86 Authorship Processing

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ABSTRACT Authorship processing supports the perception of events, actions, and thoughts as issuing from the self as a causal agent. To discern whether a given item is authored by self or has arisen from some other source, this processing mechanism consults authorship indicators—sources of information about the likely origin of the item. The elemental indicators include body and environment orientation, direct bodily feedback, direct bodily feedforward, visual and other indirect sensory feedback, social cues, action consequences, and action-relevant thought.

How can you tell that you're reading this sentence? Why is it so clear to you that it is not someone else who is doing this? For that matter, how do you know it is not just an event happening without anyone doing it at all?

Each of us can typically offer reliable answers to many questions of our own authorship, sometimes with remarkable rapidity ("Of course I was reading the sentence!"). This suggests that there is an efficient system of mind that deploys ready answers to questions of one's own agency. The topic of this chapter is this system for *authorship processing*, the set of mental processes that monitors indications of authorship to judge whether an event, action, or thought should be ascribed to self as a causal agent.

To explore how authorship is assessed, we begin by examining what authorship is and why authorship could be unclear. We then examine a series of authorship indicators—sources of information that influence the judgment of authorship—examining how these indicators inform the experience of authorship of action and thought. As we shall see, one of the main authorship indicators is intention. The person uses the previews of action that occur in mind as signs that the action emanated from the self (if I had the thought of doing it and then it occurred, I must have done it).

Why is authorship ever unclear?

Many people assume that authorship is a given, a kind of knowledge that arises in the very process whereby actions are produced. If I do something, how could I not know that I did it? The process through which mind causes an action seems to require knowledge of the action for the causation even to happen, so knowledge of authorship appears simply inherent in the way the action is produced. The usual experience of action as following directly from our conscious will suggests that we should always be intrinsically informed of our authorship. Indeed, an auxiliary system for discerning our authorship would be redundant, perhaps even likely to create confusion. Yes, we might occasionally forget about having caused an action and thus report its authorship incorrectly, but by and large, we should be able to report our authorship of actions we consciously will. If the self causes actions, it must know them.

The idea that authorship needs processing, then, only makes sense if we suspect that conscious will does not cause action. In this sense, the study of authorship processing is built on the assumption that our intuition about how actions occur is deeply flawed, an illusion created by a lack of insight into mental causation. It is only if we do not consciously cause our actions but only come to feel that we do that we might need a mental system for authorship processing—the ascription of the movements of our bodies and workings of our minds to our selves (Wegner and Wheatley, 1999; Wegner, 2002, 2003). Authorship processing, in this light, may be the mechanism that produces our experience of a self as a cause of our actions (Spence and Frith, 1999; Wegner and Wheatley, 1999; Metzinger, 2003; Wegner, in press). In contrast to the Cartesian dictum, *cogito ergo sum* (I think, therefore I am), the struggle to find an author for our actions may yield a quite different path to self, *ago ergo sum* (I act, therefore I am).

As a first step in the analysis of authorship processing, then, it is useful to ask whether and when people make mistakes in appreciating the authorship of their actions or thoughts. Does conscious will always illuminate actions to us as we do them, intrinsically informing us of our authorship, or do we make enough mistakes in authorship that this is something that indeed requires special processing? The following examples are illuminating:

- Normal people often report losing consciousness of acting, particularly when the action is repetitive or well-learned (Schooler, 2002).
- Patients with schizophrenia may say that their actions feel as though they were under the control of someone else. As one patient said, "When I reach for the comb, it is my hand and arm which move. . . . But I don't control them. I sit watching them move and they are quite independent, what they do is nothing to do with me. I am just a puppet

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manipulated by cosmic strings" (Graham and Stephens, 1994, p. 99).

- Patients with brain damage leading to alien hand syndrome experience one hand acting without their conscious will, with a "mind of its own" (Geschwind et al., 1995).
- Normal individuals helping someone communicate at a keyboard can create messages on the other's behalf, fully believing that the other is the author, when they themselves are actually originating the communications (Wegner, Fuller, and Sparrow, 2003).
- Survivors of life-threatening danger often report that the event led to an experience of depersonalization, a sense of strangeness and unreality that included the perception that their actions were involuntary or automatic (Noyes and Kletti, 1977).
- People who are susceptible to hypnosis describe the actions they perform in the state as involuntary, even though the actions appear complex, multifaceted, and temporally extended. Even behaviors performed in waking that result from posthypnotic suggestion are described as occurring without conscious will (Lynn, Rhue, and Weekes, 1990).
- When people are asked to try not to think about their intention before performing a simple task (such as winding thread on a spool), they report an increased sense that the action just seems to "happen," rather than that they did it on purpose (Wegner and Erksine, 2003).

