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The Explicit Sense of Agency — as Operationalized in Experimental Paradigms — Is Not a Feeling, but Is a Judgment

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The explicit sense of agency (SoA) is characterized as the unique and exclusive feeling generated by action or agency states (or the comparator process of the motor control system, to be specific), and (thus) this characterization assumes "cognitive phenomenology," the assumption that non-sensory states like actions or agency states, all by themselves, generate a unique feeling akin to typical sensory processes. However, the assumption of cognitive phenomenology is questionable as it fails to account for the necessity of causal interaction between the sensory organ and the phenomenal object in the production of phenomenology or experience. Thus, this paper criticizes the explicit SoA — as operationalized in experiments — by arguing that: (a) there is uncertainty in the explicit SoA operationalization (making the participants prone to judgment effects), (b) there are non-correlations or dissociations between agency states and explicit SoA reports, (c) explicit SoA reports are influenced by prior beliefs or online-generated heuristics, and (d) were the participants not uncertain about their agency (or the causal contingency between their actions and action-effects), they might not have produced non-veridical explicit SoA reports at all. Thus, this paper concludes that explicit SoA reports are not instances of (cognitive or agentive) phenomenology but are instances of heuristic judgment (under uncertainty).

Keywords: explicit sense of agency, cognitive phenomenology, feeling versus judgment

The sense of agency (SoA) is posited to be a unique feeling (of being an agent) based on the voluntariness or self-generatedness of actions, and its source is proposed to be located in the efference-copy-based comparator process of the motor system (Blakemore, Wolpert, and Frith, 2000; Carruthers, 2012; Tsakiris, Haggard, Franck, Mainy, and Sirigu, 2005). For instance, Tsakiris and Haggard (2005) state that the "sense of agency is efferent-driven" (p. 387). It is hypothesized that whenever one is making actions, the motor system in the brain produces efference commands as well as copies of those commands, called

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efference copies. Efference signals (or efference commands) prompt the muscles to deliver actions while the efference copies help the motor system to predict the sensory consequences of those actions such that online movement corrections can be made, if necessary. The comparator mechanism is not just ascribed with the function of online motor adaptation and motor control but also with a change in subjective intensity — usually an attenuation — of the perceptual or experiential quality of the sensory consequences of those actions (i.e., due to reafferences).[1] The popular examples of the attenuation of the sensory consequences of actions (due to their status of being voluntary or self-generated) are the space constancies during self-generated eye movements (von Holst and Mittelstaedt, 1950) and lack of tickliness while self-tickling (Wolpert and Flanagan, 2001). It is proposed that because of the cancellation of self-generated sensations we do not feel ticklish when we tickle ourselves, and we do not experience the visual scene to be moving when we move our eyes although the image of that visual scene on the retina is moving. The voluntariness or the self-generatedness of the actions, through the employment of a comparator mechanism, changes the nature or intensity of sensory perception or experience — visual in the case of space constancy and tactile in the case of tickling. Likewise, it is hypothesized that the same comparator process generates a unique and exclusive SoA experience (e.g., Bayne, 2008; Pacherie, 2010).

The uniqueness and exclusivity of the feeling of agency is elucidated by the contrast proposed between the "sense of agency" and the "sense of ownership" (SoO) [e.g., Gallagher, 2000; Synofzik, Vosgerau, and Newen, 2008a]. The sense of ownership is the knowledge, perception, or experience of the self or the body (such as one's limbs or one's limb movements, etc.,) gained through the (peripheral) sensory processes such as vision, proprioception, etc. (while the SoA is exclusively derived from the central processes, i.e., the brain's motor processes, particularly the comparator process), and so characterize the SoA proponents. For instance, Synofzik et al. (2008a) state: "In the case of passive movements, however, SoA and SoO dissociate. If someone else moves my arm towards a cup, I have no longer a SoA (i.e., I no longer experience myself as being the initiator of the action)" [p. 413]. Why do voluntary actions or the SoA differ qualitatively from passive movements (or SoO)? The answer given by SoA proponents is that the voluntary actions or the SoA involve the comparator mechanism while the passive movements (or SoO) do not.

With the characterization of the SoA as different and independent from other phenomenal experiences like the SoO and other sensory processes like proprioception, SoA proponents reified the SoA to be a unique (sensory) experience

[1] Here, the term exafference refers to the sensory signal derived from the external world, while the term reafference refers to the sensory signal generated by one's own actions.

(located in the comparator process).[2] Thus, the motor action processes are characterized to be acting as typical sensory processes, i.e., they receive (agency) input and produce experience (of agency) as the output, analogous to the typical sensory processes. For instance, Bayne (2011) states that "agentive experiences are best thought of in perceptual terms — they are the products of a dedicated perceptual system (or perhaps systems). Just as we have sensory systems that function to inform us about the distribution of objects in our immediate environment, damage to our limbs, and our need for food, so, too, we have a sensory system (or systems), whose function it is to inform us about facets of our own agency" (pp. 355–356). Thus, the SoA assumes "cognitive phenomenology" (Bayne, 2008; Horgan, 2011). Cognitive phenomenology is the position that experiences originate not just in the (classical) sensory processes but also in the (non-sensory) processes like thoughts, beliefs, desires, and actions, etc., (and these cognitive experiences are comparable to that of sensory phenomenology) [Jorba and Moran, 2016; Montague and Bayne, 2011; Smithies, 2013].

The proponents of the comparator process have reified the SoA to be a genuine sensory process. For instance, Bayne (2011) defines a sensory modality to be "a dedicated mechanism that takes as input raw energy of some kind and generates representations in an appropriate format, at least some of which are experiential" (p. 370), and he posits that the comparator mechanism possesses a raw input reception feature, with a qualification that the input is not a physical type such as wavelength but cognitive representations such as a comparator's prediction or an action's sensory consequence. He agrees that this sensory-like SoA process does not have transducers; but he asserts that there is a "distinction between basic and nonbasic perceptual systems, where the former takes as input forms of energy, and the latter takes as input representations. The five traditional senses (and various forms of proprioception and interoception) would qualify as basic perceptual systems, whereas the sense of agency would qualify as a nonbasic perceptual system. Nonetheless, a nonbasic perceptual system is still genuinely perceptual" (p. 370).[3] However, Mylopoulos (2015) objects to Bayne's perceptual, sensory characterization of explicit SoA and its comparator process by stating that "This is rather unlike any sensory modality with which we are familiar, and stretches the notion of a sensory modality beyond recognition" (p. 776). She argues that "adopting Bayne's characterization of non-basic sensory modalities leads to an excessively

[2] For instance, Grünbaum (2015) summarizes the assumptions of the SoA proponents as: "1. A person's ability to make voluntary movements is best explained by a dedicated, modular comparator-based control system. 2. Normally, activation of the comparator-based control system during voluntary movement produces as output a distinctive feeling of agency. 3. The feeling of agency has a distinctive type of phenomenal feel or quality" (p. 3315).

