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CAN WE BUILD THEORIES OF UNDERSTANDING ON THE BASIS OF MIRROR NEURONS?[1]

Empirical findings and introduction to the problem

Mirror neurons (MNs) have been discovered in area F5 in the ventral premotor cortex of the macaque by Rizzolatti and Gallese [Rizolatti et al. 1981, 126–146, Rizolatti et al. 1988, 491–507]. At the time of discovery it was already known that neurons in this pre-motor area were also driven by visual signals, i.e. their discharges were not only movement-related. For example, visual stimulation with objects the monkey can reach and grasp caused a modulation of the firing rate of neurons [Rizolatti et al. 1981, 147-163]. However, some neurons also changed their discharges when the monkey observed the experimenter executing an action such as grasping for a target on the table. Most interestingly, the action that caused this firing rate modulation (both increases and decreases in firing rate were reported) coincided with the monkey's movement that triggered the same firing rate modulation. Around 25% of the neurons in area F5 showed this behaviour, and the degree of similarity between the monkey's action and the observed action required to affect neuronal discharges varied. While some of these neurons only

[1] This article was previously a part of a draft, which was divided into sections written by different authors, and which, however, never appeared. Although the presented part is fully of my authorship, I want to thank Ludger Jansen, Lars Schwabe, and Mario Donick for discussions and remarks on my part of the draft, which has been extended and changed, due to being addressed towards a slightly different topic, and which finally took the form of this article.

changed responses when the executable and observable action matched exactly (grasping an object of a particular size), the selectivity of other such neurons were more invariant. They changed responses even when the executable and observable actions were only logically related. For example, the visual action most effective in firing-rate modulation was the placing of a graspable object on the table, and for that neuron the most effective executable action was grasping an object on the table. Due to this similarity between the executable and observable actions, which trigger a firing rate modulation in F5 neurons, these neurons have been called 'mirror neurons'.

The discovery of MNs and the characterization of their response properties is certainly an important achievement in neurophysiology and cognitive neuroscience. The reference to the role of MNs in 'reading' the intentions of other creatures and in the learning process fulfils an explanatory function in understanding many cognitive phenomena beginning from imitating, towards understanding, and finishing with complex social interactions. Also one of the explanatory lines of genesis of autism refers precisely to the dysfunction of the mirror neuron system (MNS). All these phenomena seem to be connected by one common activity that is involved in the cognitive processes based on MNs, namely understanding. However, one problem consists in a lack of agreement about exactly what activity can be called understanding. Is understanding only a human ability? If so, then either MNs cannot be responsible for understanding—since macaques' brains also contains MNs—or understanding is not only a human ability; thus it should be ascribed also to other species. Or maybe there is a third way of solving the problem of validity of MNs for theories of understanding.

The focus of this paper is to review selected approaches to the role of MNs in mental activity as understanding, and to conclude with some possible implications for researches on MNs for philosophical theories of understanding.

Theories of understanding in contemporary philosophy of mind

We can certainly think of an organism as a system without self-reflection, which just decodes sensory signals coming from bodily action and some natural or artificial language commands of another subject, and reacts to these stimuli—and still call this 'understanding'. This is already a complex process, and perhaps for this reason it is counterintuitive to say

that it can happen without reflective understanding. However, the distinction between unreflective and reflective understanding is made in terms of the kind of involved intentionality and not in terms of the complexity of their processes. For example, an observer might not see the object for which another subject is reaching. She has to depict in her mind this missing part, i.e. the observer has to possess the capacity of predicting the goal of movements performed by an observed subject. Such a prediction, based upon visually-sensed signals caused by the bodily acts of the other agents, is already much more complex than most inferential operations on propositional structures performed in reflective understanding.

Another reason for the distinction between unreflective and reflective understanding is that if a subject interprets a sequence of motor actions as goal-directed, then the subject ascribes intentionality to the mental states of the agent performing these motor actions. As to whether such a sequence is interpreted by assuming a goal depends on the context and is not arbitrary; but if a goal is assumed, then the understanding is clearly reflective. Without an assumed goal, the understanding of the motor action can be thought of as an unreflective understanding.

