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The social motivation for social learning

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Abstract: Through the second year, children's copying behaviour shifts from a focus on emulating to a focus on imitating. This shift can be explained by a change in focus from copying others to satisfy cognitive motivations to copying in order to satisfy social motivations. As elegant and detailed as the shared circuits model (SCM) is, it misses this crucial, motivation-based feature of imitation.

There have been considerable advances in the comparative study of primate social learning during the last two decades. As Hurley outlines, one of the key findings to emerge in this time has been the clear and consistent documentation of differences in the ways human children and chimpanzees respond to another's modelled actions. Young children tend to fixate on copying the specific behavioural means used by the demonstrator (i.e., the person modelling the target actions), even if a simpler method is available. By contrast, chimpanzees tend to focus on outcomes, preferring to discover their own means of bringing about the demonstrated end result. This difference is representative of the oft-debated distinction between imitation and emulation. Hurley presents a detailed, thought-provoking model that is aimed, in part, at identifying the possible neural underpinnings of these alternative approaches to social learning. But as elegant as her model is, it misses a crucial component of human imitation: motivation.

A critical means of distinguishing imitation from emulation is to identify whether an observer preferentially aims to reproduce the specific behavioural means a demonstrator used to bring about an outcome or whether she chooses to use her own means. Does the observer focus on copying actions or outcomes? This notion of separating actions from outcomes when evaluating copying behaviour was presaged by Uzgiris (1981), who drew attention to what she saw as two core functions of copying behaviour: a cognitive function that promotes learning about events in the world and an interpersonal function that promotes children's sharing of experience with others. According to Uzgiris, young infants are primarily driven by a need to acquire new skills and behaviours and, as such, when they are shown how to do something, they focus on what was done (i.e., the outcome). However, as they move into their second year, infants become increasingly motivated to engage in social interaction and hence, as a means of realizing the congruence that exists between themselves and others, they begin to focus on the way something was done (i.e., the means used). To put it another way, young infants *emulate* out of a motivation to learn about the world, whereas toddlers show an increasing proclivity for *imitation* based on a desire to interact with, and to be like, others (for a similar view on why adults imitate, see Dijksterhuis 2005).

Recent studies have provided evidence for this proposal of an age-related shift when copying from a focus on outcomes to a focus on actions (Nielsen 2006; Tennie et al. 2006). In a cross-sectional study, Nielsen (2006; Experiment 1) tested 12-, 18-, and 24-month-olds. An adult demonstrated how to open a series of novel boxes (which contained a desirable toy) by using a miscellaneous object to activate a switch located on the front of each box. The 24-month-olds *imitated* in attempting to open the boxes by using the object, as was shown to them. In contrast, the 12-month-olds *emulated* the demonstrator's actions and only attempted to open the boxes with their hands (18-month-olds showed reactions that were intermediate between the older and younger age groups). In a follow-up experiment (Nielsen 2006; Experiment 2), 12-month-olds did imitate the adult's object use, but only after she had "attempted but failed" to activate the switches by hand. Thus, it appears that 12-month-olds did not fail to imitate because they could not use the object, but rather because they did not interpret this action to be the most efficient alternative available (see also Gergely 2003; Gergely et al. 2002).

Following Uzgiris (1981), I reasoned that the 24-month-olds might persist in imitating a demonstrator's inefficient object use in order to satisfy social motivations. Testing this interpretation, Nielsen et al. (in press) compared the responses of 24-month-olds to live and videotaped demonstrators on the boxes task used in the Nielsen (2006) study. The rationale for using videotaped demonstrators was that they can act in a social and engaging manner but, by virtue of the medium, do not afford opportunity for spontaneous, contingent interaction. If the social motivation hypothesis is valid, children should be less inclined to imitate when the opportunity for social interaction is reduced. They should be less inclined to imitate a videotaped adult than one who is available for interaction. This is exactly what happened. The children imitated the adult's object use significantly less when she appeared on video compared to when she was "live" (Experiment 1). Critically, in a second experiment, when given the opportunity to interact with the adult on a TV monitor via a closed-circuit system (i.e., where socially contingent interaction could take place), the amount of imitation children exhibited returned to "live" levels, indicating that it was the nature of their interaction with the demonstrator that affected the children's copying behaviour, not the medium.

Hurley makes a laudable effort at trying to account for human imitative behaviour by integrating complex motor ability and a capacity for goal reading into the shared circuits model (SCM). Both elements are certainly crucial in determining how we copy others. Nevertheless, as attested to by the previously discussed studies, human social learning can be strongly impacted by interpersonal motivations. These motivations are all too frequently neglected in discussions of, and attempts at explaining, imitation. Unfortunately, the SCM is no exception. There is focus on the way in which a capacity for imitation may get developed and, in layer 5, on how this could then lead to a faculty for understanding other minds. But this is not the same as acknowledging the strong interpersonal motivations that can drive imitative behaviour in the first place.

A growing number of experiments have provided remarkable insights into the neural substrates of imitation. The SCM offers a means of unifying much of this literature and promises to make a major contribution to the field. Nevertheless, one must not lose sight of the fact that human copying behaviour is extremely complex. Its expression is affected by multiple factors and here I have tried to draw attention to interpersonal ones. If we continue to ignore these factors, our understanding of the mechanisms that lie at the heart of human imitation is destined to remain incomplete.

What kind of neural coding and self does Hurley's shared circuit model presuppose?

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Abstract: Susan Hurley's impressive article about the shared circuit model (SCM) raises two important issues. First, I suggest that the SCM presupposes relational coding rather than translational coding as neural code. Second, the SCM being the basis for self implies that the self may be characterized as format, relational, and embodied and embedded, rather than by specific and isolated higher-order cognitive contents.