[3] Other researchers also consider the comparator to be a sensory process — according to Prinz (2007) the compaprator uses the "anticipatory somatosensory image" as input, and according to Grush (2007) it employs "mock sensory information."

liberal view of sensory modalities" (p. 777). She presents the example of arithmetic calculations where the input and the output are psychological or cognitive representations, but we do not consider the activity of arithmetic calculation to be a sensory activity. But if one takes Bayne's (2011) characterization, then one has to identify arithmetic calculation to be an instance of sensory processing and one has to accept that the arithmetic processing has its own sensory modality; but this is not the case. Likewise, the assumption of the agency phenomenology and the assumption of the comparator process as its sensory modality, albeit nonbasic, has to be denied as the (psychological or cognitive) comparator process does not fit into the generally accepted view of the sensory modalities.[4]

Thus, the concept of cognitive phenomenology or agency phenomenology is being rebutted, albeit rather theoretically, on the basis of whether it has a sensory basis or not. However, a rebuttal of empirical operationalization of the SoA is lacking; so, in this paper, I critically analyze the operationalization of the SoA. The (experimental) operationalization or measurement of the SoA is divided into two types: explicit and implicit (e.g., Moore, Middleton, Haggard, and Fletcher, 2012). An "I did" report is an explicit measure of SoA while the measure of action or the agency state's effect on sensory perceptions such as time (as in the intentional binding effect) and, vision or audition (as in the sensory attenuation effect) are implicit measures of SoA, and while the explicit SoA assumes "cognitive phenomenology," the implicit measures of SoA assume "cognitive penetrability" (Zeimbekis and Raftopoulos, 2015). This paper exclusively criticizes the explicit SoA — as operationalized in the experimental paradigms, which is characterized to be an instance of cognitive phenomenology (or agentive phenomenology, to be specific). This paper concludes that the reports of explicit SoA are not instances of agentive phenomenology but judgments-under-uncertainty by arguing that (1) the operationalization of explicit SoA displays uncertainty (making the participants susceptible to judgment effects), (2) there are dissociations between actions or agency states and explicit SoA reports, (3) explicit SoA reports are influenced by prior beliefs and/or online-generated heuristic responding patterns, and (4) there might not be any inaccurate explicit SoA reports under certainty (about agency or causal contingency). Those reports that are elicited under uncertainty and that are based on prior beliefs or online-generated heuristic responding patterns can be accounted for by the compositional nature of the judgments, thus justifying the conclusion that explicit SoA is not an agency/cognitive phenomenology effect, but is a judgment effect.

[4] Carruthers (2012) is optimistic about the comparator model's explanatory success with respect to agency phenomenology if suitable adjustments are made in the model. However, Wong (2012) points out that the tweaks may lead to the conclusion that the "the term 'comparator' is just standing proxy for whaever mechanism is responsible for the sense of agency" (p. 50).

Uncertainty in the Explicit SoA Experiment

Many experiments find that explicit SoA reports (i.e., "I did it") are made in the presence or context of agency or action. However, almost all explicit SoA experiments display uncertainty about the causal contingency over the action-effects (about which the participants are supposed to generate reports). Here, the term "uncertainty" should not be taken to mean a total lack of information, but as an incompleteness in information; and the uncertainty has many manifestations like probability, ambiguity, vagueness, and variable or delayed outcomes (Smithson, 2012). I will show that explicit SoA experiments have variable or delayed outcome types of uncertainty, as described below.

The typical explicit SoA experiment has two stages: (a) contingency learning during the acquisition session, and (b) report of the explicit SoA over the action-effects when these action-effects are congruent or incongruent with respect to the previously learned relationship, during the experimental session (e.g., de Bézenac, Sluming, O'Sullivan, and Corcoran, 2015; Sato and Yasuda, 2005; Schmidt and Heumüller, 2010).[5] During the acquisition period the participants (are trained to) learn the relationship between their actions — e.g., button press X or button press Y on the keyboard — and the (distal) action-effects — e.g., a display of red color image or blue color image on the computer monitor — i.e., they learn to associate the pressing of the key X with a popup of a red color image and the pressing of the key Y with a popup of a blue color image. The learning of the association between actions and action-effects is not limited to a laboratory setting but one could acquire it in typical day to day life, such as switching on or switching off a light, turning on or turning off an alarm, opening or closing a lift door by a button press, picking up or hanging up on a phone call and so on. SoA proponents propose that this learning of the relationship between action and the action-effect makes changes to the comparator process such that experience of agency (i.e., explicit SoA) is generated if the actions produce corresponding action-effects.[6]

After the acquisition phase comes the experimental phase which involves the "variable action-outcome contingency" where, as an experimental manipulation,

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[5] A critical distinction is to be noted between movement and action; here, the sensory consequences of the movement are typically proximal (to the body) such as the experience of proprioception and effort etc., while the sensory consequences of the action are distal such as those visual effects in the environment (led by the action) such as light switched on, phone call received etc. The sensory consequences that are typically studied in explicit SoA research are of the distal action-effects (rather than the proximal movements).

[6] The action and action-effect relationship learning is analogous to that of the voluntariness or self-generatedness, by virtue of learnt "predictive coding" of the relationship between the action and its effect/outcome. Simply put, the ensuing action-effects that are congruent to the action are analogous to voluntary or self-generated actions while the action-effects that are incongruent to their (causative) action are analogous to involuntary or passive actions.

the contingency (and thus congruency) between actions and action-effects is not strictly obeyed (in all of the trials) i.e., a keypress of X can lead to the display of a blue color in some trials and also the display of a red color in other trials. The action-effects/action-outcomes in this phase are variable from that of the learned relationship in the acquisition phase. In the typical explicit SoA experiments, the participants are informed that the (variable) action-effects that they see could be either due to their own actions or due to the actions of some other entity (such as the computer or the experimenter). Participants were asked to report the felt-agent of the (seen) action-effects, i.e., the explicit SoA. As predicted by the agency phenomenology hypothesis (and its mechanistic counterpart of the comparator theory), the participants reported "I did it" when the action-effects (seen) were congruent with the actions, and they reported that "I didn't do it" or "somebody else did it" when the action-effects (seen) were incongruent with their actions. In the SoA literature, various types of (experimental) stimuli are used as the incongruent or variable action-effect stimuli, such as angular perturbations (e.g., Farrer, Bouchereau, Jeannerod, and Franck, 2008), temporal distortion (e.g., Farrer et al., 2008; Haering and Kiesel, 2015, 2016; Sidarus and Haggard, 2016; van der Wel, Sebanz, and Knoblich, 2012), (in)congruency with respect to loudness of sound (e.g., Dewey and Carr, 2013; Kumar, Manjaly, and Miyapuram, 2014), and (in) congruency with respect to spoken words (e.g., Lind et al., 2014a, 2014b) etc.

Although the administration of "variable action-outcome contingency" during the experimental phase is necessary to observe whether the participants are reporting based on the acquired relationship of action and action-effect (or through learned anticipations or predictions, in other words), it also leads to an uncertainty with respect to contingency of the actions i.e., the participants are uncertain whether the action-effects are under their control or not.[7] The participants might come to believe (in the course of many trials) that the action-effects are not contingent on one's actions, and thus are uncertain about one's control over the action-effects.[8] So, the participants are unsure about the cause of the action-effects. Additionally, the participants are susceptible to ambiguity concerning their causal contingency over actions due to psychological phenomena like executive ignorance and choice blindness.

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[7] Although the "variable action-outcome contingency" task is employed to experimentally generate the instances of incongruent or erroneous action-effects, there is a possibility that the instances of variable outcomes can be considered by subjects as cases of a lack of (or uncertain) causal contingency rather than as cases of self-generated errors.

[8] In line with the extinction of the learned relationship in operant conditioning (Ferster and Skinner, 1957), the "variable action-outcome contingency" task might lead to the extinction of the relationship learned during the acquisition phase and thus leading to the contingency uncertainty. Thus, it might not be legitimate to compare the experimental phase's reports to what has been observed in the acquisition phase, as the variable action-outcome contingency (akin to variable schedule of conditioning) may lead to extinction of the acquisition phase's learning.

Executive ignorance. A typical feature of the motor actions is that we are not aware of the physiological processes of how actions are generated; we are aware only of the output of those processes. We are entirely phenomenally blind to neural processes involved in actions (Prinz, 1992) and we are unconscious of the details of motor programs involved in actions (Hommel, 2009; Hommel and Elsner, 2009). In this line, William James (1890) pointed out that "we are only conversant with the outward results of our volition, and not with the hidden inner machinery of nerves and muscles which are what primarily sets it at work" (p. 499). This is termed as "executive ignorance" (Turvey, 1977).[9] And, according to Hommel (2017a), executive ignorance is "the phenomenon that voluntary agents have conscious access to their action goals only but no insight into how these are translated into action" (p. 1). For example, we are not conscious of how vocal cords are generating speech; we are only aware of sensory consequences such as vocal proprioception, pressure on the vocal tract, and audition of generated speech. Hommel (2017a) claims that it is the perceptual-like representations (e.g., what word is spoken) but not the motor-like representations (e.g., how the vocal cords generate words) that we are aware of as the contents of (motor) working memory (also see Jeannerod, 2006).[10]

The rationale provided by Prinz (1992) for executive ignorance is that the motor commands and early sensory codes (used by the brain) during the execution stage "are not closely related to their central representations and to each other — they are coded in very different ways, which must make direct communication difficult" (Hommel, 2017b, p. 113). Ideomotor theorists explain executive ignorance by implicating the goal-representedness of the action. In the course of life, we learn and store in memory the contingencies between actions and action-effects. According to the ideomotor theory, the idea[11] or thought of the action-effect is able to initiate (voluntary or otherwise) actions by spreading activation to the ideomotorically learned motor patterns; in this line, Hommel (2017b) says that "This means that conscious access to the latter [action-effect or sensory consequence] is sufficient to control the former [motor action], so that conscious access to motor activities is not necessary — executive ignorance" (p. 113).[12] Due to executive ignorance, the participants rely on distal action-effects rather than proximal movements while judging their agency or their control over

[9] Executive ignorance might be an evolutionary consequence where consciousness is epiphenomenal and (intelligent) actions can be unconscious.

