and ambiguous input.

The predictive nature of the brain fits a broader characterization of the brain as storyteller. A wealth of research from psychological and brain sciences has shown that the brain is not a veridical recording device but fills in gaps and even manipulates space and time to make sense of incoming sensory input (see Wheatley, 2009, for a review). To this end, even basic cognitive processes such as perception and memory are actively constructed and embellished, often without our awareness. The visual system, for example, operates by making assumptions: converging lines indicate distance, a dark line is seen as an edge, and so on. Through recurrent processing with higher order areas, these assumptions help us translate two-dimensional retinotopic input into a sensible three-dimensional model of the world. Moreover, these perceptual assumptions facilitate the prediction of later events. Representational momentum is one illustrative example.

In the first demonstration of representational momentum, Freyd and Finke (1984) presented participants with four sequential presentations of a rectangle that only varied in terms of where the rectangle appeared onscreen. The first three rectangles were presented consecutively in either a clockwise or counterclockwise direction. The participant's task was to judge whether the fourth rectangle appeared in the same position as the third. Interestingly, participants made a consistent error: they were more likely to respond "same" if the fourth rectangle was slightly beyond the location of the third, along the expected trajectory. That is, participants couldn't help but be biased by a kind of perceptual inertia. In 1996, Reed and Vinson examined whether this perceptual prediction was an impenetrable, low-level visual phenomenon or whether it could be modulated by prediction-relevant conceptual knowledge. In their study, participants were told that the rectangle (now with a pointy top) was a "rocket" or a "steeple." Participants told that the shape was a "rocket" experienced more representational momentum than participants told that the shape was a "steeple," but only when the shape ascended in a vertical trajectory, as a rocket would. This finding illustrates that top-down semantic knowledge can influence bottom-up stimulus processing to ensure that our perceptual predictions are consistent with our knowledge of the world.

The need to predict can be observed at all levels of information processing from the retina to complex social behavior. Gilbert, Pelham, and Krull (1988) showed that a cursory glance of someone's behavior floods our minds with thoughts about that person's personality, intentions, and emotional state. Being able to attribute internal states from the actions of others is invaluable. Simply observing that Alex bought the *Washington Post* has little predictive value in and of itself. Using the same observation to infer that Alex is probably a well-educated, politically aware, mid-Atlantic resident with Democratic leanings is potentially far more useful in predicting his future behavior. Clearly, the brain must generate predictions at multiple, interacting levels of analysis (Bar, 2007). How this prospection is realized in the wet matter of glia and neurons is not well understood. However, adaptation and prospective coding may be two relevant indices.

The Neurobiology of Prospection

Adaptation

One way to probe the processing characteristics of a particular cortical region is to observe its adaptation dynamics. If neurons adapt (fire less) to a repeated stimulus, it suggests that the first presentation of the stimulus facilitated those neurons. That is, the first presentation *potentiated* particular neural pathways through which subsequent presentations are processed more rapidly. Several researchers have suggested that this neuronal adaptation, and its hemodynamic correlate "repetition suppression," reflects the brain's ability to make predictions in order to increase efficiency (see Henson, 2003; Schacter & Buckner, 1998; Wiggs & Martin, 1998, for reviews). Part of this efficiency is the speed with which the neurons resolve "prediction error" (Grill-Spector, Henson, & Martin, 2006). Prediction error is defined as the difference between the prediction and the actual occurrence (evidence). If you expect to get a painful injection but feel nothing, the prediction error is larger than if the predicted pain occurred. Prediction error is resolved through recurrent processing and is an essential mechanism of learning. How quickly neurons adapt to a stimulus reflects the size of the prediction error. Thus, neural adaptation may be considered an index of the "goodness of fit" of a neural prediction. The more accurate the prediction, the smaller the prediction error and the more efficient the processing.