In her impressive article, Susan Hurley offers the shared circuit model (SCM) as the common structure underlying perception and action, which, as such, can provide the foundation for the overlapping and shared dynamics between self and other. Without going into further details here, I comment on two important conceptual questions raised in Hurley's remarkable account. First, the SCM raises the question of the kind of neural coding that must be presupposed in order to make the SCM and its shared dynamic between perception and action possible. Second, the SCM raises the question of the characterization of the self that is supposed to be based upon the SCM.

The term *code* describes a mean or measurement that captures and reflects teleogically meaningful activity in a system; this mean or measurement is implemented in certain rules and mechanisms that guide and format the system's processing of various contents (see deCharms & Zador 2000; Friston 1997). For instance, these rules and mechanisms may format and guide the neural processing of perceptual contents and action contents. Hurley's SCM, which assumes a shared dynamic and structure between action and perception, implies a common code for perception and action. Referring to the theory of event coding (TEC) by Hommel et al. (2001), Hurley mentions that there might be common coding between action and perception; but she does not elaborate on it in further detail. The TEC (Hommel et al. 2001) claims that perceived events (perception) and to-be-produced events (action) are equally represented by integrated networks and so-called event files (Hommel 2004; see also Noë 2004). What remains unclear, however, is the exact format (e.g., the formal structure) according to which these event files are coded.

Since these "event files" are supposed to be common to both action and perception, there can no longer be translation between the two for a couple of reasons. First, translation presupposes different formats (i.e., formal structures) between action and perception – or else, translation would not be needed. Second, a need for translation would imply that event files are *not* shared between perception and action. Accordingly, there must be a different kind of coding than what I call translational coding, in order to account for Hurley's SCM. How must incoming or outgoing stimuli be coded in order to allow for the SCM and the assumed common structure of perception and action? I suggest that rather than the stimuli themselves being coded, be they either perceptual or action related, it is the relation between different stimuli that is coded. That is, it is not the incoming stimulus of some perceived event that is coded in isolation but rather its relationship to actually generated motor stimuli and vice versa. Such a relationship can be coded only if translational coding is replaced by what I call relational coding (Northoff 2004). Relational coding assumes that the stimuli are formatted according to their relationship to other stimuli as, for instance, incoming sensory stimuli are set and coded in relation to outgoing motor stimuli, and vice versa.

Hurley suggests that the SCM provides the basis for constituting and distinguishing self and other. One would consequently assume that relational coding might also provide the format according to which self and other are coded. This implies not only that self and other are based upon the relation between perception and action but that our self is essentially a rather basic and relational function that is always already set in relation to others and the environment. Rather than attributing some special contents like higher-order cognitive contents to the self, this implies that the self may be considered some kind of specific format that allows for stimuli to be set in relation to each other, which in turn implicates relation of the stimuli to the respective organism and ultimately to the environment. Instead of considering the self as a special encapsulated entity or function, our self may then be essentially relational so that one may speak of a relational self. This would be well compatible with recent suggestions of self-related processing, which implicates a subcortical-cortical midline network (Northoff et al. 2006; in press). Self-related processing concerns stimuli that are experienced as strongly related to one's own person.

Without going deeply into abstract philosophical considerations, I would like to give a brief theoretical description of what I mean by the terms *experience* and *strongly related*, while *to one's person* is meant very simply as an organism. *Experience* refers to phenomenal experience such as, for example, the feeling of love or the smell of a rose. The term *strongly related* points out the process of associating and linking interoceptive and exteroceptive stimuli with a particular person. The main feature here is not the distinction between diverse sensory modalities, but rather, the linkage of the different stimuli to the individual person, that is, to his or her self. What unifies and categorizes stimuli in this regard is no longer their sensory origin but the strength of their relation to the self. The self-stimulus relation results in what has been called *mineness*; Lambie and Marcel (2002) speak of an "addition of the 'for me'" by means of which that particular stimulus becomes "mine," resulting in "mineness."

In sum, I suggest that Hurley's assumption that the SCM provides the foundation for self and other presupposes (1) a different concept of the self that characterizes the self as format, relational, embodied, and embedded (see also Clark 1997; 1999); and (2) self-related processing rather than by specific contents, a special isolated entity or function, and higher-order cognitive processing. In other terms, Hurley's SCM provides a highly fruitful starting point for reconceptualizing our notion of self and to abandon philosophical and psychological substance-, entity-, or cognitive-based models of self – and, at the same time, for gaining some insight into the hitherto unknown mechanisms of neural coding.

How do shared circuits develop?

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Abstract: The target article discusses a model of how brain circuits mediate social behaviors such as imitation and mindreading. Hurley suggests potential mechanisms for development of shared circuits. We propose that empirical studies can be designed to differentiate the influence of genetic and learning-based factors on the development of shared circuits. We use the mirror neuron system as a model system.

The target article describes several possible scenarios for the development of "shared circuits." For example, this mechanism could be "hardwired" by genes or acquired through learning, or a combination of both. We discuss the evidence for each claim and then suggest experiments that may disentangle the factors contributing to the development of shared circuits by using the mirror neuron system to illustrate our strategy.

As discussed in the target article, studies designed by Meltzoff and Moore (1977) provided evidence for neonatal imitation in infants as young as a few hours of age. Specifically, these infants imitated mouth opening, tongue protrusion, and hand opening. The researchers suggest that the pattern of imitation is not likely the result of conditioning or innate releasing