Theoretical Article

Representing Oneself and Others

An Event-Coding Approach

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Abstract: Human beings are assumed to own a concept of their self, but it remains a mystery how they represent themselves and others. I shall develop a theoretical framework, inspired by the Theory of Event Coding, of how people represent themselves and others, how and under which circumstances these two kinds of representations interact and what consequences this has. In a nutshell, I shall argue that self- and other-representations can overlap to the degree that they share features, that the shared features are particularly relevant or salient, and that the individual is under a particular metacontrol state. Then I shall argue that self-concepts emerge through active exploration of one's physical and social environment during infancy and childhood, as well as through cultural learning, and that their main purpose is related to social communication but not online action control.

Keywords: Self-representation, metacontrol, social sognition, theory of event coding, minimal self, narrative self

The self is a particularly colorful concept that occupies a central position in the cognitive and social sciences since their existence: It is the agent that is doing the thinking in Descartes' quest for a proof of human existence, the target of religious and political persuasion, the ultimate goal of personal development and therapeutic intervention, and the key factor in attributing legal and ethical responsibility. But what is the self? It is often taken as a given, or at least as a useful fiction (as in juridical thinking), but it is hotly debated how it works, where it comes from, and what its potential might be.

Philosophical approaches distinguish between the so-called "minimal self" and the "narrative self" (e.g., Gallagher, 2000). The concept of a minimal self relates to a person's phenomenal experience in the here and now and to the way one is perceiving oneself in a particular situation. While this experience is likely to be dominated by information delivered by the senses, that is, by self-perception in a literal, immediate sense, human beings also have knowledge about themselves, amassed over years, and a sense of understanding how their self relates to others. The concept of a narrative self is considered to capture these aspects, which include the past and the future, and communication about the self both with oneself and with others. In the following, I shall focus on the minimal self for the most part (and thus speak of "self" whenever I mean "minimal self") and suggest a theoretical framework explaining how people might represent others and themselves, how these two kinds of representations might interact and emerge through experience during infancy and childhood. Finally, I shall briefly touch the possible connection between minimal self and narrative self (which I shall consistently refer to as "narrative self") before I conclude and ask some open questions.

Representing Others

How do we cognitively represent another person? Imagine yourself to be a newborn being exposed to your caregiver, say, your mother. While your sensory systems might not yet be fully developed, you are likely to perceive a number of features, even though not all of them will be relevant or salient for you: She will have a face of a particular shape that you learn to recognize after a while, particular hair, fingers, breasts, and so on. With the visual features come auditory features, such as the sound of her voice, tactile features, such as the feeling of her touch, and so forth. Insights into object perception suggest that all these features will be bound into some integrated feature network that can be considered the representation of the person that is your mother. How spontaneous this binding works is demonstrated by research showing that arbitrary stimuli enjoy privileged/efficient processing if they were simply presented as "representing" oneself or a close family member (Schäfer, Frings, & Wentura, 2016; Sui, He, & Humphreys, 2012). However, people are not as static as objects are but act more or less continuously. Some of these actions will be specific to your mother, such as caressing and breastfeeding you, while others are shared by other people, such as moving around and talking. It will thus be essential to not only represent these actions but also to bind them to the people that carry them out. How does that work?

According to the Theory of Event Coding (TEC; Hommel, 2009; Hommel, Müsseler, Aschersleben, & Prinz, 2001), actions are represented by codes of features of their sensory consequences, which is true for both the actions of others and the actions one is carrying out oneself. Hence, both stimulus and action events are represented by codes of their perceptual features that are integrated into multimodal event files (Hommel, 2004). As pointed out elsewhere (Dolk et al., 2014; Hommel, Colzato & van den Wildenberg, 2009; Ma & Hommel, in press), the concept of an event file is perfectly suited to account for the representation of people, even though representations of human beings are likely to be more complex than representations of objects and also contain more abstract features (Greenwald et al., 2002). For instance, the feature of fatherhood is likely to be grounded in sensorimotor experiences with other adults caring about and playing with a particular infant, driving a particular adolescent to school, hosting the grown-up adolescent on important holidays, and living with someone else doing the same (cf. Hommel, 2016, pp. 85–88).