Adaptation is not limited to tracking identical visual repetitions. Instead, it appears to be a general neural mechanism. In the inferotemporal cortex, adaptation is robust to whether a stimulus (e.g., chair) changes in size and location, indicating that this region cares about semantic categories more than specific visual details (Ito, Tamura, Fujita, & Tanaka, 1995; Lueschow, Miller, & Desimone, 1994; in humans: Dehaene et al., 2004; Grill-Spector, Kushnir, Edelman, Avidan, Itzchak, & Malach, 1999). Purely conceptual information can also show adaptation effects. Reading the word "dog" produces less activity after another animal word (e.g., "horse") than after the word "cup." As the letters of words are arbitrary symbols, the reduced activity in this example can only be caused by the conceptual repetition (Wheatley, Weisberg, Beauchamp, & Martin, 2005). More recently, adaptation has been used as a tool to probe even higher order judgments, including the understanding of self and other (Jenkins, Macrae, & Mitchell, 2008). In sum, neuronal adaptation appears to be a useful index for the strength of *any* neural prediction.

Most commonly, adaptation has been used to probe the contents of particular brain areas. If seeing an apple for the second time reduces activity in brain region X, then brain region X is assumed to care about apples. The focus of research has been on neural prediction (the mapping of neural commands to their effects), not neural prospection (the prediction of future events). However, it could be used in this way.

For example, in the sequential will study, making a fist likely readied the brain for the act of knocking because the two are temporally correlated. If so, the act of knocking would have required less energy (more adaptation) than doing something unrelated to having made a fist. Perhaps one reason why adaptation has been underutilized as a prospective trace is that it requires an inference of its own—that the observed adaptation was caused by prior facilitation. A more direct index of prospection would gauge the facilitation itself. Single cell recordings with monkeys and recent multivoxel pattern analysis with humans suggest that it is now possible to measure neural codes that directly predict upcoming thoughts and actions.

Prospective coding

Prospective coding refers to the anticipatory or predictive component of neuronal firing. Neurophysiological research has shown that neurons in the lateral prefrontal cortex of rhesus macaques predict the monkey's next action (Rainer, Rao & Miller, 1999) and the reward value of upcoming trials (Watanabe, Hikosaka, Sakagami, & Shirakawa, 2002). Of course we cannot infer from these results that the monkey is consciously thinking ahead, but part of the brain appears to be anticipating the monkey's next move. More recently, similar prospective codes have been demonstrated in humans.

Soon, Brass, Heinze, and Haynes (2008) updated the classic Libet paradigm by having subjects decide whether to press a button with their left or right hand while lying in a functional magnetic resonance imaging (fMRI) machine. Similar to Libet's "planned action" condition, subjects reported that they decided to act about a second before they pressed the button. Soon et al., were curious to find out whether these decisions could be detected earlier in the brain data. That is, could hemodynamic activity reveal subjects' decisions before they even knew it themselves? By using machine learning algorithms to detect patterns associated with upcoming decisions, Soon and colleagues found something remarkable. Two regions in the brain predicted subjects' upcoming decisions several seconds in advance, much earlier than the time at which subjects first became aware of these decisions. These two regions were located in the posterior parietal and lateral prefrontal cortices.

While subjects' decisions could be predicted by the brain data much earlier than phenomenology, the accuracy of these predictions was not 100% or even 80%. It was simply, but importantly, above chance. This suggests that Soon et al., were not tapping into a specific prospective code linked to a single motoric decision. Instead, this weak but reliable prediction several seconds in advance may best be characterized as a *biasing* of the system. As one gets closer to the actual decision, this biasing may narrow into a single, stronger prospection.

From diffuse biasing to specific action codes, prospection appears to be the modus operandi of multiple sensory and motor systems in the human and other mammalian brains. Herein lies the rub. If neural prospection is a general process across species, how could it further our understanding of a phenomenological experience presumed to be unique to human minds? The following section offers a theoretical account of how this general mechanism of neural prospection may be fundamental to the feeling of will.