[10] However, proprioceptive sensations are available when attention is brought to motor working memory.

[11] As in "ideo" of the term ideomotor.

[12] The theory of mirror-neuron system is also used to justify executive ignorance by Hommel (2017b): "If the same neuron responds to both the production of a particular action and the observation of the same action carried out by another person, it must code for the distal, but not the proximal, characteristics of the action" (p. 113).

actions. For example, if a person makes a vocal movement that actually generates the sound "ba" when intended to generate the sound "da" but hears (due to the experimental manipulation) "da," then due to executive ignorance, she thinks that she has indeed produced the sound "da." Due to the uncertainty or ignorance of the executed identity of the movement, the individual perceives the (experimentally surreptitiously altered) shown action-effect to be of her own generation, post-hoc (e.g., Lind et al., 2014a, 2014b; Lindner and Henkel, 2015).

Choice blindness. In some occasions where the participants are asked to choose or select their preferred object-image among the many, and when they are misled to believe an item, e.g., the image of a red car, to be their original choice that has been surreptitiously switched with the original choice item, e.g., the image of a pink car, and were asked to report why they choose the red car (i.e., the switched but not the original item), they not only fail to notice the switch but also come up with elaborate reports of why they preferred the switched item. This is an instance of "choice blindness," the tendency of people to fail to remember their original choice and subsequently accept an externally supplied choice to be their original choice (particularly, when they failed to notice that their own choice-item has been surreptitiously switched with some externally chosen item) [Johansson et al., 2005]. This sort of blindness can also occur with respect to motor actions, e.g., when the participant moves the mouse to the right, but the cursor is surreptitiously shown to be moving to left, the participant may misremember (post-hoc) that he had initially made a left side mouse movement (e.g., Fourneret and Jeannerod, 1998; Müsseler and Sutter, 2009).

A crucial factor responsible for choice blindness is "change blindness" (Berberian, Chambaron–Ginhac, and Cleeremans, 2010; Johansson, Hall, and Sikström, 2008). Change blindness is the failure to detect changes in sensory information (Rensink, 2002; Simons and Levin, 2003). Choice blindness, and consequently, choice self-ascription, can be said to be contingent on change blindness; for example, if the surreptitious switch is from a red car image to a pink water bottle image, then the switch is easily noticeable by the participants compared to a switch between red car and pink car (as these two scenarios differ with respect to the level of change). That is why in the action awareness studies the unawareness of the action-effect's angular perturbations occurs only within a narrow range of angular distortion (e.g., Cleeremans and Sarrazin, 2007; Johnson and Haggard, 2005); in the range where the change can be detected, angular perturbations of action-effects are successfully detected.

Thus, the explicit SoA experimental setup has uncertainty (about the causal contingency between action and action-effect) due to the presence of variable action-effects, executive ignorance, and choice blindness. The uncertainty might lead participants to respond heuristically about the question of their agency. This is particularly the case given the lack of correlation between the (subjective) SoA reports and (objective) agency/action.

Dissociation between Explicit SoA Reports and Motor Control

In the typical explicit SoA experiment, the participant reports the SoA when the action-effects seen are congruent with the action, and reports a lack of SoA when the action and the action-effect are not congruent. This is interpreted (by the proponents of SoA) as proof for the comparator process, i.e., a match between efference copy and action-effect gives rise to the phenomenology of agency, and if there is no match then there is no phenomenology of agency. In line with this, the comparator based formulation upholds that only two types of contingency occur in the typical SoA experiment, such as (a) a match between intended/learned action and actual action-effect, and (b) a mismatch between intended/learned action and actual action-effect. However, in the "variable action-outcome contingency" task, there, indeed, occur four types of contingency (between action and action-effects). These are displayed as the 2x2 contingency matrix (see Figure 1 below), analogous to the 2x2 contingency matrix of the research domains such as causal induction, learning, the illusion of control, etc. (e.g., Barberia and Vadillo, 2017).

	Congruent action-effect	Incongruent action-effect
Intended action	**a**	**b**
Unintended action	**c**	**d**

Figure 1: Contingency matrix of the types of contingency between action and action-effect.

As shown in cell "a," intended/learned actions can lead to (acquisition) congruent action-effects or they can lead to incongruent action-effects, i.e., cell "b." Likewise, unintended/non-learned (or other-generated, i.e., computer or experimenter generated) actions can lead to congruent action-effects, i.e., cell "c," or they can lead to incongruent action-effects, i.e., cell "d." As mentioned above, almost all operationalizations of explicit SoA experiments and the (comparator based) interpretation of the data in these experiments recognize the instances of cell a and cell b but ignored analyzing cells c and d.

Comparator theory explains the presence of SoA in the instances of cell a by attributing SoA to the presence of a match between efference copies and the sensory consequences (of actions), while the lack of SoA phenomenology during the instances of cell b is explained by lack of a match between efference copies and sensory consequences. However, this comparator explanation fails in the case of cell c. In cell-c-like instances, there will be a mismatch between the efference copies and the sensory consequences and, theoretically, it is expected that the participants report no SoA over actions in these cases; but the participants have reported SoA over cell-c-like instances as well, and this is due to the heuristic anchoring of the SoA report to the outcome rather than due to the involvement of the comparison between efference copies and the action's sensory consequences.

Researchers seem to ignore the distinction between (self) committed error and (externally) feedback-given (artificial) error. A committed error is an error or incongruency that happened due to the participant's movement error or unintended action such as in the case of cell d, while the feedback-given error is the artificial error generated by the experimenter such as in the case of cell b. It can be argued that the participants do not consider these two errors to be the same as they might be able to distinguish whether the errors are their own or artificially created. This is particularly the case given that the participants grasp the non-contingent nature of the experimental setup; although the participants are potentially unaware of the instances of the perturbations and the variability in their action-effects in each trial, they can detect whether the action-effects are contingent on their actions or not in the course of many trials (or at the block level) [e.g., Rohde and Ernst, 2016; Subramaniam et al., 2018].[13] For instance, the SoA experiments that had a debriefing session (e.g., Couchman, Beasley, and Pfordresher, 2012; Kumar et al., 2014) have documented that the participants were aware of their non-contingency for the actions in the "variable action-outcome contingency" set up.