There are a variety of anomalies of authorship, errors produced not only by brain damage or psychopathology but also occurring in normal individuals responding in special situations. These examples suggest that authorship knowledge is not a "given" when people produce apparently voluntary actions, and instead that resolving the question of authorship for any action may require considerable information and inference. What exactly is it that people are trying to judge when they describe their sense of authorship?

The nature of authorship

Authorship processing is a form of causal inference in which events are attributed to entities that are perceived to cause them. The idea that people are entities that cause things to happen is an old one, of course, but the idea that this is a unique form of causal judgment is somewhat more contemporary (Michotte, 1963). Fritz Heider (1958; Heider and Simmel, 1944) emphasized that the perception of agency or authorship in animate objects is quite unlike the perception of causation that occurs for physical events or inanimate objects (as when one marble rolls into another). Agents are seen as first causes or uncaused causes, origins of action to which authorship can be ascribed. Authorship is not of concern in determining the causal underpinnings of events caused by prior events, then, and only arises when events are traced to agents.

Agents are entities that cause events through self-movement. Agents of all kinds (humans, animals, plants, and even artificially intelligent software devices) can be described in terms of the operation of sensors, processors, and actuators. Agents input information through sensors, process the information, and output behavior through actuators (Russell and Norvig, 2003). An agent may sense a flying object, recognize it as a housefly, and dart out a tongue to snatch it (ideally, this particular agent is not a human). Quite simply, agents appear to cause events "on purpose," and this facility is the basis for authorship ascriptions (Johnson, 2003). An observer asked about this event, for example, would likely mention that "the frog ate the fly," rather than describing the mechanism of causes and effects underlying the event.

Processing one's own authorship is a subset of the general problem of processing the authorship of any agent. However, there is an important difference. When we ascribe an act to another person, we often do so dispassionately, noting merely that this is something they have done ("he hit the ball"). Part of authorship processing involves just such judgments pertaining to our selves. However, when we sense our own authorship of an action, there is an additional quality present, a feeling of doing, that marks the event uniquely. The feeling of doing adds a psychological exclamation point to the action ("I hit the ball!"). This experience of consciously willing the action is the feeling that anchors our pesky intuition that we might not even need to analyze authorship at all—that we are intrinsically informed of authorship in causing our actions.

The experience of consciously willing an action is an *authorship emotion* (Wegner, 2002), a feeling that ties the basic fact of the causal event to a bodily response and lends it a sense of "embodiment" (Barsalou et al., 2003). Knocking in a nice pool shot, opening up a box of candy, or typing the letter T can each be remembered and identified as "my own" more readily because of the experience of conscious will. This experience need not be a veridical expression of how the action came about (although we tend to interpret it this way), but it does serve to authenticate the action as something done by the self. Authorship seems to be a self-recognition of agency, then, that has both a rational component (knowledge that one was the agent causing the action) and an experiential component (the feeling of consciously willing the action).

Authorship should be distinguished from ownership. Several of the thought anomalies that occur in schizophrenia, for example, give rise to experiences of thoughts occurring in one's own mind but which are seemingly authored by someone else (Frith and Fletcher, 1995). When this happens, the thought may still seem owned by the self, in that it occurs to the self and can be self-reported, but it can seem not caused by the self, in that another mind was the agent that made it occur (Stephens and Graham, 2000;

Gerrans, 2001). The simple fact of having a thought occur in mind may not be sufficient to guarantee that the thought is something one authored. An experience of authorship involves an ascription of a thought or action to an agent as cause.

Authorship indicators

Authorship processing normally seems unproblematic and transparent, yielding rapid-fire judgments of what one has done. Yet these judgments must take into account bits of information from multiple sources that often arrive in varied order (Georgieff and Jeannerod, 1998; Frith, Blakemore, and Wolpert, 2000). Authorship cues arrive from the environment, direct bodily feedback, indirect bodily feedback, direct bodily feedforward, social situations, knowledge of action consequences, and knowledge of action-relevant thoughts. Often these authorship indicators converge and complement each other, and sometimes they conflict, but each may be sufficient to support inferred authorship in the absence of others.