On the other hand, the question 'What does the action mean?' is involved in the process of reasoning, where an observer considers the performer of the action as having beliefs. This is a matter of ascribing intentions to others and, in consequence, of ascribing intentional mental states that precede the intended action. Here it is suggested that such a grasp of intentional content is made possible via reflective understanding. However, actions can also be understood in an unreflective way; but in this case the meaning of actions is grasped though the signals provided by bodily acts without assuming intentional states. In addition, misunderstanding an action can be both reflective and unreflective. In both cases an observer identifies the wrong goal on the part of an agent. In the case of unreflective understanding an observer misinterprets the behaviour of the agent, while in the case of reflective understanding an observer ascribe false beliefs to the agent. Hence, an observer needs to have a set of capacities even to be able to misunderstand actions.

In the face of this, the statement can be made that MNs are helpful in the explanation of unreflective understanding, but in order to consider

reflective understanding we need more sophisticated theories referring to intentions, beliefs, and reasoning. And there are many philosophical theories explaining the process of understanding as a kind of conscious inference. Here are three such theories: Donald Davidson's radical interpretation, Christopher Peacocke's theory of concept understanding, and, third and more general, theories of meaning as understanding, represented for example by Michael Dummett.

According to Davidson, the act preceding the action understanding is simply the observation of an agent's behaviour. On this basis an interpreter ascribes to an agent intentions, beliefs, desires, and other propositional attitudes. Davidson calls this way of interpreting an agent's behaviour 'an epistemic triangle': to understand the behaviour of an agent the interpreter has to have a hypothesis about his intention and then check this hypothesis with respect to the external conditions in the world. In this way, he can verify or falsify his interpretation. If it is wrong, then he has to change it and form another hypothesis. To do this, the interpreter needs to possess the mechanism of thinking and rationalizing. In order to treat the subject's behaviour as rational, one cannot quit the mentalist terminology, because it refers to subject's beliefs and intentions—which form a coherent, logical, integral whole [Cf., Davidson 2001].

Davidson's approach has important consequences for first-person authority, because it seems to be obvious that the thinker does not need to watch himself, or to watch his own behaviour, to know that he has a belief. Davidson's argument as why it should be this way, proceeds as follows [Lepore, Ludwig 2005, 395–396]:

1. To have beliefs is to be an agent.
2. To be an agent is to be capable of acting.
3. To be capable of acting one must be able to have intentions.
4. One's beliefs and desires must be coordinated in the right way to provide rationalizations of one's potential actions.

Davidson claims that a person can have neither beliefs nor concepts without having the concept BELIEF, and this means that the person must have some beliefs about beliefs, at least the most crucial belief that beliefs can be right or wrong.

> […A] person cannot just believe that he or she is seeing a cat: in order to believe this, one must know what a cat is, what seeing is, and above

> all, one must recognize the possibility, however remote, that one may be wrong. [Davidson 1999, 8]

So one cannot be an agent without having the concepts of belief and other related propositional attitudes [Lepore, Ludwig, 2005, p. 396]. Davidson's theory of the meaning of linguistic expressions is a consequence of his theory of radical interpretation. Semantic properties of expressions are not identifiable without reference to the interpretation of linguistic behaviour. The radical interpreter individuates content of expressions by referring to objects and events that are their cause. Therefore the understanding of behaviour is strongly connected to the meaning of understanding more generally. Knowledge about meaning is inferential because it is the result of reasoning performed on the basis of observations of the sender, and many other factors that the interpreter must take into account. These include expressions, reasoning, and compatibility of beliefs.

According to Davidson, rationalization of behaviour has the form: 'If I do A, then *p*'. This standpoint meets a criticism presented by E. Lepore and K. Ludwig [Lepore, Ludwig, 2005]. According to them, recognizing whether somebody has a belief or not happens by a characterisation of the internal state of a person, and thus by her intentions. This recognizing and rationalizing could take a form of the condition: 'If I intend to do A, then that is a result of this intention to do so'. Davidson presents an externalist approach to knowledge about meaning, according to which one can recognize that somebody has a belief through an external observation of the behaviour of this person, and thus without any reference to the internal states of the observed agent.