NEURAL PROSPECTION AND THE FEELING OF WILL

In all mammals, environmental unpredictability leads to poor physical and mental health. Rats given unpredictable electric shocks develop extensive stomach ulcers and give up pressing a bar for food. When the identical series of shocks are paired with a warning sound the negative outcomes are greatly reduced (Weiss, 1970). From rats to humans, predictability impinges as much or more on physical and mental health as the nature of the situation itself. In humans, unpredictable negative events can lead to post-traumatic stress disorder and panic disorders which in turn exacerbate anxiety to unpredicted threats (Grillon, Lissek, Rabin, McDowell, Dvir, & Pine, 2008). Predictability affords a level of control. Even though I cannot control the weather directly, I can grab an umbrella in response to a rainy forecast. Even if I know I will receive an electric shock, I can prepare myself psychologically. The occasional surprise party aside, knowing exactly what is coming down the pike is the preferred state of affairs. And even when we don't know what will happen next, we find comfort in believing that somewhere, Someone has a master plan. On a more micro time scale, prospective coding may offer a measure of the predictability we desire.

The kind of predictability afforded by prospective coding is very different from foretelling whom we will marry, but it may provide something nonetheless powerful: the feeling of being in command. A paradox of human behavior is that even when we have no conscious awareness of what we are about to think, say or do, our thoughts, words, and deeds rarely surprise us. Though we do not know exactly what we are about to say, the words tumble out sounding reasonable. Gestures are unplanned yet feel natural. Even when we find ourselves picking lint off our sweater it feels as if somehow, deep down, we knew we would do it.

In Wegnerian terms, realized prospective codes are fulfilled previews. Thus, prospective codes can contribute two of the three necessary ingredients of will: priority and consistency. However, these two ingredients cannot by themselves yield the full experience of will. For that, we must perceive that we are the sole and voluntary author of our actions (exclusivity).

Authorship

Exclusivity refers to the knowledge that the action, thought, or event was initiated voluntarily by oneself without external manipulation. In the I Spy paradigm, participants did not misattribute will if they believed that the confederate heard the same preview words as themselves (Wegner & Wheatley, unpublished). Hearing the preview word and seeing the consistent stop was not enough—participants needed to think that the preview was theirs alone.

Exclusivity provides authorship; defined as "*I initiated this action*." Recent neuroimaging evidence suggests that this perceived authorship may require activity in the ventral medial prefrontal cortex (vmPFC). This region is engaged when introspecting about oneself (Blakemore, Winston, & Frith, 2004; Mitchell, Banaji, & Macrae, 2005) and shows relevant adaptation effects: self-reflections activate this area less if prior thoughts were also self-relevant (Jenkins, Macrae, & Mitchell, 2008). Thus, thinking about oneself activates this region, which then facilitates more self-relevant processing. Together, the realization of prospective codes and the attribution of authorship fulfill the three sources of will. The following section examines how these ingredients of will may combine in different strengths to produce a variety of phenomenological experiences.

PROSPECTION AND AUTHORSHIP

As can be seen in Figure 13.2, prospective coding and authorship may interact to produce several perceptions associated with the feeling of will (or lack thereof). The following paragraphs detail these categories, organized by the nature of the prospection.

No Prospection

The first column in the figure is the least likely to be associated with will. Here, actions occur without any relevant, anticipatory neuronal activity. This is commonly the case when watching others act in unpredictable ways. However, this can also occur when one behaves so quickly—so reflexively—that prospective codes have no chance to develop.

Without Authorship

If a completely unexpected action occurs and we feel no authorship for it, it is impossible to experience the act as willed or intentional. Our predictions about what may happen in the near future are incorrect, violating the tenets of priority and consistency. Moreover, we feel that we are not the one performing the action, additionally violating the principle of exclusivity. Because these actions are unpredictable, they may seem strange and misplaced. Imagine that a colleague stands up in a meeting and starts doing jumping jacks. Nothing in the environment, or in our past knowledge about this colleague, could have facilitated such a prediction, thus there would have been no relevant prospective neural activity. No will is evoked.