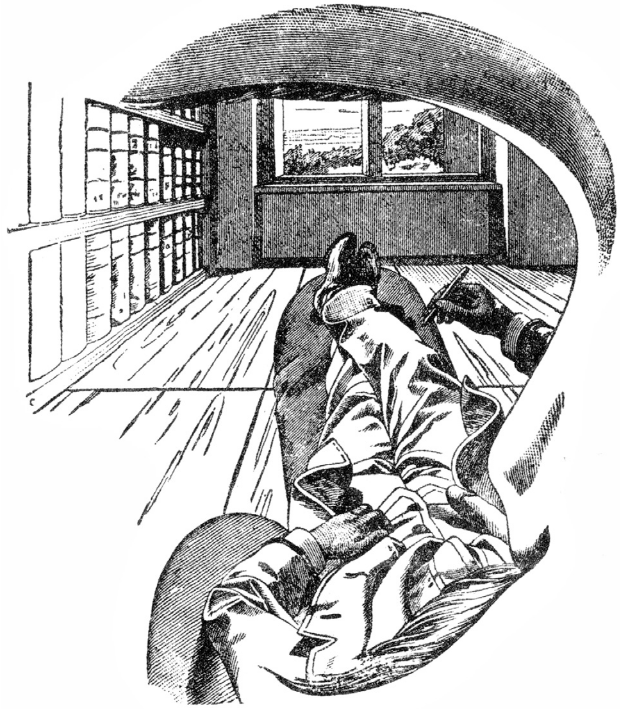

Figure 1. Ernst Mach, watching himself out of his left eye ("Innenperspektive," public domain; retrieved from Wikipedia.org).

Representing Oneself

As one of its key characteristics, TEC assumes that perceiving a stimulus event is not any different from carrying out an intentional action (given that both are considered more or less dynamic events) and that perceiving other people is not systematically different from perceiving oneself. This implies a bundle-self concept as propagated by David Hume (1739), who claimed that the (what now would be considered minimal) self consists of nothing but the total of all perceptual information a person currently has about herself. As soon as active perception stops, like when going to sleep, the self is literally assumed to "cease to exist." Nevertheless, perception is always constrained by the mechanics and position of the receptors it relies on and bound to a particular perspective. Given that the perspective from which we perceive ourselves is systematically different from the perspective from which we perceive others, as nicely illustrated by Ernst Mach's famous picture (Figure 1), we tend to have somewhat different information about ourselves than we have about others – which can lead to dramatically different interpretations of perceived events (Jones & Nisbett, 1972).

But even the perceptual quality of a given event is likely to differ between self- and other-perception: In addition to the perspective dependency of the information provided by exteroceptive channels, like vision, audition, tactition, and olfaction, information from interoceptive channels is exclusively available for the self-perceiver – at least in a strict online sense of perceptual awareness. Accordingly, a perceived action will have a stronger proprioceptive and affective (given that many internal receptors are closely linked to affective experience) feel to it if it is carried out by oneself rather than by another person. However, as we will see below, the possibility to have overlapping representations of self and other can reduce this discrepancy.

A second important difference between self- and other-perception relates to one's motor activity. According to TEC, it is not only feature codes that become integrated into event files but codes of motor activity (which by itself is not considered to be perceivable) as well. This reflects the ideomotor heritage of TEC. Ideomotor theories aim to tackle the question how people can carry out intentional actions (i.e., generate goal-directed motor activity) despite their "executive ignorance" (Turvey, 1977), that is, despite having no direct access to, and no specific knowledge about their motor system. Ideomotor theories account for this ability by assuming the obligatory integration of the motor components of actions, which are cognitively inaccessible, and the perceptual representations of these actions' outcomes, which are cognitively accessible (for a review, see Shin, Proctor, & Capaldi, 2010). While TEC has broader ambitions, it contains this assumption by claiming that event files integrate feature codes related to the context and the perceivable consequences of an action as well as the motor codes driving it (Hommel et al., 2001). On the one hand, this implies that representations of, or including, self-performed actions have a stronger motor component than representations of, or including, other-performed actions (except for other-performed actions that systematically co-occur with particular self-performed actions, such as in interactive sports). On the other hand, however, we will see that this discrepancy is likely to be less pronounced if and to the degree that representations of self and other overlap.