THE BODY IN THE ENVIRONMENT The relationship between body and environment provides cues to authorship. Actions often require props or tools, for example, or they can only be done by someone who is in a particular place or has a certain vantage point. Cooking happens in kitchens, yelling happens at sports stadiums, painting happens when a brush is at hand, and so on. Any environment affords some actions and not others, so knowing one's relation to the environment is a clue to authorship. This realization is part of the ecological approach to perception and action (Gibson, 1977), and has also been described in accounts of action identification (Goldman, 1970; Vallacher and Wegner, 1985). An action alone in a room may be "pursing lips," for instance, whereas the same action in the presence of a lover may be "puckering up for a kiss." Knowing what the action is, in turn, may contribute to understanding who did it.

Environments can be sufficient to stimulate relevant actions. In patients with certain forms of frontal lobe damage, for example, environmental stimuli can cause action in what has been called "utilization behavior" (Lhermitte, 1983). One patient was induced by the mere presence of a glass of water to drink repeatedly, eventually downing a whole liter even though he said he was not thirsty. In normal individuals, in turn, contextual primes suggesting thoughts of aging can prompt people to walk slowly (Bargh, Chen, and Burrows, 1996) and primes suggesting intelligence can lead people to perform well in a game of Trivial Pursuit (Dijksterhuis and van Knippenberg, 1998). However, the stimuli that prompt behavior do not simultaneously and automatically induce knowledge of authorship. A stimulus to behave may yield the behavior and also prompt a secondary processing of the stimulus to yield an authorship judgment, but these pathways are separable. Beyond their influence on behavior per se, environments serve as cues to authorship inference.

Ambiguities in authorship occur when environmental cues do not distinguish one author from another. One case of such confusion can be observed when two people are in a position to perform the coaction of moving a Ouija board pointer. Both place their fingers on the pointer and attempt together to "receive messages" from some spirit agent. This circumstance obscures whether any particular movement is one's own or belongs to the other (or is that of the imagined spirit), and the sense of authorship may be lost while the pointer spells out messages. A study modeled on the Ouija board setting found that the authorship confusion is sufficient in this context to make people lose the capacity to track their causal influence (Wegner and Wheatley, 1999). In general, however, the perception of one's body in its environment can be a helpful authorship clue. The person standing near the elevator buttons, after all, is likely to be the culprit who pushed them all.

BODILY ACTION FEEDBACK The most widely studied authorship indicators are the forms of sensory feedback about action that the brain receives directly from the body. Such proprioceptive or kinesthetic feedback includes sensations derived from muscles, skin, joints, and tendons, as well as from the vestibular system (Gandevia and Burke, 1992). These indicators not only point to what was done, but may subtly contribute to judgments of authorship. Obviously, we lack such feedback for the movements of others, so this authorship indicator is only helpful for discerning authorship other than our own by a process of elimination. If I didn't feel I did it, perhaps you did it.

Much of the study of proprioception has been carried out under the assumption that bodily processes are the sole basis of the processing of authorship. Historical arguments about topics such as muscle sense, innervation sensations, efference copy, and the like have raged in part because it seemed that the pathway from mind to action and back for simple voluntary actions could yield a full understanding of how authorship is determined (Scheerer, 1987). However, two key observations suggest that such direct perception of the body is only a part of authorship processing.

First, there is no proprioception for thought, but thoughts certainly vary in the degree to which they seem authored by the self. Creative insights, for example, often strike as "bolts from the blue," and are experienced as much less willed than are other thoughts (Schooler and Melcher, 1995). And as mentioned earlier, thoughts experienced as authored by other agents are common in schizophrenia (Hoffman, 1986; Frith, 1992). Unless a muscle connection is suggested for all mental events, authorship processing for thoughts cannot involve any of the standard pathways assumed for proprioception. A second reason for doubting the primary influence

of proprioception in authorship processing is that proprioceptive influences are often weak in comparison with other sources of feedback (Fourneret and Jeannerod, 1998). Indirect sources of feedback can eclipse proprioception in producing authorship ascriptions.