	Neural prospection		
Perceived authorship	None	Unattended	Attended
No	No authorship, no prospection	No authorship, unattended prospection	No authorship, attended prospection
	Unpredicted acts of others	Predicted, unattended acts of others post hypnotic suggestion	Predicted, attended acts of others
Yes	Authorship, no prospection	Authorship, unattended prospection	Authorship, attended prospection
	Unpredicted acts of self e.g., reflex, instinct	Predicted, unattended acts of self e.g., gestures, gait, conversation	Predicted, attended acts of self e.g., willed action

Figure 13.2 Interactions of Prospection and Authorship.

With Authorship

This category contains unpredicted actions of the self. Here authorship is fulfilled—the action is deemed self-initiated—but no relevant prospective codes are in place. Such a situation may occur if an action happens so quickly that it cannot engage a predicted neuronal association (e.g., reflexive behavior). The potential lack of a prospective code may help explain why people who impulsively risk their lives to rescue others are uncomfortable with the label "hero." Recent newspapers report two such examples. In one, passer-by Michael Warburton spotted an elderly woman struggling to escape a burning building. He ran to help, grabbed a neighbor's ladder and climbed up to the roof. Later he eschewed the label: "I'm not a hero. Instinct just took over." Likewise, a cop who grabbed the loaded gun of an assailant thereby thwarting a homicide clarified: "I wasn't being brave, I was just reacting." Their discomfort with the label may be caused by the lay belief that heroic acts must be *decided in advance*, with full knowledge of the consequences. Instinctive acts may feel unwilled because they are too rapid to gain a prospective neural foothold. Our body does the acting while our mind lags behind. Five minutes before he climbed to the roof of the burning building, Michael Warburton was looking out the window of his girlfriend's car. Jumping out of the car and racing toward fire would not have felt predictable despite the undeniable fact that it was his body doing the racing. Instinctive and reflexive actions hijack our bodies regardless of whatever Bayesian neural facilitation was leading us to expect.

Unattended Prospection

The second column of Figure 13.2 refers to prospective codes that are fulfilled but unattended. Such prospective codes are likely to occur for everyday actions that typically unfold without our attention (e.g., walking). These codes may be singular (as in the specific facilitation of putting one step in front of the other) or diffuse. Diffuse prospective codes may occur when multiple associations are facilitated with the strength of each being inversely proportional to the total number. Thus diffuse prospective codes may be inherently weaker than prospective codes for a specific event.

Without Authorship

This category refers to the situation in which we have a vague idea of what we may see, hear, or feel but no concomitant sense of authorship. Returning to our overathletic colleague, it may seem strange to witness his jumping jacks in the middle of a meeting, but reasonable to witness the same behavior at a gym. Entering a gym primes us to detect acts of athleticism, broadly defined. Thus the processing of jumping jacks is facilitated, albeit weakly, along with other athletic acts one might expect given the setting. Clearly, vague expectations of others' actions are unlikely to feel willed. It may also seem obvious that only the acts of others would end up in this category. However, posthypnotic suggestion may be an unusual case in which a subject's own actions feel predicted but not self-initiated.

Posthypnotic suggestions are commands given during hypnosis that are intended to be obeyed once the subject is out of the hypnotic state. For example, a hypnotist might say "after you awaken from hypnosis, you will turn your head every time you hear me cough." Typically, these suggestions are combined with a suggestion of amnesia: "but you won't remember that I told you to do so" (Shor & Orne, 1962). This begs the question: how does the subject forget the instruction and remember to do it at the same time? For now this mystery remains unsolved though it suggests a stratified nature of consciousness (Schooler, 2002). Most importantly for the present discussion is how a posthypnotic suggestion *feels*. In collaboration with Dan Wegner, we ran several studies using posthypnotic suggestion and were surprised by the consistency of subject's self reports. Subjects referred to feeling a powerful urge to do the act without knowing why. One participant later described feeling as though a battle was occurring between his conscious and unconscious mind:

> It was an awkward experience. I felt like there were different parts of me speaking at the same time—different parts of me were analyzing the situation. It was like "I see this apple and this orange" and one part of me was saying "pick it up" but there was another part of me questioning why and then one part of me forces me to do it and the other part still questioning why. Almost like two sides. I didn't feel too whole to tell you the truth.