A third difference between representations of self- and other-performed actions relates to prediction. Some actions performed by others may be very easy and reliable to predict, but most of the time we will do a better job in predicting our own actions. According to Wegner (2003) and the cybernetically inspired comparator model of action control (Frith, Blakemore, & Wolpert, 2000), we perceive ourselves as an active agent by comparing the predicted outcomes of an action with its actual outcomes (for an overview, see Hommel, 2015a): the better the prediction the more agency we perceive. Given that we can predict the outcomes of our own action more often and more reliably than the outcomes of other people's actions, we are likely to perceive ourselves more as being the originator of our actions and less as being the originator of other people's actions. Again, this discrepancy might be moderated by the degree of self–other overlap, but the degree of perceived agency will commonly be more pronounced for self-performed actions.

Intentional Weighting and Metacontrol

In the non-social world, what we perceive as one event and what as another is often relative and heavily context-dependent. Depending on our attentional set and current intentions, we can perceive the components of a letter as different and separate or as part of the same letter, which can be perceived as part of a word that is part of a title that is printed on a book that is placed in a shelf that is located in a room, and so forth. Similarly, Gestalt psychology has taught us that items or objects that share particular features, like color, orientation, or motion, can be perceived as one object or event. Buddha (see Harvey, 2012) has applied the same logic to self and other. In particular, he has emphasized the relativity of the self and proposed that the degree to which an individual is perceiving herself as separate from, or as a part of a larger social unit (such as a couple, group, or society) can vary. He even suggested that overcoming the perceived separation from others would constitute an important goal for life and proposed particular kinds of meditation as a means to overcome this separation. Indeed, there is evidence that the perceived distinction between self and other differs between cultures and religious practices (Colzato, Zech, et al., 2012) and can be affected by priming (Colzato, de Bruijn, & Hommel, 2012; Colzato, van den Wildenberg, & Hommel, 2013; Kühnen & Oyserman, 2002). How can we explain these kinds of observations?

TEC and recent TEC-related developments provide two theoretical tools to make sense of both intra- and inter-individual differences in the degree of self–other overlap. First, the original TEC has suggested that not all feature codes of a given event file are involved in representing a particular event in a particular situation. Rather, codes that refer to a perceptual dimension that is (or seems) either relevant for the current task and action goal or particularly salient in the current situation are "intentionally weighted" (Memelink & Hommel, 2013), which means that their impact on the processing of this event (e.g., selecting an appropriate action) is increased relative to codes that do not receive intentional weight. This is indicated in Figure 2, where a female tall student represents herself, as well as a short male student who happens to be a father of a kid (other). In the situation captured by this figure, three feature dimensions are relevant: body size, perhaps because this is the topic that the two are discussing, studenthood, because they met in a university after a psychology course, and the fatherhood of the male student, which might be another topic of the communication. Another feature is perceivably available: the gender of the two, but it is not currently relevant and does not receive any weighting, which is why it plays a minor role at best in the current representation of the two students.