DIRECT BODILY FEEDFORWARD A great deal of research in the history of psychology and physiology has been devoted to establishing the origins of proprioception. The focus has been on whether we sense our movements by virtue of outgoing or efferent signals from brain to body, through incoming or afferent signals from body to brain, or through some combination of these. The question has been whether knowledge of what will be done is ever necessary for authorship processing, or whether authorship is determined solely by information about what has been done. Current answers suggest that the combination of outgoing and incoming signals is often required (Jones, 1988; Gandevia and Burke, 1992; Jeannerod, 1997).

The role of outgoing or efferent signals is demonstrated, for example, in research on the central cancellation of the tickle sensation (Blakemore, Wolpert, and Frith, 1998). The feeling of being tickled is more pronounced when the tickle stimulus is not self-produced. Signals originating in the process of producing the tickling movement must somehow operate to cancel the tickle sensation. Blakemore and colleagues (1998) provide evidence that this form of authorship processing occurs on the way to the sensation of being tickled through deactivation of cerebellar function by the tickling action. The conclusion suggested is that authorship of action is influenced by motor plans, not only by sensations returning to the brain from peripheral sensation.

VISUAL ACTION FEEDBACK People can be fooled by indirect visual feedback about the authorship of their own actions. To begin with, visual feedback can be sufficiently compelling that it influences the perceived locus of sensations. Botvinick and Cohen (1998) found that people who watched a rubber hand being stimulated while their own hand was similarly stimulated out of view came over time to sense that they were feeling the stimulus being applied to the rubber hand (see also Pavani, Spence, and Driver, 2000).

False visual feedback can also influence the experience of authorship. In an early study, Nielson (1963) had participants view what appeared to be their own gloved hand, but which was actually the hand of an experimenter projected in its place. When the experimenter's hand went astray in drawing a line, participants regularly attempted to compensate. Subsequent research finds that such misperception is increased when the other's hand is oriented in the same way as one's own hand (fingers pointing away from the body), and is particularly increased when the other's hand is performing the same action as one's own hand (van den Bos and Jeannerod, 2002). Similar brain activations have been found in a positron emission tomography study when one's own and other's hands have similar orientations (Farrer et al., 2003). The readiness to accept visual feedback in place of proprioception makes sense in view of the finding that in monkeys, visual cues and proprioceptive cues for limb position act on the same neurons (Graziano, 1999).

Normal individuals have been found to be moderately susceptible to misleading visual feedback, whereas people with schizophrenia are far more susceptible, often showing exaggerated tendencies to mistake others' visually presented hand movements for their own (Daprati et al., 1997). Both normal and schizophrenic individuals make more errors when their own and the other's hand movements are presented with temporal delays (Franck et al., 2001). Individuals whose parietal cortex lesions have led to certain forms of apraxia are also susceptible to visual overshadowing of proprioception. Apraxic and control participants in one study were asked to produce simple and complex hand movements to be viewed on video, and were to judge whether it was their own or the experimenter's hand. Apraxics were worse than control subjects when experimenter movement was consistent with their own planned movement, for complex movements. These errors occurred when subjects performed the movement inaccurately and the experimenter performed the movement correctly (Sirigu et al., 1999). It is as though subjects preferred to claim authorship for the experimenter's correct movement when their own movement was faulty. Overall, the susceptibility of both normal and special-population participants to misperceptions of own hand movement in these paradigms suggests that visual feedback can have a profound influence on authorship.

SOCIAL CUES When the prom queen and king get tangled up and fall to the floor during the spotlight dance, people want to know who did it. Questions of authorship are often social questions. Authorship processing in social situations involves the presence of other agents, of course, and so introduces layers of complexity beyond "whose hand was that?" Other people have not only other hands but also other minds, and the many processes involved in mind perception can affect how authorship is understood (Wellman, 1992; Baron-Cohen, 1994; Gilbert, 1997; Flavell, 1999; Blakemore and Decety, 2001).

The issue of authorship in social settings is most acute in cases of *obedience* and *imitation*. In the case of obedience, when one person instructs another to act, the first person may be understood as deserving a share of authorship ascription for the second person's action. This sharing of authorship influences individuals' perceptions of their own authorship and seems to affect even the most basic aspects of authorship processing. If you pick up a pen to write, for example, your experience of authorship may be strongly

undermined by the mere fact that another person picked up a pen just before you did, or that another person asked you to pick it up. When people obey or follow others, they experience an "agentic shift" such that their sense of authorship is reduced (Milgram, 1974). Chaminade and Decety (2002) have observed differential brain activity underlying the experience of leading versus following the actions of another. The dramatic reductions in experienced voluntariness of action accompanying hypnosis (Lynn, Rhue, and Weekes, 1990) provide another example of this phenomenon.