To conclude, according to Davidson understanding is a complex process requiring conceptual capacities the guarantee the ability of interpretation. Reasoning, as a higher mental capacity, is a part of this process. It must be also said that Davidson assumes a neural basis for mental events, so it is unquestionable that the ascription of beliefs also has its neuronal fundaments and maybe a part of this neuronal basis consist in MNs. However, the consequence of the supervenience-thesis should not be the claim that we should infer from MNs something about their role in understanding, since we do not know anything about the nomological connection between physical and mental spheres. Again, on

the basis of Davidson's theory, although based on a claim about the supervenience of the mental on the physical, we cannot infer anything about the supervenience of understanding on MNs.

Another theory of understanding through concepts comes from Christopher Peacocke. According to Peacocke, it is not possible to state that 'I understand', without self-knowledge. So to answer what is it like to understand means to answer what is it for a subject to have self-knowledge, which rests on possession conditions for concepts describing our mental states. To say, 'I believe that I believe,' we have to form beliefs of a certain kind. To say, 'I understand' requires the possession of the concept UNDERSTANDING and the concept I, which requires the capacity of self-reference through beliefs constituted by concepts and forming propositional content. Peacocke argues that the reference (or meaning, in Frege's terms) and truth play an explanatory role for understanding in general, and for the possession of concepts in particular. He summarizes his standpoint by saying that we need a realistic theory of concepts based on the theory of truth, in order to correctly grasp the observational concepts of time and space. Concepts here are individuated by rules of reference. Only such a holistic approach to the theory of concepts, meaning, and truth helps explain understanding [Peacocke, 2008b, 159].

Although Peacocke does not agree with the justificationist theory of meaning—mainly because of its being anchored in antirealism—he uses some central ideas that also ground Dummett's theory of meaning as a theory of understanding. According to Dummett, it is impossible to understand a single sentence without the possibility of understanding another sentence. This is called the 'Generality Constraint', and was originally formulated by Gareth Evans—to which Peacocke also refers.

> If a subject can be credited with the thought that a is *F*, then he must have the conceptual resources for entertaining the thought that a is *G*, for every property of being *G* of which he has a conception. [Evans, 1982, 104]

Evans claims that thoughts are structured not because of the composition of their elements but thanks to some conceptual abilities like the possession of certain concepts. In one footnote he makes an important comment, namely that the Generality Constraint makes the fundamental difference between human thoughts and information

processing in our brains, because it applies to the former but not the latter, if we agree that the system of thought we possess underlies our use of language [Evans 1982, 104]. Defining thinking as a structure consisting of conceptual abilities, Evans recalls the Geach thesis, according to which concepts are specific mental abilities exhibited in the act of judging. Understanding a sentence is therefore a consequence of having a set of certain conceptual abilities.

It seems that Peacock understands the Generality Constraint similarly to Evans; however he formulates it on his own way:

> If a thinker can entertain the thought *Fa* and also possesses the singular mode of presentation *b*, which refers to something in the range of objects of which the concept *F* is true or false, then the thinker has the conceptual capacity for propositional attitudes containing the content *Fb*. [Peacocke, 1992, 42]

Peacocke, taking the standpoint of realism, constructs a Principle of Dependence that refers to the ability of a subject, who can express a judgment containing a certain concept only if she possesses this certain concept. According to the Principle of Dependence, understanding will be defined also as a consequence of having these abilities [Peacocke, 1992, 5].

From all the above given conceptions of understanding follows the conclusion that understanding is not equal to information processing. To understand means to grasp a content of an attitude, hence it means that a subject needs to have some conceptual capacities to have the ability to understand something. In turn, to have conceptual capacities means to have the ability to represent; so it seems that understanding begins not on the level of neural information-processing but on the level of representation.

In general, there are two possible strategies for explaining understanding. Both are philosophical, and hence somewhat hypothetical and speculative. Strategy 1 has a *subjective starting point*. It assumes that to ascribe intentions to others, a subject first has to ascribe mental states with intentional content to herself. This capacity depends on a theory that can be called self-reference, reflective self-awareness, or introspective self-awareness. To perform this self-ascription, the subject has to think about herself as the subject of such a state. Strategy 2 has an *objective starting point*. It assumes that a condition of the ascription of

states of consciousness to oneself is also ability to ascribe them to others [Strawson 1996, 99].