Even though the actions were self-performed and predictable once the cue was given, subjects lacked a coherent sense of authorship. This is all the more striking given the nature of the suggestions: juggling with fake fruit, rolling a ball along the floor, covering ones ears, and talking into a plastic banana as though it were a telephone. These were not rapid, reflex-like actions nor could they be mistaken for mindless gestures. These were complex behaviors that looked nothing if not self-initiated and intentional. However, the experience of the subject could not have been further from a feeling of will.

The feeling of will for a posthypnotic suggestion was examined via self-report—we simply asked subjects how intentional the action felt. Self-report is the measurement of choice for questions of phenomenology. As Libet put it: "one begins with the premise that the subjective event is only accessible introspectively to the subject himself, some kind of report of this by the subject is therefore a requirement" (Libet, 1993, p. 272). In short, if you want to learn how a person feels, you must ask them.

In order to thwart suspicion in our study, subjects were asked how a variety of actions felt rather than just the posthypnotic suggestion. To reduce the possibility of malingering, subjects were asked how these actions felt over an intercom while they were alone in a room, observed by a hidden camera. A constant stream of sounds played over their speaker allowed for the insertion of an auditory, posthypnotic cue at particular times. Subjects were left alone to play with various toys, knowing that every now and then they would be asked to report out loud what they were doing and how intentional it felt using a seven-point scale (1—not at all intentional; 7—very intentional). The most surprising finding across these studies was the sheer absence of will for the hypnotically suggested acts. The mean intentionality for all normal (nonsuggested) actions was around a 5. In contrast, the modal response for a posthypnotic suggestion was a 1. To put this in perspective, we sometimes asked participants to report on "nonactions" such as staring into space, yawning, or stretching absentmindedly. The purpose of this was simply to avoid suspicion of a hidden camera, but the results provided a useful baseline. Even though participants sheepishly admitted to not doing much of anything at these times, the modal rating was a 3 on a 7-point scale. Staring into space was a "3"! In contrast, deliberately walking over to a particular bookcase in order to use a plastic banana as a telephone was rated as a "1." Something unusual was a foot. Subjects knew what they were about to do but felt like living marionettes. Why?

One intriguing possibility is that posthypnotically suggested actions have unconscious, prospective codes that offer predictability but that these actions are not tagged with a coherent authorship signal.

With Authorship

The bulk of our daily actions reside in the unattended, self-authored category. While the decision to walk to the post office may feel willed, the subsequent actions that get us from point A to point B are only vaguely anticipated in consciousness. The same goes for normal conversation: we may be conscious of the topic and tone but have little access to the specific words that will pop out of our mouths. Nonetheless, conversation is not the worse for wear. A colleague of ours recently commented that he had no idea how to answer a student's question but started talking anyway because he "trusted that the words would come out ok" and they did. Even though we are not actively attending to these actions, we feel a sense that they were self-initiated. To use driving as a metaphor, the experience may be akin to driving a car down a familiar route, as if on autopilot. And similar to driving, when the spotlight of attention shifts to the action at hand, our phenomenological experience becomes more agentic.

Attended Prospection

The final column of Figure 13.2 is the most strongly associated with the feeling of will. Here, fulfilled prospective codes guarantee priority and consistency, and attention intensifies the concomitant phenomenology. Under these conditions, the addition of perceived authorship evokes the prototypical sensation of will. However, even without authorship, a "proxy" or "pseudo" will may arise.