Imitation is a second social situation in which authorship processing becomes complicated. A variety of recent studies suggest that there are important interrelations among the cognitive processes and brain structures that support the perception of others' actions and the production and perception of own actions (e.g., Jeannerod, 1999; Dijksterhuis and Bargh, 2001; Ruby and Decety, 2001; Decety et al., 2002; Prinz and Hommel, 2002). The discovery of mirror neurons in monkeys, which are activated both by performing an action and by watching another perform an action, also points to the possibility that imitation may be supported by a common neural substrate (Gallese et al., 1996; Rizzolatti et al., 1996). The question of whether action and perception of action are entirely enmeshed in the brain, however, remains a matter of discussion (Gallese and Goldman, 1998; Gallagher, Cole, and McNeill, 2002).

One conclusion suggested by this work is that authorship processing may occur at early stages of action perception and production, rather than requiring high-level cognitive processing or rational inference. The potential common coding of action and perceived action may promote distinctions between self and nonself early in the production of action, as in the case of the aforementioned cancellation of self-produced tickle sensations (Blakemore, Wolpert, and Frith, 1998). However, the common coding of one's own and other's action might also provide occasions for the confusion of own and other authorship. In imitating another person or empathizing with the other, the individual may lose track of one's own authorship because the neural bases of self's action and the perception of other's action are enmeshed.

ACTION CONSEQUENCES Sometimes the consequences of actions help to establish authorship. When individuals are known to have preferences for action (e.g., Reeder et al., 2002), consequences consistent with preferences are telling. If you want a cup of soup and your friend wants a big steak, for example, you will likely perceive your friend as the author of your travels if you end up making a joint trip to a steakhouse. Information indicating what self and other agents want can figure prominently in authorship processing because the assumption that agents are self-interested guides inferences of authorship (Miller, 1999). People are likely to locate causality in the self when they have succeeded in performing an action, and less likely to do so when they have failed (Jenkins and Ward, 1965; Langer and Roth, 1975). Success is normally defined in terms of the self-interest of an individual, so the person for whom things turn out well is likely to be seen as having been "behind" the course of events. When things go particularly well, however, people may be tempted to ascribe authorship to an external agent such as God who could have caused the good fortune (Gilbert et al., 2000).

The consequence of an action may increase the person's experience of willing the action when the consequence lends purpose to the action. Wheatley (2001) asked participants to perform each of a variety of different simple actions (e.g., put hands out, facing each other). They were subsequently asked to perform an action enabled by this prior act (e.g., clap) or an action unrelated to the prior act (e.g., reach arms over head), and then to report their experience of intentionality for the initial action. Those who performed the enabled action reported greater feelings of intentionality for the initial action. When the initial action had an apparently reasonable consequence, it was experienced as more likely to be authored by the self.

Action consequences can become bound to action even more concretely, as discovered by Haggard, Clark, and Kalogeras (2002). Participants performed either a voluntary finger movement or an involuntary finger movement (instigated by transcranial magnetic stimulation), which was followed by a tone 250 ms later. Participants shifted their perceptions of both the timing of the finger movement and the corresponding tone, depending on the voluntariness of the action. In the voluntary movement-tone pair, participants perceived that the finger movement occurred later and the tone occurred earlier. The opposite pattern was found for the involuntary movement-tone pair. This pair repelled each other, with participants perceiving an earlier movement and a later tone. A perceptual binding of action and consequence might conceivably influence authorship judgments as well.

ACTION-RELEVANT THOUGHTS A person's own thoughts about action are a key source for understanding action authorship. The person who thinks of suicide in advance and writes a note before plummeting from a cliff, for example, is likely to be understood as the author of his or her own death, whereas the person who has no prior mental output may be viewed as merely clumsy.