A problem for the first strategy is the asymmetry between ascribing current mental states of a thinker to herself and by other persons to that thinker. In other words, the problem concerns the asymmetry between first- and third-person perspective [Davidson 2001, Lepore 2005]. The meaning of intentional acts is identified by the interpreter on the basis of the agent's behaviour. However, it seems obvious that the thinker does not need to watch herself to know that she is in the specific intentional mental state, yet there is also no contradiction in asking about oneself: was it me, who did this terrible blunder? Was this my intention? A problem with the second strategy is the necessity of assuming a primary—maybe innate—concept, through which individuals could be identified as persons, subjects, or rational agents—anyway, as psycho-physical individuals. The question is whether PERSON or SUBJECT are primary concepts, which allow for such an identification. Maybe the basic concept is different, for example it might be the concept of SELF. In which case it would not be the identification of another as a subject, but as a Self, that would be fundamental.

Both strategies have one common property: They presuppose that the subject has privileged access to her own mental states and no direct access to the mental states of others. In other words, they presuppose first-person authority as characterized by three features: (i) *infallibility* of our judgments about our own mental states (if I am in pain, I cannot be wrong); (ii) *incorrigibility* (our judgments about our own mental states cannot be corrected by others); and (iii) *self-intimation* (our mental states are transparently available to us) [Guttenplan, 1994. 291]. In turn, first-person authority is inextricably related to introspection or reflection.

In such a philosophical account understanding is reserved for subjects, who possess self-knowledge. The whole process of gaining self-knowledge is constituted on the grounds of self-consciousness, which is possible thanks to the capacity of self-reference. Therefore self-consciousness is the basic condition for acquiring self-knowledge. The intentionality is that understanding is directed upon a content of the conscious state and at the same time directed upon the very same mental act. However, in such account self-consciousness is a necessary but

insufficient condition for understanding. It excludes many creatures, some of whom even passed the Gallup test [Gallup 1970][2], or simply show a kind of behaviour this in some sense could be called 'understanding'. That is why there is a need for an extension of this term.

How to combine a neuroscientific approach to the role of MNs in understanding with a philosophical account

While each of three theories of understanding mentioned above appears at least partly plausible, they have not been spelled out in sufficient detail to address the question whether the finding of MNs can challenge them.

Rizzollatti speaks directly about the crucial role of MNs in understanding. Marco Iacoboni adds that the link between MNs and understanding extends through empathy, which 'plays a fundamental role in our social lives. It allows us to share emotions, experiences, needs, and goals' [Iacoboni, 2009, 109]. According to Iacoboni, the main function of MNs is not understanding but empathy. Of course it is important to underline that the functions are described in the language of folk psychology, hence the proper formulation should follow: the main function of MNs is not what we call understanding but so-called empathy: 'Mirror neurons provide an unreflective, automatic simulation (or "inner imitation" […]) of the facial expressions of other people, and this process of simulation does not require explicit, deliberate recognition of the expression mimicked' [Iacoboni, 2009, 111–112]. Iacoboni is sure that this is the role empathy, which allows for proper functioning of a society. But to restrict the role of MNs only to the decoding of emotions is obviously not sufficient, although Iacoboni infers from it more about self-recognition, self-identification, and hence about 'self'. However, he points out that there is no need for reflection in these processes. They need not even be consciously realized. They simply impact upon our behaviour. This means that one can participate in a joint action or perform an individual activity only on the basis of empathy, but without

[2] The mirror test: the indicator of awareness in this case is self-recognition in the mirror. But the test has been criticized for its focus on visual apparatus, excluding *ipso facto* organisms with senses better developed than vision.

understanding in the proper sense intended when we talk about the meaning of performance. The examples could be joint actions, such as participation in rituals, or individual action like following the leader.