The second theoretical tool is labeled "metacontrol." As elaborated elsewhere (Hommel, 2015b; Hommel & Colzato, 2017a), the way people exert cognitive control over their cognitive processing shows considerable intra- and inter-individual variability. Depending on individual predisposition and learning history, as well as on situational circumstances, cognitive control can either be characterized as showing persistence or exhibiting flexibility, and truly adaptive behavior requires an appropriate balance between these two extreme metacontrol poles (Goschke, 2003). Following the Metacontrol State Model (Hommel, 2015b), biases toward persistence and flexibility moderate processing as indicated in Figure 2. The dominant metacontrol state is assumed to emerge from the interaction of two competing functional systems (that may correspond to frontal and striatal dopaminergic pathways, respectively: Cools & D'Esposito, 2011), which modulate the degree to which

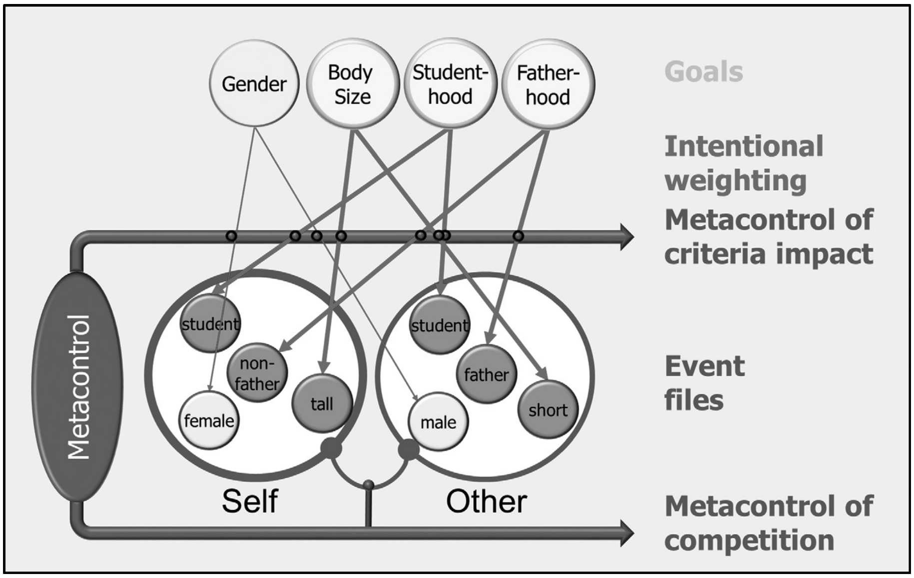

Figure 2. Representing self and other, moderated by metacontrol and intentional weighting. Self and other are represented by bindings (event files) of four features each (a simplification), of which three features (body size, studenthood, and fatherhood) are relevant in the present context, that is, intentionally weighted (primed) by the communication goals of the interacting individuals. The degree of self–other discrimination is determined by the competition between self- and other-representation, which in turn is modulated by metacontrol, which varies between high persistence (maximizing self–other discrimination) and high flexibility (maximizing self–other overlap).

goals impact the activation of cognitive representations (metacontrol of criteria impact) and the degree of competition between event files (metacontrol of competition). A strong bias toward persistence would strongly focus the system on currently relevant information and create a strongly "exclusive" processing state, whereas a strong bias toward flexibility would widen the focus and create a less selective, more "integrative" processing state (Hommel & Wiers, 2017). Among other things, this can be assumed to affect the degree to which an agent discriminates between particular events. With respect to self- and other-representation, this implies that a bias toward persistence would increase self–other segregation while a bias toward flexibility would reduce segregation.

Taken altogether, intentional weighting and metacontrol can be assumed to co-determine the degree to which people represent themselves in a way that does or does not overlap with how they represent someone else. Shared features should increase the overlap but mainly if they receive strong intentional weighting – that is, if they are relevant or salient in the present context. In addition, representational overlap is more likely under a flexibility bias than under a persistence bias, irrespective of whether this bias is due to the impact of more permanent factors, such as genetic predisposition and cultural learning, or more context-sensitive factors, such as mood (Hommel & Colzato, 2017a). Given the strong evidence that open-monitoring meditation (the ultimate Buddhist means to overcome self–other boundaries) biases metacontrol toward flexibility (Hommel & Colzato, 2017b; Lippelt, Hommel, & Colzato, 2014), it is thus unsurprising that practicing Buddhists show evidence of greater representational self–other overlap (Colzato, Zech, et al., 2012).