In nonscientific intuitions about the mind, of course, some thoughts about action—intentions—are presumed to have the special status of causing action. Other thoughts may not be seen as causal but can bear on whether an action was intended or not, such as when legal or moral interpretations hinge on issues of *mens rea*, or guilty mind, or when religious opprobrium is attached to "unclean thoughts." In

understanding how people use thoughts to arrive at judgments of authorship, however, these special mental states may be no different from garden variety thoughts about an action such as self-predictions, hopes, desires, beliefs, expectations, action identifications, or conscious perceptions of the environment. All the various things a person might think about that are relevant to a particular action could conceivably influence the perception of action authorship. By the same token, the processing of authorship for a thought may take into account the constellation of other thoughts relevant to the target thought.

The idea that thought could influence the experience of authorship was recognized by Hume (1888). He held that the "constant union" and "inference of the mind" that underlies the perception of causality between physical events must also give rise to perceived causality in "actions of the mind." Drawing on this idea, the theory of *apparent mental causation* (Wegner and Wheatley, 1999; Wegner, 2002) suggests that the experience we have of causing our own actions arises when we draw a causal inference linking our thought to our action. When thought seems to cause action, we experience will. Principles guiding such inferences follow principles of attribution and inference that govern cause perception more generally (Heider, 1958; Michotte, 1963; Kelley, 1972; Gilbert, 1997).

According to this theory, when a thought appears in consciousness just prior to an action, is consistent with the action, and is not accompanied by salient alternative causes of the action, we experience conscious will and ascribe authorship to ourselves for the action. In contrast, when thoughts do not arise with such priority, consistency, and exclusivity, we experience the ensuing actions as less willed or voluntary. The theory suggests that authorship is experienced primarily when thought about action is the primary candidate for having caused the action that is observed.

For many actions, we often do have thoughts of action that are consistent, prior, and exclusive. We may think of driving to work before we do so, for example, so when we indeed go, we quickly conclude that we did it. If we were not thinking of driving to work but nonetheless found ourselves suddenly on the way to the office, the lack of consistency between our thought and action would undermine our feeling of conscious will for the action. If we thought of going to work only after the action, in turn, we would have the requisite consistent thought, but its lack of appropriate priority would yield little sense of will for the action. And, of course, if we were led to drive to work by other forces—say, a series of oddly placed detour signs—even if we had thought of going and had been contented with the idea, we might find our experience of will undermined because the thought was not an exclusive cause.

Evidence from several experiments has accumulated relevant to this theory. Tests of the consistency principle, for example, examined whether people accept authorship of actions merely because they have had thoughts consistent with those actions (Gibson and Wegner, 2003). Participants were asked to type letters randomly at a computer keyboard without seeing the screen. They were told that the experiment examined "automatic typing" and that their random responses would be analyzed. Just before this, participants were exposed to the word *deer* in an ostensibly unrelated task. Then the "automatic typing" began and participants typed for 5 minutes. The experimenter ostensibly ran a program on the typed text to extract the words that had been typed, and then asked participants to rate words to indicate the degree to which they felt they had authored that word. None of the words rated were actually produced, yet participants reported higher authorship ratings for the word they had seen in the prior computer task (*deer*) relative to other words, and also reported relatively higher ratings that they had authored an associated word, *doe*. These findings suggest that people can experience will for an action that was never performed, merely when they have prior thoughts consistent with the action (see also Aarts, Custers, and Wegner, 2004).

In a study of the priority principle, Wegner and Wheatley (1999) presented people with thoughts (e.g., a tape-recorded mention of the word *swan*) relevant to their action (moving an on-screen cursor to select a picture of a swan). The movement participants performed was not their own, as they shared the computer mouse with an experimental confederate who gently forced the action without the participants' knowledge. Nevertheless, when the relevant thought was provided either 1 s or 5 s before the action, participants reported feeling that they acted intentionally in making the movement. The operation of the priority principle in this case was clear because on other trials, thoughts of the swan prompted 30 s before the forced action or 1 s afterward did not yield an inflated experience of will. So, even when the action is forced and thought of the action is baldly prompted by an outside stimulus—in this case, over headphones—the timely occurrence of thought before action leads to an erroneous experience of apparent mental causation.

In view of such studies, it appears that knowledge of one's own thoughts can have a pivotal influence on the experience of authorship. Beyond concrete perceptions of environment, the proprioceptive and visual experience of the body, and the perception of the social context and the consequences of action, the world of the mind offers a range of further authorship indicators. Each of us is in the unusual position of knowing the previews our mind offers us for what our bodies do, and we are thus able to make causal inferences about actions that can take those previews into account.