A brilliant analysis of the role of MNs has been presented by Elizabeth Patcherie and Jerome Dokic [Pacherie, Dokic 2006]. They distinguish four levels of understanding: visual, motor, agentive, and meta-represenational. Their argumentation is reasonable and balanced:

> On the one hand, we will argue that mirror neurons do not by themselves provide a sufficient basis for the forms of agentive understanding and shared intentionality involved in cooperative collective actions. On the other hand, we will also argue that mirror neurons can nevertheless play an important role in an account of the production and understanding of joint action, insofar as they provide the basic constituents of implicit agent-neutral representations and are useful elements in a process of online mutual adjustment of participants' actions. [Pacherie, Dokic, 2006, 101]

Pacherie and Dokic refer to other authors who describe the role of MNs as: 'coding the perceived effect the action exerts on the object, then the perceived effect is encoded in "ego-centric" terms, as a type of effect I can produce by performing a certain motor act. Hence the main function of mirror neurons is to increase the tendency of the agent to reproduce the same action (response facilitation)' [Jordan, Knoblich, 2002, 116]. They see, however, a need for a distinction between informational and representational content, which has led them to form a distinction between four levels of understanding. Here it is also visible that two kinds of content reflect the distinction between reflective and unreflective understanding.

In addition, theories of understanding referring either to an introspective self-awareness or to self-knowledge, and hence to the mind's activities, do not neglect the fact that the basis of the mind is constituted by the brain: in Davidson's theory, although mental states are also physical they cannot, however, be reduced to their physical basis, namely the brain, and do not allow for an explanation in purely physical terms. However, the gap between the first- and third-person perspectives can be partly bridged by MNs. The most important philosophical consequence is that via MNs a subject can have non-

inferential knowledge about the states of others. As this knowledge is non-inferential, it is not necessary for this knowledge to have propositional content. In addition, the subject does not need to be conscious of it. In other words, a subject can understand, in a very special way, what is it like to understand.

From the point of view of this paper, the most interesting comment on the connection between personal and subpersonal spheres is given by Peacocke:

> The way we think of a type of bodily movement, when we perceive it made by someone else, yet also perceive it as an action of a type that we ourselves could make, provides another type of example. No doubt the underlying ground of the possibility of such concepts [canonical concepts of concepts] involves the now-famous "mirror neurons" identified by Rizzolati and his colleagues. It is an empirical matter that there are such representations in our psychology. They make possible much that would not otherwise be possible. To deny the existence of ways of coming to apply concepts that rely on empirical facts would rule out large tracts of human thought and experience. This applies equally to our ability to know about the intentional content of our own mental actions and our other conscious states. [Peacocke, 2004, 312]

Although Peacocke does not give a detailed analysis of the relation between mirror neurons and concepts, he gives a very important signal that such considerations are justified and necessary.

Proposing here conditions for successful action understanding, we can identify four capacities that any subject must possess in order to understand the actions of others:

C1. Identification: A subject needs to have the capacity to identify bodily movements.
C2. Conceptualization: A subject needs to have the conceptual capacity to recognize motor actions.
C3. Determination: A subject needs to have the capacity to determine the recognized motor action as goal-directed.
C4. Interpretation: A subject needs to have the capacity to decode intentional information, which is borne by the intentional acts.

Ad. C1: Identification of the bodily movement concerns the phenomenal content of experience, which can be internalized without accompanying introspective self-awareness. On the neural level, it is the role of the visual system to detect stimuli and identify them as the movement of another creature and to distinguish this from the movement of an artefact. The phenomenal content comes from the senses and refers to physical phenomena like sound, colour, or shape. In other words, the perceptual content conveys information about physical phenomena. Since it does not require the participation of introspective self-awareness, the identification capacity can also be possessed by creatures of other species.

Ad. C2: The capacity of conceptualizing a motor action is necessary for the development of reflective understanding in the sense ascribed to human beings. It also presupposes the identification capability. However, this capacity can be possessed by other species as well, because recognition does not require introspective or access awareness. Recognizing motor actions is a function of an agent; this means that any agent has dispositions to react (more or less adequately) to a specific situation. But if the relation to the external world is more complicated than mere stimulus-response, a cognitive system has to have the capability of representing the content of its perception in some conceptual form. In other words, we can understand conceptualization as the implementation of neuronal information on a cognitive level that requires some form of representation that can fulfil a certain function in the cognitive process.