If this is the case, then the participants' SoA reports on their own errors, as well as artificial errors, might have been due to two different processes. There is evidence that motor systems (and thus efference copy) behave differently for one's own error and (externally inserted) artificial error/incongruence (De Vignemont, Tsakiris, and Haggard, 2006; Fourneret and Jeannerod, 1998; Logan and Crump, 2010). For instance, Logan and Crump (2010) found that post-error slowing occurs only for self-generated errors but not for artificially inserted errors. This implies that either it is the case that both efference — that gives rise to post-error slowing down — and efference-copy — that leads to an explicit SoA report — are independent, or it is the case that an explicit SoA report is independent of the motor/agency system. However, as the former claim (of the independence between efference and efference-copy) is theoretically implausible, the latter claim (that the explicit SoA and the motor system are independent) might be the case. Further, the claim that SoA reports are not based on motor processes, particularly in comparator processes, is substantiated by the empirical evidence of dissociations between the motor processes and the explicit SoA report (in the typical variable action-outcome contingency task). For instance, empirical work has shown dissociation between movement error and the explicit SoA report (Jensen et al., 2014; Logan and Crump, 2010; Steinhauser and Kiesel, 2011), between (shown or artificial) feedback error and action control (Banakou and Slater, 2017; Kannape

[13] Although the fact of executive ignorance and choice blindness predicts that the participants might not, sometimes, grasp whether the erroneous action-effects are of their own doing or due to the experimental manipulation, the fact of awareness of non-contingency (at the block level) predicts that the participants can, sometimes, grasp whether the errors are self-generated or artificially inserted.

and Blanke, 2012; Rohde and Ernst, 2016; Salomon et al., 2016), between self or externally generated error and post-error slowing (Couchman et al., 2012; Logan and Crump, 2010; Weller et al., 2018; Wilbert and Haider, 2012), between goal-directed (contra habitual) action and SoA report (Gorea, 2009; Janczyk, Heinemann, and Pfister 2012), and between intention (or outcome-thought) based SoA report and action (Jensen et al., 2014; Morewedge, Gray, and Wegner, 2010; Pronin et al., 2006; Wegner and Erskine, 2003), etc.[14]

Likewise, there is also evidence that the participants sometimes report a presence of SoA over passive actions (Burin et al., 2018; Cameron et al., 2012; Greville and Buehner, 2016; Wegner, Sparrow, and Winerman, 2004), and also, sometimes, exhibit a bias to attribute the agency to others or to external factors although the actions are self-generated (de Bézenac et al., 2015; Lawson and Crane, 2014; Spengler, von Cramon, and Brass, 2009; Wegner, Fuller, and Sparrow, 2003). To summarize, if the comparator is not the originator for SoA reports — as there is a dissociation between the SoA report and actions — then it is possibly due to heuristic responding or the prior beliefs of participants.

Heuristic Responding in the Explicit SoA Experiment

In the acquisition phase of the "variable action-outcome contingency" task, the participants learn the relationship between a particular action and its (reafferent, sensory) action-effect. For SoA proponents, the locus of the behavioral manifestations such as SoA reports — due to the learning of the relationship between action and action-effect — is the comparator process of the motor system. However, behavioral manifestations like the SoA reports can also be alternatively accounted for by the learning of the *cognitive representations* of action and action-effect without recourse to the involvement of the *motor representations* (of the comparator processes). In this line, the "ideomotor theory" of action interprets the behavioral manifestations of the compatibility between action and action-effect as due to the cognitive or abstract or idea-like representation of both actions and (perceptual or sensory) action-effects (Badets, Koch, and Philipp, 2016; Gentsch et al., 2016; Hommel, 2015; Shin, Proctor, and Capaldi, 2010).

Ideomotor, cognitive representation of action, and action-effect compatibility. The typically studied compatibility effects between actions and action-effects are reaction time, and preferred or anticipatory responding. It is found that people's reaction times will be shorter while making a (motor) response for a learned cue (due to stimulus–response learning), and people choose a particular (motor) response more often, in response to a stimulus (i.e., to an action-effect stimulus or outcome-stimulus) that has been paired (during the acquisition/learning

[14] There is also an empirical work that found no relationship between physiological factors like skin conductance and heart rate, and the explicit SoA report (David et al., 2011).

phase) more often with that particular motor response (Dutzi and Hommel, 2009; Janczyk and Lerche, 2018; Pfister, Kiesel, and Hoffmann, 2011). The explicit SoA report can also be categorized as one of those compatibility effects that arise due to the learning of the relationship between action and action-effect, as the ideomotor theory equally accounts for the cases of the comparator process, including the behavioral manifestations like the SoA report due to the match between intention or stimulus-driven cue and the action-effect, even without incorporating the role of efference copies. So, the match or congruency that guides the SoA reports is not necessarily the match between (the comparator's) efference copy and actual action-effect, but the match between cognitively represented intention and the actual outcome (e.g., Grünbaum, 2015). For instance, there is evidence that cognitive representation of intention can mediate the ideomotor action and action-effect compatibility due to the learning history between that intention and the action-effect (e.g., Hommel, Brown, and Nattkemper, 2016; Moeller and Frings, 2017). Likewise, there are findings that show that the sensory features of the action-outcome can also mediate the action and action-effect compatibility due to the learning history between action and the action-effect stimulus (Hommel, 2013; Huffman et al., 2018; Watson et al., 2018).

Cognitive representation can also be in the form of a (semantic) cue that generates or guides the action, in the case of stimulus-driven action; so, the cognitive antecedents of the actions are not necessarily self-generated or intended. There are findings that show that ideomotor compatibility effects between actions and action-effects (such as shorter reaction time between action and action-effect stimuli that are consistently paired, and learned preference to elicit a particular action in response to a particular action-effect) can occur even without the action being voluntary or comparator based. For example, action and action-effect compatibility (and thus the explicit SoA reports anchored in this compatibility or congruency) can even occur over non-actions (Kühn et al., 2009; Pfeuffer et al., 2017; Weller, Kunde, and Pfister, 2017). This is due to the fact that the relationship between non-action and its action-effect — analogous to action and its action-effect — can be ideomotorically learned. Thus, the action related cognitions like intention, self-generatedness, action selection, sensory consequences (both proximal and distal), and even non-actions can become one "event file" through a history of associative learning.[15] According to the ideomotor theory, the effects of voluntariness or self-generatedness are not unique, but belong to a family of (associatively learned) ideomotor effects (Hommel et al., 2017b; Janczyk et al., 2012; Pfister et al., 2011). Compatibility effects without the necessity of the role of the voluntariness or the efference copies can be interpreted to be due to the learning history (that typically happens in the acquisition phase of the variable

[15] Ideomotor theory can be characterized as a species of (associative) learning theory focused exclusively on action (learning).

action-outcome contingency task) between action and action-effect (Paulus et al., 2011).

Ideo-motor working memory is goal or action-outcome based. The most crucial cognitive representation of the action that gives rise to the compatibility effects between action and action-effect is the "goal" or distal action-effect representation, according to ideomotor theory (James, 1890; Shin et al., 2010; Stock and Stock, 2004). The goal can be considered as the metavariable towards which motor control corrects, adapts, and learns. In an SoA experiment, the aim of a participant's limb motor action is to reach a goal (location) or produce a particular action outcome.[16] Visual or other sensory feedback is used by the participant — by calculating a match or mismatch between action and goal accomplishment — to evaluate whether the participant has attained the goal or not, and to change or recalibrate subsequent motor action. Similarly, the explicit SoA report is also anchored to goal representation (Aarts, Custers, and Marien, 2009; Grünbaum, 2013) — if the goal is attained then an SoA is reported, and a lack of SoA is reported if the goal is not reached. So, voluntariness or self-generation per se is not special either in motor control or in the SoA report because of the fact that the action is represented in terms of distal "goal states" rather than in terms of the proximal (voluntary) "self" (Hoover, Elzein, and Harris, 2016; Nachev and Husain, 2010; Verschoor and Hommel, 2017).[17]

The action-effects (or reafferences) can be divided into two types: proximal and distal. Sensory consequences of actions such as proprioception, muscle effort, and tactillity are proximal to the body, while sensory consequences or action-effects that occur in the world are distal. Many times what one wants to achieve (through action generation) is the distal effect such as switching on the light or crushing a mosquito. In scenarios like these, there can be a successful or unsuccessful achievement of a distal action-effect without a corresponding change in a proximal action-effect. For example, one can have the same muscle effort or proprioception even when the light failed to be switched on. This implies that proximal sensory consequences are uninformative about goal achievement or success, and thus about the sense of agency (over a distal action-effect).[18] So, the SoA report is anchored to the distal action-effect, i.e., to the action's goal (particularly in the "variable action-outcome contingency" task). Similar to the way the goal-state acts as the reference point for action adaptation, recalibration, and learning, the explicit SoA report is also anchored to the (distal) goal or action-effect. For the comparator theory, the SoA report is due to efference-copy-based voluntariness (emphasizing

[16] How do goals come about? From both drives and needs (of both phylogenetic and ontogenetic origin). Also, in the typical SoA experiments, they arise from the instructions.