Counterfeit authorship

The authorship of action and thought is something people find out about, not something they know immediately and intrinsically. The evidence surveyed in this chapter makes this point in various ways, and suggests that there may be many instances in which action authorship is experienced incorrectly. People can feel they have done things that they did not do, and can feel they were not authors of things they did. Authorship must be indicated because it is not given in the process of acting or thinking.

HELPING HANDS STUDIES The interplay of authorship indicators is illustrated in studies we have recently conducted on the counterfeit experience of authorship—the sense that one has authored actions actually performed by another (Wegner, Sparrow, and Winerman, 2004). In these studies, participants were led to experience the arm movements of another as if the movements were their own. The participant was attired in a robe and positioned in front of a mirror such that the arms of a second person standing behind the participant could be extended through the robe to look as though they were the arms of the participant (figure 86.1). The second person wore gloves to aid in this illusion. (You might recognize this circumstance as the "helping hands" pantomime sometimes used as a party game.) Participants kept their own arms at their sides and were instructed not to move. Both participant and "hand helper" wore headphones.

For the experiment, the helper's arms performed a series of 32 movements (e.g., snap the fingers of your right hand, wave hello with both hands) in response to a series of instructions the helper was given via the headphones. In the first experiment, participants also heard the instructions for each of the arm movements through their own headphones, or they heard nothing. Those who heard the instructions thus were provided with consistent previews (prior thoughts) for actions they perceived visually to be occurring in the position their own actions might occur. Participants in the second experiment also participated in these preview and no-preview conditions, or heard inconsistent previews (i.e., the instructions would say "wave your left hand" but what would be seen was hands clapping).

FIGURE 86.1. Hand helper (left) and participant (right) in the helping hands experiments.

In both experiments, the consistent previews led participants to report an enhanced feeling of control over the arm movements as compared with other participants. Participants did not feel that they had full control of the arms, of course, as they had no control at all, but they reported a significantly enhanced *impression* of such control.

This impression was found to have psychophysiological consequences. Participants in the second experiment had skin conductance measurements taken while the hand helper twice snapped a rubber band on the wrist of one arm. These snaps occurred before and after the hand movement portion of the experiment. All participants showed significant skin conductance responses (SCRs) to the first snap of the rubber band, perhaps revealing a startle response to the snap. The preview conditions had an interesting effect on the reaction to the second snap. Participants who had heard consistent previews maintained the strong SCR they had shown for the first snap, whereas participants who heard no preview or inconsistent previews apparently had habituated, as they showed reduced SCR to the second snap. Hearing a consistent preview seemed to cause an empathic entrainment and enhanced sensitivity to the other's arm that coincided with the enhanced feeling of control over the arm's movement.

In these studies, authorship indicators were arranged so as to counterfeit the experience of authorship for participants. Environmental cues were deemphasized by having the participant see the helper's arms in place of the participant's own arms. Proprioceptive cues were not manipulated specifically, but visual cues to arm movement were provided by having participants see the helper's arms perform the actions. Social cues to imitation or obedience were not manipulated, and the consequences of the actions were also kept constant across conditions. The key variation, then, was the presence of thoughts consistent with the action—thoughts provided merely by hearing instructions for arm movements—and this variation was found to yield both subtle changes in the experience of authorship and enhanced psychophysiological sensitivity to insult to the observed limbs. In the context of a host of authorship indicators, the occurrence of thoughts relevant to action can be

sufficient to induce an experience of authorship that is reflected both in self-reports and in bodily responses.

New directions

There remain many challenges for research in authorship processing. The measurement of brain activations associated with experiences of authorship is one important avenue for progress (Farrer and Frith, 2002). The rapid development of technologies for creating virtual realities in turn suggests that it will be useful to examine how authorship processing occurs when actions occur in simulated environments with simulated consequences, and perhaps even simulated social contexts (Blascovich et al., 2002). And eventually the invention of techniques for prosthetic actions—the control of mechanical devices by neural activation (e.g., Chapin et al., 1999)—will yield a brave new world for authorship processing as well. Eventually it may be possible to specify at the neuronal level the processes underlying the processing of authorship. As people can do more and more in ways that transcend all the usual authorship indicators, the challenges for authorship processing will grow apace.

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