Without Authorship

As noted earlier, the ability to predict future events is comforting and may evoke a sense of mastery. This may help explain why strong predictions of events external to ourselves may sometimes produce a sensation similar to will. Pretend for a moment that you are playing bingo; you are very close to winning and B-13 is the only open spot left on your card. Next, you close your eyes and concentrate as hard as you can on "B-13." Suddenly it is called, and you cry out, "BINGO!" While your rational mind may remind you that this is purely chance, it *feels* as though it was your concentration that tipped the odds in your favor.

The same "proxy will" may be felt by sports fans who feel that their team's performance depends on their own attendance at the game or on what they are wearing. The presence or absence of a lucky sock, for example, may determine the predicted outcome in the fan's mind: "I am wearing my lucky sock therefore they will win." The importance of the game amplifies attention, and the fulfillment of the prediction evokes a sense of personal responsibility.

A similar scenario may apply to the phenomenon "basking in reflected glory," in which fans are more likely to use the collective pronoun after a win ("we won") than after a loss ("they lost"; Cialdini, Borden, Thorne, Walker, Freeman, & Sloan, 1976). The common explanation for this effect is that people attempt to gain social stature by associating with successful others and distancing themselves from unsuccessful others. However, prospection may also be at play, since people often expect their favorite team to do well. This "rooting on" may facilitate the experience of positive outcomes (e.g., hitting the ball). When those prospections are fulfilled (the player hits the ball), it may feel like a collective event. When those predictions are not fulfilled (the player misses), it may feel like the player was acting on his own. Of course, no sane person would admit to willing the Red Sox to victory. However, if forced to be honest with ourselves, it sometimes *feels* that way.

With Authorship

The final category is an easy one. The strongest sense of will occurs when we attend to our own, prospected actions. We feel as though we are in the driver's seat and fully engaged. Thus, this category represents the full-blown, subjective experience of agency, regardless of whether the experience itself is causally effective vis-à-vis action.

PROSPECTION VS. RETROSPECTIVE INFERENCE

By comparing prospection and retrospective inference as two explanations for the experience of will, we do not wish to imply mutual exclusivity. The evidence for neural prospection of will is currently outnumbered by demonstrations of retrospective inference that could not be explained in any feed-forward way (Banks & Isham, 2009; Johansson, Hall, Sikstrom, & Olsson, 2005; Kassin & Kiechel, 1996, Loftus, 1993). Most likely, the feed-forward mechanisms of prospection and authorship work in tandem with retrospective inference to create the full range of subjective experience. Also, the distinction drawn between prospection and retrospective inference is largely temporal (prospective vs. retrospective) rather than inferential (no inference vs. inference). As Wegner notes, "the inference process that yields conscious will does its job throughout the process of actual action causation, first in anticipation, then in execution, and finally in reflection" (Wegner, 2002, pp. 68–69). Thus, prospection and authorship are susceptible to inference if not inferences themselves. The difference between them and retrospective inference is that they occur earlier in time.

SUMMARY

Prospection gives us a sense of agency, a feeling that the world is a predictable place and we are in command. This may well be illusory. We know that normal, healthy adults can be misled in matters of will, that patients can feel will for actions they can't perform (e.g., for phantom limbs) and lack will for actions they do perform (e.g., alien hand syndrome). Thus, the feeling of will can be imputed, manipulated, and taken away—all inappropriately and independent of action. Currently there is no evidence that the feeling of will is any more than an illusion.

And yet the illusion not only persists, it thrives. Regardless of whether the feeling of will does anything in a causal sense, the perception that everything happens for a reason and that our conscious selves are at the helm allows us to experience life more fully. Those who overestimate true contingencies between their actions (e.g., button press) and an outcome (flash of light) are less likely to be depressed than those who are more accurate. The depressed are "sadder but wiser" (Alloy & Abramson, 1979). The proactive nature of our brains helps keep us sane, comforted, and feeling as though we are in command of all of our actions even as we stare into space.

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