[17] This is particularly the case given the executive ignorance of the motor system.

[18] Almost all SoA experiments operationalized the action-effect to be distal, and so proximal sensations are irrelevant in almost all of them.

action, outcome link), while for ideomotor theory the SoA report is due to associative learning (emphasizing the action-outcome and a self-tag link) without any necessity of voluntariness of the action. It can be argued that it is the learned match between outcome and SoA-tag or self-tag that leads to explicit SoA reports.

In line with this, there is evidence that participants make explicit SoA reports not based on what they did but based on the outcomes or action-effects (artificially) shown (e.g., Salomon et al., 2016; Sugimori and Asai, 2015; van Elk et al., 2015). Thus, it can be argued that participant reports are never due to the efference copies but due to the "cognitive" match (or congruence) between intention (or ideomotor cue) and the outcome — this is clearly evident in the case of cell "c" where the participants anchored their reports to the shown outcome rather than their own motor involvement. The claim of outcome-based (or congruency-based) responding (for explicit SoA reports) is further substantiated by the presence of processes like executive ignorance, ideomotor goal-representation (of action), and uninformativeness of the proximal action-effects. This tendency to anchor SoA reports on outcomes leads to biased self-attribution of action-effects even when those action-effects are not due to self-generation or efference involvement per se. Furthermore, the nature or modality of action-effect stimuli such as temporal, angular, or conceptual is not crucial to outcome-based (or congruency-based) responding for the explicit SoA. For instance, there is evidence that shows that it is not a particular but a general or amodal "congruency" metavariable that is learnt between actions and outcomes (Kimura and Takeda, 2018; Ratcliffe and Newport, 2017; Singh, Frings, and Moeller, 2019), irrespective of whether the action-effect stimulus is visual, auditory, or of other senses (Barne et al., 2018; David et al., 2016; Sugano et al., 2010); this (congruency) "metavariable" is (heuristically) employed (by the participant) to produce explicit SoA reports — for instance (erroneous or otherwise), inserted feedback by the display of the (metavariable) words like "right action" or "wrong action" (irrespective of the nature of the action-effect stimuli, such as visual, auditory, or temporal) leads to outcome-based (i.e., inserted-feedback-based) responding (Kumar et al., 2014).[19] Under uncertain situations like the variable action-outcome contingency, the participants have no choice other than responding based on congruency or outcome (Schmidt and Heumüller, 2010; Sugimori et al., 2011; Wen, Yamashita, and Asama, 2015). This leads to self-attribution biases of actions, irrespective of self involvement (e.g., Banakou and Slater, 2014; Dewey and Carr, 2013; Preston and Newport, 2010).

[19] Although Kumar et al., (2014) argued the feedback-based or outcome-based responding to be an instance of recalibration of the comparator prediction, it can alternatively be explained to be an instance of attribution-shift or change in response strategy according to the congruency or outcome (or inserted feedback). This conclusion is substantiated by the observation that participants fail to make a distinction between self-generated vs. externally generated errors while generating explicit SoA reports. Moreover, the evidence of a dissociation between motor action and SoA reports leads to skepticism about recalibration (of the comparator's prediction) account.

The self-attribution bias in explicit SoA reports can be because of the causal beliefs and heuristic responses that the participants employ under (contingency) uncertainty.[20] There is evidence that explicit SoA reports are based on the causal beliefs that participants hold (Buehner and May, 2004; Kawabe, Roseboom, and Nishida, 2013; Ruess, Thomaschke, and Kiesel, 2017; van der Weiden, Aarts, and Ruys, 2011; Wegner, 2003). Also, there is evidence that self-attribution bias is due to an availability heuristic as thoughts about self are the ones that are easily available, particularly under uncertainty (Bar-Hillel, Peer, and Acquisti, 2014) — the heuristic employed is that "if the action is correct then it is due to me, and if it is an error then it is not due to me." The self-attribution bias is also due to the success bias, i.e., the tendency to attribute successful outcomes to self rather to others (Cañal–Bruland, Balch, and Niesert, 2015; Dixon et al., 2018; Palminteri et al., 2017; Preston, Ritter, and Wegner, 2011).[21] An example of persistent success expectancy bias is the gambling at casinos; this sort of success expectancy bias seems immune to extinction (Reed, 2001). Furthermore, the self-attribution bias occurs irrespective of knowledge or detection of non-contingency between actions and action-outcomes (Inoue, Takeda, and Kimura, 2017). This implies that this bias is not rational but emotional (Gentsch and Synofzik, 2014). However, some researchers argue that self-attribution bias, although inaccurate, is evolutionarily a rational strategy as guessing that the self could be the more likely cause in natural situations is adaptive (Johnson et al., 2013; Schmidt and Heumüller, 2010; Walker et al., 2015).[22] However, agency attribution bias is not just limited to self, but to any salient agent among many agents (Schmidt and Heumüller, 2010), as it is an algorithmic judgment strategy (Williams, Dunning, and Kruger, 2013) that results in guessing the salient agent.

Thus, as attribution biases are mediated by causal knowledge or beliefs, or an algorithmic judgment strategy, people sometimes also exhibit an other-bias in agency attributions as long as their causal belief is that the others are causing the actions (even when the actions are self-generated) [e.g., de Bézenac et al., 2015; Lawson and Crane, 2014; Spengler et al., 2009; Wegner et al., 2003]. The presence of uncertainty, goal-representedness of actions, and prior beliefs or theories of causation by self or others lead to self-attribution bias as well as other-attribution

[20] In a typical explicit SoA experiment, a participant's contingency is uninformative as the (action-effect) feedback is always random and non-contingent; so the participants resort to responding heuristically or by "guessing." Heuristics are the simple mental shortcuts to solve complex problems (often leading to cognitive biases).

[21] Interestingly, these exaggerated expectations of success for self-generated actions (over the observed) are unaffected by learning, however, they are correlated with trait optimism (e.g., Wolpe et al., 2014).

[22] Although Kahneman and Tversky (1996) opine the heuristics and biases to be irrational, Gigerenzer (1996) contends that the heuristics and biases are rational (see Samuels, Stich, and Bishop, 2012 for a detailed debate between Kahneman and Gigerenzer).

biases. Thus, the explicit SoA report is not an instance of self-bias per se but is a causal belief (and thus heuristic responding) which is uniformly pertinent to both self-bias as well as other-bias.

Explicit SoA as a species of causal learning. It is fairly well established that beliefs and prior theories about the causal relationship between self and the action-effects influence explicit SoA reports. However, the question is how these causal beliefs and theories form in the first place. Are they intrinsic to the action itself or are they learned (and thus changeable based on the learning history)? Researchers working in perception or inference of causality (e.g., Buehner and Humphreys, 2009) classify action and action-effect learning to be a case of (more general) causal induction and inference. This means that the reports in explicit SoA experiments are essentially causal inferences (and the causality between action and action-effect is learned in the acquisition phase). However, during the experimental phase, there is a possibility of the uncertainty of this causal relationship, as the variability (of outcomes) and non-contingency leads to the extinction of learning. Consider the example of the temporal (delay) action-effect stimulus, which is one of the most popular action-effect stimuli used in the "variable action-outcome contingency" task. Many researchers propose that the temporal aspect is intrinsic to causal induction, for instance, an event is considered as a cause if it occurs temporally prior to an effect; temporal proximity between action and effect is crucial (Dickinson, 2001).