Sharing Experiences and Internal States

Apart from explaining individual variability and cultural differences, the combined impact of intentional weighting and metacontrol on self–other overlap helps to make sense of the intuition that some people seem to be better able to "put themselves into the shoes" of others and even seem to be able to share particular experiences with them. Recall that I have considered that perceiving a self-performed action is likely to have a stronger proprioceptive and affective feel than perceiving an action performed by someone else, that it may generate more motor activity, and create a stronger sense of agency. This is certainly true for a situation in which there is little self–other overlap, such as if an infant is comparing a self-performed action with that of an adult foreigner. But consider a situation with greater self–other overlap, such as when the infant is observing its own identical twin, say. Watching the twin will not only activate the codes of highly relevant or salient features but also retrieve/reactivate already stored event files that are sharing these features (Hommel, 2004). Some of these files will have been acquired by having performed similar actions oneself in the past, and so, they are likely to contain proprioceptive, affective, and motor codes that were integrated on this occasion and that now tend to be reactivated (Kühn, Keizer, Colzato, Rombouts, & Hommel, 2011). To the degree that this happens, and that metacontrol is sufficiently biased toward flexibility, the currently observed action will tend to have a proprioceptive and affective feel to it and even be accompanied by motor activity, which reduces the phenomenal discrepancy between mere observation and self-experience. Along the same lines, familiarity with the action and its expected effects will facilitate action–outcome prediction and therefore introduce some degree of perceived agency even for actions performed by others. This means that true sharing of perceptual and affective experiences is indeed possible, to the degree that the cognitive representations of observer and actor overlap, which is particularly likely if they share features, if the shared features are relevant or salient, if the observer is in a metacontrol state that is biased toward flexibility, and if the observer already had similar experiences before.

In a certain sense, increasing representational self–other overlap implies the blurring of the borders between self and other, just as recommended by Buddhist thinking. This blurring can be considered to facilitate informational exchange between self and other, and the sharing of perceptual and affective experiences might be one consequence thereof. An even stronger form of exchange has been demonstrated recently in our laboratory. Human participants were exposed to the head of an avatar on a screen in front of them, with the avatar's head movements being either synchronized or not synchronized with the movements of the participant (Ma, Sellaro, Lippelt, & Hommel, 2016). The idea was that synchronization would induce a perceptual experience not unlike when looking into a mirror, which also results in the view of a head that moves in synchrony with one's own movements. As expected from previous studies in the rubber-hand illusion tradition (Ma, Lippelt, & Hommel, 2017), synchronization increased identification with the avatar and perceived agency over the avatar's movements. More interestingly, however, the avatar started to smile at some point, and the question was whether the mood state that this expression signals would transfer to the participant. Indeed, participants showed better mood and better performance in a mood-sensitive creativity task (as a more implicit mood measure) if being synchronized with a smiling avatar – but not if the avatar was smiling but not synchronized or synchronized but not smiling. In other words, the feature "mood" migrated from the representation of the avatar to the representation of the self, apparently facilitated by the self–other overlap created by the synchronization procedure. Another study successfully demonstrated the migration of perceived (or attributed) intelligence (Ma, Sellaro, & Hommel, in press): Participants were synchronized or not synchronized with a human avatar, which at some point started to morph into an ape. As expected, participants synchronized with the ape head showed lower scores in an intelligence test and were more convinced that animals have empathic abilities than participants whose movements were not synchronized with those of the ape head.

The Emergence of the Self

Buddhist accounts suggest particular ways to get rid of a self, with meditation being an important ingredient in this process. But where does the self come from in the first place? Self-theorists commonly take the existence of a self for granted and often assume or imply (explicitly or implicitly) that the self is a given from birth on, if not earlier (e.g., Bruner, 1973; Meltzoff & Moore, 1997; Rochat, 2001). Such self-as-a-given approaches are difficult to test and particularly difficult to disprove, because they fail to provide the mechanisms underlying the emergence or construction of a self. While the reasons for assuming a given self are not always obvious, some authors have pointed to signs of agency very early on, in some cases in newborns (e.g., Meltzoff & Moore, 1997). As elaborated elsewhere (Verschoor & Hommel, 2017), the related evidence is unconvincing, and the case of very early agency seems overstated. More importantly for present purposes, however, there is evidence for the assumption that agency and ownership, the two ingredients of the minimal self (Gallagher, 2000), emerge slowly and through active sensorimotor experience of the developing agent.