Ad. C3: To determine an action as goal-directed, an observer needs to be not only capable of recognizing a motor action, but also able to ascertain the relation between agent and environment. In the process of the determination of such a relation only phenomenal nonpropositional content referring to psychological phenomena of the type 'feeling like…' or 'intend to…' is relevant. This state can be internalized on the level of bodily self-awareness and already carries information about the goal of x, doing y. In other words, determining the goal of an action often involves connecting the bodily movement of an agent with an object that is present in the visual field.

Ad. C4: To decode information that has an intentional character means to interpret an action. In the language of psychology, this comes down to ascribing mental states to the agent in the form of propositional

attitudes. Obviously, the term 'intention' is not the same as 'goal-direction', which is specified by the determination capacity. To interpret an action as intentional in the full-blown sense, an interpreter has to refer to psychological phenomena in the form of 'aboutness', which characterises propositional attitudes. From the standpoint of psychologism, aboutness means being directed at the inner content of mental acts, which is accessible through introspection. According to anti-psychologism, which is more popular these days, intentionality is an relation between mental acts and external objects, and can be represented in language (Rojszczak, 2001, p.99). However deep their disagreement may be, both presuppose a capacity for self-reflection.

We may accordingly distinguish two varieties of intentionality: external and internal intentionality. *External intentionality* is a relation between a subject and an object in the world: e.g., If I see a cat, I (as the subject) stay in a relation of seeing to the object in the world (the cat). *Internal intentionality*, on the other hand, is a relation between a subject and an object in the mind, a mental representation: e.g., If I believe that at night every cat is black, I stand in the relation of believing a mental representation of the form 'I see that there is a cat'.

Given these two kinds of intentionality, there are also two analogous ways of understanding, which we could dub *unreflective* and *reflective* understanding, respectively, according to the requirements of the presence of reflective self-awareness. Passive, unreflective understanding happens when one stands in an appropriate relation to external objects via, e.g., perceiving or grasping them without reflection on the fact that one is seeing or acting, i.e. without reference to the content of these acts. Reflective understanding, however, involves a reflection on the act and its content in a form such as 'I see that there is a cat'. This form of intentionality is represented in language in the form of the ascription of propositional attitudes. The distinction between unreflective and reflective understanding will turn out to be fruitful for determining the role of MNs in understanding. More specifically, possessing a capability for identification and conceptualization will be sufficient for an unreflective understanding, but all four capabilities, including those for goal determination and interpretation, need to be present for full reflective understanding.

In general, bodily movement, complex behaviour, or even speech acts are kinds of signals that have a meaning—since they are goal-

directed. These signals can then be interpreted by another organism either in a reflective or an unreflective way. Identification and conceptualization both presuppose phenomenal content in the sense that it is grasped, but not in terms of transforming it into the propositional form of beliefs. In contrast, goal determination and interpretation introduce strong suppositions: A subject interpreting an action does so by forming propositional attitudes, as compared to only picking up content.

Conclusion

Action understanding is a complex process, because of the intentional character of the mental states accompanying the act of understanding. Actions are always goal-directed, which means that in order to understand an action one also needs to understand the agent's intention. However, to understand why somebody performs a particular action, a formation of propositions may not be enough. Instead, inferential operations on propositional structures are needed. On the one hand, this does not exclude unreflective 'thinking' (or 'computing') as a relevant basis for understanding. On the other hand, MNs cannot be the sufficient condition for understanding, because, as many examples show, one can participate in a joint action or perform an individual activity simply on the basis of empathy, but without understanding in the proper sense meant when we talk about the meaning of a performance. So the answer to the title question of this paper is: yes, we can build theories of understanding on the basis of MNs; however we have to treat MNs as basis, that is, as a neuronal basis of mental states, but not as sufficient condition for this mental ability.

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ABSTRACT

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The discovery of mirror neurons and the characterization of their response properties is certainly an important achievement in neurophysiology and cognitive neuroscience. The reference to the role of mirror neurons in 'reading' the intentions of other creatures and in the learning process fulfils an explanatory function in understanding many cognitive phenomena beginning from imitating, towards understanding, and finishing with complex social interactions. The focus of this paper is to review selected approaches to the role of mirror neurons in mental activity as understanding, and to conclude with some possible implications for researches on mirror neurons for philosophical theories of understanding.

KEYWORDS: mirror neurons, understanding, intentionality, self-reflection, concepts, self-knowledge