Along with the priority aspect, contiguity between the causal event of voluntary action and the action-effect also imparts causal induction or causal awareness. There are findings that show that (temporal) contiguity between action and action-effect leads to explicit SoA reports (Repp and Knoblich, 2007; Ruess et al., 2017); and thus, the intrinsic temporal features of the actions such as priority, contiguity, and tempo are considered to influence SoA reports (Daprati, Wriessnegger, and Lacquaniti, 2007; Repp and Keller, 2010; Sevdalis and Keller, 2014; Wöllner, 2012). However, one can argue that the contiguity is not intrinsic to causal induction but is learned. Indeed, it is found that the contiguity-based causal induction/inference hinges on the learning of consistency or constancy of delay between the causal event and the action (Bogon, Thomaschke, and Dreisbach, 2017; Dignath and Janczyk, 2017; Haering and Kiesel, 2012; van der Wel and Knoblich, 2013; Wen et al., 2017). For example, for causal learning to happen between a causal event and an effect event, the effect is not required to occur contiguously, for instance just 100 ms or less later than the cause, but it can occur 500 ms or even 1s later than the cause, as long as this delay/interval is consistently learned between the causal event and the effect event (which is the crucial criterion for causal learning). Haering and Kiesel (2012) and Dignath et al. (2014) found that not just the identity of the effect but the delay of the effect is also learned and represented in the action-effect event-file (which is reflected in the measure of RTs and anticipatory responses in their experiment, as proposed by

ideomotor theory). Elsner and Hommel (2004) found that longer delays between action and action-effect hinder associative learning between them. However, the specificity of the delay between action and outcome behaves like the identity of its event file. For instance, Dignath and Janczyk (2017) showed that the interval between action and effect is learned irrespective of action-outcome identity. If the consistency of the delay is perturbed, then the action-effect is reported to be before the action itself (e.g., Arnold, Nancarrow, and Yarrow, 2012; Desantis et al., 2016; Rohde and Ernst, 2013; Rohde, Scheller, and Ernst, 2014; Toida, Ueno, and Shimada, 2014). Likewise, the window of the action and action-effect is open for longer delays, as long as they are consistent (e.g., Arikan et al., 2017; Corveleyn, López–Moliner, and Coello, 2015; Desantis, Roussel, and Waszak, 2014; Farrer, Valentin, and Hupé, 2013; Keetels and Vroomen, 2012). Similar to (action and action-effect or otherwise) causal learning, it is being found that the explicit SoA reports are based on the consistency of the delay between action and action-effect (Haering and Kiesel, 2015, 2016; van der Wel and Knoblich, 2013). Thus, one can argue that the causal inference or induction for an explicit SoA is variable or flexible based on learning history and prior beliefs or theories of the participant.

Hume had famously argued that we could not directly perceive causation. We make inferences about causal events from our perceptions of events. A common thread behind all these sources is the learning (of causal relations) and the knowledge that builds upon this learning history. Obviously the (causal) learning and thus (causal) knowledge are reliant on the natural regularities in the world. Although priority, consistency, and exclusivity are proposed to be general principles behind causal inference, I contend that these (subjective) principles are consequences of learning, that are built on the (objective) natural regularities which lawfully exhibit priority, consistency, and exclusivity relationships between (physical) cause and (physical) effect. In typical conditions, contingency knowledge relies on knowledge of the physical (causal) relationship; for instance, I conclude my switch-press has caused the light to be on (a contingency knowledge), by knowing that the switch causes light — an instance of causal knowledge. Actions are seen as mediators or facilitators of the causal relationship; that is how one can label some actions as magic or miracle if they are attained without the causal physical processes that our knowledge prescribes. So, natural regularities afford causal learning, causal learning affords causal knowledge or theory, and causal knowledge affords (immediate) causal perception or inference. Although the world is lawful, the natural phenomena are complex or multifactorial, and thus the materialization of the causal relationship between entities or events vary in different situations (but for natural reasons). For example, if one considers the cause and effect relationship between clouds and wetting of the ground, a cloudy sky does not always lead to rain, and the ground can be wet due to many factors other than rain. So, the causal inductions about these events will depend on different cues, and vary from situation

to situation. Likewise, an action does not always lead to action-effects, and the action-effects can be due to reasons other than actions (e.g., due to exafferences rather than reafferences). The materialization of action-effect is contingent on many natural factors (assuming that this phenomenon is complex). So, natural variability leads to variability in learning and (storage in the form of) knowledge of the cause–effect relationship. Although temporal cues such as temporal priority and contiguity are used to infer the causal relationship, as argued above, these (subjective) features arise only if the objective natural phenomenon in question exhibits these regularities (of being temporally prior and contiguous, for instance). If natural regularity is perturbed (such as in the "variable action-outcome contingency" task), then the temporal cues are used flexibly for causal inferences. For instance, there exists a trade-off between various aspects of action and action-effect contingency while providing SoA reports such as angular distortion vs. temporal distortion (Farrer et al., 2008), congruency vs. contiguity (Buehner and May, 2004; Haering and Kiesel, 2015, 2016; Ruess et al., 2017), congruency vs. proprioception (Brooks and Cullen, 2014; Cameron et al., 2012; Sevdalis and Keller, 2010), vision vs. interoception (Tajadura–Jiménez and Tsakiris, 2014), contiguity vs. body schema (Cook et al., 2011), contiguity vs. priority (Rohde et al., 2014; Timm et al., 2014), contingency vs. congruency (Ma, Hommel, and Chen, 2018), contingency vs. contiguity (Buehner 2017; Buehner and McGregor, 2009; Dewey and Carr, 2013; Elsner and Hommel, 2004; Farrer et al., 2013; Haering and Kiesel, 2012, 2016), instruction vs. intention (Liefooghe and De Houwer, 2018), intention vs. contingency (Baker, 2011; Grünbaum, 2015; Mylopoulos, 2017), and temporal vs. identity based congruency (Dignath and Janczyk, 2017). The fact that there is trade-off between different cues in explicit SoA reports (about action situations) implies that these processes are not "sensory" or "perceptual" processes with a defining "iconic" property; these processes can be identified as "thought" or "cognitive" processes with a characteristic "compositional" tendency.

A distinction between perception/feeling and thought/judgment is made, as the former is sensory-based while the latter is language-based (Fodor, 2008; Pylyshyn, 2003).[23] Many researchers propose that perception and thought differ with respect to their content and format: perceptions are characterized to possess nonconceptual content while cognitions have conceptual content; similarly, perceptions are conceptualized to have iconic format while cognitions possess

[23] Weber (1937) says that psychologists use the term "judgment" like the terms dogs or babies, because everybody understands them without a definition. Weber offers the following tentative definition for judgment: "a cognitive reaction initiated by a query, and involving inspection, discrimination, comparison, appraisal, and a degree of *belief*" (p. 266; italics added). Judgment is a contrastive term, here. It is contrasted with a report based on sensory processes. So, the term "judgment" refers to verbal reports based on thoughts, beliefs, inferences, concepts, i.e., any cognitive process other than sensory perception (and it also applies to the verbal report that is essentially an experimental artifact rather than that tapping into a genuine psychological process).

(language like) compositional format (Block, 2014; Fodor, 2008; Raftopoulos, 2009; Tye, 2006). This distinction of feeling and judgment has implications for the explicit SoA as it is being characterized as a unique feeling or perception based on the motor system. For instance, Synofzik et al. (2008b) say that "perceptual agency representations are not compositional and have no object-property structure, and are therefore non-conceptual" (p. 228). Judgment or thought or cognition (contra perception) has the tendency of compositionality by virtue of its nature of productivity and systematicity. The systematicity of thought implies that a new thought or concept can be generated by repeating (by using the principles of) an already generated thought. For instance, by having associated the SoA concept to priority in one situation, the participant can associate concepts of SoA and congruency in the next situation, and so on. This implies that SoA reports are not necessarily perceptual or phenomenological or based in the motor, comparator, or efference processes. So, explicit SoA reports can be argued to be conceptual (unlike percepts which are non-conceptual) in nature that arise due to individual-specific learning, or online heuristics and inferential generation of concepts about the relationship between action, action-effect, and self-reference.