Regarding agency, much has been made of observations that infants are sensitive to contingencies between their own movements and particular action effects (for a review, see Gergely & Watson, 1999), such as of newborns that adjust their sucking rate in response to their mother's vocal feedback (DeCasper & Fifer, 1980). While sensitivity to action–effect contingency is certainly an important ingredient of the ideomotor learning process that is assumed to underlie voluntary action control, it does not yet show that newborns can make active use of expected action effects to carry out the movements necessary to produce them, nor does it show that they have integrated motor patterns with representations of the perceptual effects they produce. A direct test of this latter process has been conducted by Verschoor, Weidema, Biro, and Hommel (2010), who presented 9-, 12-, and 18-month-olds with a touch-sensitive surface that generated salient audiovisual events if being touched. In one condition, participants were allowed to touch the surface and to generate one kind of event while in another condition another kind of event was generated without the surface being touched. Thereafter, participants were exposed to one or the other event, and the question was whether this would induce the tendency to touch the surface – which would indicate that bidirectional action–effect associations had been formed. All three age groups passed this test and showed more surface-touching tendencies when encountering the event that they had previously produced themselves. In a follow-up study comparing 7- and 12-month-olds, Verschoor, Spapé, Biro, and Hommel (2013) found no evidence for action-effect learning in the choices and reaction times of the 7-month-old. Interestingly, however, they did find an effect in the pupil-size behavior of this age group: even the 7-month-old showed bigger surprise if carrying out a movement that did not fit the presented action effect. This means that infants around that age are able to acquire knowledge that allows them to predict which action effect is associated with which a movement, but they are not yet able to employ this knowledge to select the action *in order to* generate that effect. In other words, they do have knowledge about the action and its consequences, but it is not yet "their" action that they carry out. Even if one considers having of this knowledge as being relevant for the self-concept, it seems to consist of a sort of causal knowledge but not yet functional agency. Accordingly, the human self seems to emerge from active exploration and sensorimotor experience, as suggested by Mead (1934), but is unlikely to be a genetic given.

Functions of Minimal and Narrative Self

If the minimal self emerges from active sensorimotor exploration of one's physical and social environment and if engaging in such exploration can be considered a goal-directed action, it follows that having a self in terms of body ownership (i.e., having the experience of the acting body as one's own) and agency (i.e., having the experience of being the cause of one's action) is not a precondition for the ability to carry out goal-directed actions but rather the consequence of having this ability. Indeed, in contrast to the often implicit assumption of self-as-a-given theorists that goal-directed action necessarily implies a self, there is no reason to assume that having a goal that is realized through some activity presupposes an agent who knows that it is him/her who is realizing this goal. There are good reasons to assume that not even conscious knowledge or insight into one's goals is a requirement for goal-directed action, as there is indeed no unequivocal evidence for any functional role of conscious experience in action control (Hommel, 2013; Masicampo & Baumeister, 2013). So what is having the concept of a self good for?