Similarly, the inconsistent (or contradictory) reports such as self-attribution bias as well as other-attribution biases in the explicit SoA research domain can parsimoniously be accounted for by the systematicity of judgment. For instance, Fodor (2008) proposed a "language of thought" hypothesis according to which our thoughts are language-like and thus employ the transformational rules of natural languages, such as systematicity and productivity. For instance, one can entertain a thought of "person X rides a horse" and can also think that "horse rides person X"; although it is nonsensical to think (and believe) that horses are riding people, it does not preclude one from having that thought. The very fact that these nonsensical thoughts are judged to be nonsensical (by the person who is having these thoughts) entails that the individual is entertaining those very thoughts; indeed, it is due to entertaining those thoughts that the individual can notice them to be nonsensical or contradictory in the first place. So, irrespective of whether the thoughts are physically materializable or not, one can entertain nonsensical and contradictory thoughts, although those nonsensical and contradictory thoughts lead to epistemic discomfort. Furthermore, it is possible that nonsensical thoughts might not feel nonsensical as long as they are grammatical, as the thought or cognition is fundamentally language-like. For instance, consider the sentence "colorless green ideas sleep furiously" (Chomsky, 1957). This sentence does not feel nonsensical compared to the sentence that "furiously sleep ideas green colorless," although both are not physically true (i.e., ideas do not sleep). Thus, dichotomous reports of self-attribution, as well as other-attributions of agency, do not appear nonsensical or contradictory (for those participants who exhibit this dichotomy), as it is a case of (compositional) judgment.

I have argued that the explicit SoA report is an instance of judgment and/or (the causal belief-based) heuristic response. One sort of heuristic response is the "attribute substitution" (Kahneman and Frederick, 2002), the tendency to substitute judgments about one attribute, with some other (often, irrelevant) attribute or cue.[24] For instance, a person can answer the (computationally complex) question of "how satisfied is he with his life" by substituting it (mostly unconsciously) with the attribute of how is his mood at present (Schwarz and Clore, 1983). Similarly, a person exhibiting a beautiful-is-familiar effect finds beautiful faces to be familiar (Monin and Oppenheimer, 2005). According to Kahneman and Frederick (2002), attribute substitution occurs due to the employment of the availability heuristic. Kahneman (2011) proposes that the human cognitive apparatus has "dual processes:" system 1 and system 2. System 1 undertakes quick, intuitive judgments while system 2 deals with calculated reasoning. Under situations like computational complexity, cognitive load, and uncertainty, humans tend to take shortcuts in decision making by employing the quick and intuitive system 1; one such quick response is attribute substitution (Tversky and Kahneman, 1974). Attribute substitution, typically occurs (1) when the target attribute (that gets substituted) is inaccessible or uncertain; (2) when an (unrelated but conceptually associated) substitute attribute comes to mind easily; and (3) when (reflective) system 2 fails to prevent the attribute substitution (Kahneman and Frederick, 2002). Therefore, it can be argued that the explicit SoA report can also be a case of attribute substitution as (1) the explicit SoA experimental setup has uncertainty, and (2) the prior or online-generated beliefs and heuristic responses come to mind easily and influence the explicit SoA report (under uncertainty about agency or causal contingency).[25]

Kahneman and Frederick (2002) propose that attribute-substitution effects can be curbed by careful thought, elimination of computational complexity, or elimination of uncertainty by employing system 2 (of the dual processes of human cognitive apparatus). In the section below, I propose a hypothetical scenario to argue that non-veridical explicit SoA judgments might not have occurred at all if the explicit SoA experimental setup had (contingency) certainty.

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[24] The attribute substitution should not be considered as a wrong answer per se but is an answer to the wrong question.

[25] One of the proponents of SoA, Bayne (2008), also anticipates the misattribution critique by the skeptic of agency phenomenology. For instance, he says that "Perhaps, the sceptic might suggest, so-called agentive experiences are actually more familiar experiential states that are misdescribed as distinctively agentive" (p. 185), and he identifies two types of experiential states that could potentially be misdescribable as SoA: (1) bodily sensations associated with movements and (2) conscious judgments with contents concerning agency. However, he cautions that "Although agentive experiences are intimately associated with bodily sensations of various kinds, we should resist identifying agentive experiences with bodily sensations" (p. 185).

No Explicit SoA Misattribution under Contingency Certainty

The typical explicit SoA experimental setup, such as the "variable action-effect contingency task," has contingency uncertainty. Under this uncertainty, participants are likely to anchor their SoA (i.e., "I did it" or "(s)he did it") reports to learned or online-generated (cognitive) congruency (between action and action-effect). Thus, I contend that, had there been no uncertainty about the contingency between action and action-effect then there would not have been self-attribution (or other-attribution) biases of agency on the part of the participants. For instance, consider the (thought experiment) scenario of "constant action-outcome contingency task" (contra "variable action-outcome contingency task") where the action-effects are always consistent and contingent upon the action. An example of the "variable action-outcome contingency task" is that the keypress of X leading to the display of blue color in some trials and also the keypress of X leading to the display of red color in other trials; and an example of the "constant action-outcome contingency task" is to strictly obey the relationship learned in the acquisition phase, for example, the keypress of X leading to display of red color in all the trials (and never a display of blue color) and the keypress of Y leading to display of blue color in all the trials (and never a display of red color). In a scenario like this, the participant always knows whether the action-effect is due to her own action, as she is certain of her agency contingency — because of the consistency between the actions and the action-outcomes. In these cases she reports "I did it" or "I did not do it" solely based on the visual and proprioceptive information, thus making the involvement of the efference copies redundant in these reports.[26] So, the SoA would not have occurred under contingency certainty; and the purported SoA would be nothing but SoO (which is contrasted with SoA). What is perceptual, i.e., "intentional" in the agency context is the proprioception and visual or auditory action-effects, which are categorized as instances of SoO.[27]

Rebuttal of the Claim that the SoA Is Both a Feeling as Well as a Judgment

So far, I have argued that the explicit SoA is a judgment rather than a feeling. Some researchers also make a distinction between a feeling and a judgment by proposing that SoA occurs in two stages — first, a feeling level, and second, a judgment level (Bayne and Pacherie, 2007, 2014; Gallagher, 2012; Haggard and Tsakiris, 2009; Synofzik et al., 2008a, 2008b). However, my position is that SoA

[26] The job of the efference copy, here, is to guide motor action but not in the awareness of agency (if there is such a thing) per se.

[27] SoA proponents made a distinction between SoA and SoO by saying that proprioception and visual or auditory action-effects are common for both passive and active movements, and the difference between them is what the source of them is — for SoA, the source is the comparator mechanism while for the SoO the source is proprioception, vision, or audition etc.

does not consist of two stages but only one, and SoA is only a heuristic judgment (under uncertainty). The two-stage theory of SoA can be read as having three different connotations — (1) feeling of agency (FoA) occurs first, and judgment of agency (JoA) occurs later in the sequence, and the feeling acts as an input to judgment, (2) FoA is prospective while JoA is postdictive, and (3) FoA manifests as so-called implicit SoA measures such as intentional binding and sensory attenuation, and JoA manifests as the explicit SoA.

(1) Rebuttal of the claim that "FoA is an input to JoA." According to Synofzik et al. (2008a), FoA, which is perceptual or non-conceptual, occurs in the first stage, and "If the non-conceptual FoA is further processed by the cognitive system by additionally involving conceptual capacities and belief stances, then a conceptual, interpretative judgment of being the agent (judgment of agency; JoA) is produced" (p. 416). The FoA is considered to act as an input to JoA; for instance, Synofzik et al. (2008a) say that "The JoA is formed by a rationalization process that normally has a[n] FoA as input" (p. 417).[28] As the FoA is the distinctive mark of voluntary action, it attains the status of the epistemological ground for JoA reports — so claim SoA proponents. For instance, Haggard and Tsakiris (2009) claim that "Under normal circumstances, the FoA (feeling of agency) is a necessary condition for JoA (judgment of agency), and indeed forms the evidence base for the judgment" (p. 243). Similarly, Bayne and Pacherie (2007) claim that "agentive judgments are typically grounded in and justified by agentive experiences. In the normal case, we judge that we are the agent of a particular movement on the grounds that we enjoy an agentive experience with respect to it; here, our agentive judgments are simply endorsements of our agentive experiences" (p. 477).[29] They also say that "Agents will typically judge that they are the authors of a movement — that it realizes one of their own actions — if and only if they have an agentive experience with respect to it" (p. 486). This proposal that FoA is input to JoA has parallels to one of the arguments in cognitive phenomenology — the content grounding argument. According to the content grounding argument, it

[28] Gallagher (2012) uses the terms SA1 and SA2 to refer to FoA and JoA, respectively.

[29] Some researchers like Gallagher (2012) propose that JoA can also act as an input to FoA. He says that FoA or "SA1 can be supplemented and complicated by SA2, which is based on higher-order considerations about whether what I plan to do or have done is consistent with my belief system, or with my conception of efficient means–end relations" (pp. 28–29). However, Bayne and Pacherie (2007) say that JoA does not influence FoA. They say that the FoA is "largely impervious to the agent's judgments about what they are doing in much the way that the output of perceptual systems is mostly impervious to the agent's judgments concerning the objects in their perceptual environment. In the same way that one's judgments about the relationship between the two lines of the Müller–Lyer illusion will not change the way that they look, so too one's judgments about whether or not one is an agent (or is really in control of one's body) will not, we suspect, have much impact on how one experiences one's own agency" (p. 485). This argument parallels the cognitive impenetrability argument (Firestone and Scholl, 2016; Zeimbekis and Raftopoulos, 2015), which contends that cognitions and judgments do not influence feelings or perceptions postdictively.

is by virtue of possessing a phenomenology that one has corresponding thoughts or content, i.e., one's thought content or intentionality (or aboutness) is grounded in its phenomenology.

My objection to the two-stage theory (in its characterization as "FoA is an input JoA") is that it is redundant to propose two levels for a single experience or one report (as in SoA experiments). Also, this is not the typical case with other experiences such as color or pain. We do not talk about the feeling of color and the judgment of color as two levels of color perception, although we have feeling of color and thoughts about color as two different psychological processes, namely perception and thought, respectively. It has to be noted that SoA reports are always given once. It is improper to propose two levels from a single (experiential or otherwise) report (and I have not come across any experiment that found both FoA and JoA with two reports — one for each — in a single experiment).

(2) Rebuttal of the claim that "FoA is predictive/prospective and JoA is postdictive." For some researchers, the FoA is predictive or prospective, i.e., it happens before the action is implemented. For instance, researchers emphasizing the role of action selection fluency — such as Chambon et al. (2014), Sidarus (2016), and Sidarus et al. (2017) — argue that the SoA is prospective. Haggard and Chambon (2012) say that there exists a prospective SoA, such as action selection fluency, and it has a biological function of supervisory control: "For example, we often make errors by pressing the wrong button on a machine, or by not knowing which button to press. The prospective sense of agency may be the brain's way of generating the feeling of 'just knowing the right button to press' " (p. 392). Similarly, Bayne and Pacherie (2014) propose that FoA can be generated before any action effect has occurred and is solely based on premotor processes, and they suggest temporal priority of intention or will (i.e., W-judgment) to that of actual movement in the Libet experiment as the evidence for this.

The objection I have with the two-stage theory (as characterized as "FoA is predictive and JoA is postdictive") is that the construct "prediction" or "postdiction" is not a property or a phenomenon in itself, and it fails to unambiguously refer to any psychological phenomenon. For instance, there occur so many events and processes before action, such as learning, intending, desiring, motivating to act and put effort, action planning, calculating the consequences, and, after action, there occur multiple events such as self-esteem for acting, desire/need cessation, exhaustion, refractory period, etc. However, the terms prediction and postdiction fail to specify to what exact process(es) they refer. If these terms refer to those phenomena that behavioral scientists are already aware of, then the constructs "prediction" (or "predictive coding") and "postdiction" are redundant.

(3) Rebuttal of the claim that "FoA is an implicit SoA and JoA is an explicit SoA." One more characterization of the two-stage theory of SoA is that FoA is an implicit SoA as manifested as intentional binding and sensory attenuation, while

JoA is an explicit SoA. For instance, Bayne and Pacherie (2014) assert that "This conceptual distinction is echoed methodologically in the ways agency is measured in experimental studies. While some studies (Farrer et al., 2003; Metcalfe and Greene 2007; Sato and Yasuda, 2005) investigate agency by asking participants to explicitly judge whether they caused a particular sensory event, other studies use implicit agency measures such as intentional binding and sensory suppression" (p. 217). However, there is mounting evidence for the dissociation between the implicit measures of SoA such as intentional binding, sensory attenuation and an explicit measure of the "I did" (feeling) report. There is no correlation between (implicit) sensory attenuation and an explicit SoA report (e.g., Candini et al., 2014; Desantis, Waszak, and Gorea, 2016; Sato, 2008; Timm et al., 2016; Weller et al., 2017), and no correlation between (implicit) intentional binding and an explicit SoA report (e.g., Cravo, Claessens, and Baldo, 2009; Ebert and Wegner, 2010; Majchrowicz and Wierzchoń, 2018; Moore et al., 2012; Oren, Eitam, and Dar, 2017; Saito et al., 2015). So, it can be argued that the constructs of FoA and JoA (or implicit and explicit SoA) are neither a manifestation of a unitary phenomenon of SoA nor a manifestation of two levels of SoA, as FoA and JoA dissociate.[30]

Unlike the two-stage theorists, I argue that SoA reports occur only once and on the judgment level. For the two-stage theory, SoA is a feeling plus a judgment; while for me, the instance of SoA is just a judgment. Additionally, I propose that the judgments in explicit SoA experiments are not due to agency (or with intentional-content about agency) at all, as they are due to attribute-substitution (and can be reduced to SoO). Thus, my position is that the explicit SoA report is essentially a "judgment of substituted attribute" rather than a judgment "of agency" per se.[31] Although the two-stage theory of SoA agrees that the SoA is a judgment, it fails to acknowledge that the implication of the attibute-substituted judgment is that the purported judgment of SoA is not a judgment "of agency" per se — as it is a substitution of some other attribute. Thus the purported SoA judgment is not due to "content grounding" in the experience or perception[32] but

[30] An interesting question to ask is, why is there no relationship between implicit and explicit SoA reports? It could be because there is no "feeling of agency" in the first place as a common process for both implicit and explicit SoA processes. One more reason could be that the SoA, either implicit or explicit, is a judgment and the lack of association could be due to peculiarity in heuristics, attribute substitutions, or conceptual inferences that these (implicit and explicit) measures afford or bear, as expected by the compositional nature of thoughts or judgments.

[31] But why do the reports (in the SoA experiments) have agency as the content? It is due to the leading question that is supplied which has the content of agency (but not due to perception/experience of agency per se).

[32] For instance, Bayne and Pacherie (2007) claim that "agentive judgments are typically grounded in and justified by agentive experiences. In the normal case, we judge that we are the agent of a particular movement on the grounds that we enjoy an agentive experience with respect to it; here, our agentive judgments are simply endorsements of our agentive experiences" (p. 477)

an attribute-substitution that occured due to uncertainty or computational complexity (Kahneman and Frederick, 2002) in the typical "variable action-outcome contingency task." If explicit SoA reports are mere instances of attribute-substitutions then this implies that there is no cognitive ontology of an explicit SoA (which is characterized as a proprietary phenomenology of agency).

Conclusion

Proponents of explicit SoA have characterized it as a unique experience or perception based on motor processes. However, this paper concludes that the assumptions underlying explicit SoA are untenable for the following reasons: (a) explicit SoA operationalizations have uncertainty about the information that the participants have to report, i.e., about their contingency (thus, making the participants prone to judgment effects); (b) explicit SoA reports are dissociated or otherwise not correlated with agency states; (c) explicit SoA reports are influenced by prior or online-generated beliefs or heuristic responding, such as self-attribution bias or congruency (or outcome) anchored responding; (d) typical explicit SoA reports will not occur if the uncertainty is controlled for — for instance, if the "constant action-effect contingency task" is used. Thus, I conclude that the influence of prior beliefs or online-generated heuristic responses in explicit SoA reports can be parsimoniously explained by the flexibility afforded by the compositional nature of the thought or judgment, implying that explicit SoA reports are instances of judgments rather than feelings (or phenomenology). I also conclude that the lack of correlations between explicit SoA reports and agency states or actions imply that SoA reports are not the instances of (comparator-process-based) "agency phenomenology" (akin to "cognitive phenomenology") per se. If the purported explicit SoA reports are judgment effects then it is a category mistake or lack of construct validity on the part of SoA proponents to portray the explicit SoA report as an instance of feeling.

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