It is interesting to note that theorists are commonly not overly explicit with respect to why they think the concept exists in the first place and what particular cognitive functions it might have. In fact, one may ask why an agent might find it important to determine the individual authorship of a given action – beyond having reached the intended goal. While the widespread absence of a justification of this assumption seems to suggest that it is self-evident for readers with a Western background, it might be less obvious to readers with a different cultural background. As research on the cultural construction of the self shows, members of Eastern cultures tend to have a rather extended self-concept that includes family members, peers, and colleagues (Markus & Kitayama, 2003) and experience something that Markus and Kitayama (2003, 2010) have coined "conjoint agency." If one considers culture as just one of the many social factors that shape human cognition (Hommel & Colzato, 2010, 2017a), one would expect that other social factors have similar effects. For instance, there is evidence that Buddhists spontaneously relate their own action to the action of a co-actor more strongly than culture-matched atheists do (Colzato, Zech, et al., 2012). Observations of this sort suggest that the sense of individual agency is a social construct (particularly popular in Western societies) rather than a basic ingredient of cognitive functioning that can simply be taken as a given. Along the same lines, Hofstede, Hofstede, and Minkov (2010, p. 385) have suggested that "In explaining why she puts in extra effort on her job, an American may note the money she receives, a French person may mention her honour, a Chinese person may point to mutual obligations, and a Dane may mention collegiality," which according to the authors puts strong limitations on the commonsense "agency theory" that they characterize as "US-based."

All these considerations suggest that the perception of ownership and agency are post-actional phenomena in the sense of Wegner (2003). Wegner has suggested that goal-directed actions are driven by unconscious processes that do not only trigger the action in a motoric sense but that also generate expectations about the likely outcome. It is this expectation that can become conscious and that, if it matches the actual outcome of the action, generates the experience of intentionality and, so I would argue, the feeling of agency. Whether people do or do not have this experience plays no role for action control and the successful achievement of intended goals. However, it may very well play a role for post-actional activities, such as constructing a reason for the action for social justification, emphasizing particular aspects of the action over others to steer the attentional focus of other individuals, so to facilitate successful imitation or observational learning, and more (Hommel, 2013, 2017; Masicampo & Baumeister, 2013). It is interesting to note that all these functions have more to do with the concept of a narrative self than with that of a minimal self. Indeed, an increasing number of findings suggest that so-called implicit measures of the minimal self are less systematic and more difficult to predict than the common explicit measures, that is, responses to verbal inquiries into the experience of body ownership and agency (e.g., Dewey & Knoblich, 2014). As I would argue, such verbal inquiries constitute the basic ingredients of a social communication/justification situation that draws on the ability to explain one's actions and to put them into a meaningful context, and it is these situations that our skill to construe a narrative self is made for. Outside of these kinds of social situations, the experience of owning the body that is performing an action and being the agent of it has hardly any obvious use. Hence, I would argue that a continuous self exists only if, and to the degree that we ask questions about it – selves are constructed on request.

Conclusions

The phenomenal aspect of the human self (the so-called minimal self) is likely to emerge through active, explorative interaction with one's physical and social environment. Representations of oneself and of others do not seem to differ qualitatively from representations of other, non-social events. They consist of event files, integrated networks of codes that represent the perceptual aspects of the given individual, together with associated actions and affective responses. Event files are retrieved by similar events, and the contribution of each feature codes is weighted according to the relevance and salience of the underlying feature dimension. The degree of overlap between two given representations, such as between the representation of oneself and that of another person, depends on the number of shared features, on the weighting of these features in the present situation, and on the present metacontrol state – with persistence propagating representational segregation and flexibility promoting representational integration. While the basic assumptions of TEC and the discussed theoretical extensions stem from research on non-social events, there is no reason why the same theoretical framework should not work for the social domain as well. This opens new opportunities for the communication between the cognitive and the social sciences. The suggested framework provides a mechanistic basis for understanding phenomena in the social domain and at the same time allows the generation of new predictions based on insights into human cognitive functioning. Along the same lines, the representational assumptions of TEC are easy to translate into neuroscientific and technological concepts, which opens the previously rather philosophical treatment of the self to rigorous neuroscientific investigation and invites the creation of artificial selves in robots and other agents.

Open Questions

1. Does the perception of agency and ownership develop spontaneously or are the two concepts a social construct?
2. Do perceived agency and ownership develop independently or is the former a precondition of the latter?
3. Given the connection between object and person perception, does the cultural impact on the latter change the former systematically – as implied by Markus and Kitayama (2010)?
4. Can systematic training of object perception or practices affecting metacontrol (like meditation) reduce or eliminate biases in person perception and improve social behavior?
5. How are minimal and narrative selves related?

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