Motor Intentions: How Intentions and Motor Representations Come Together

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Abstract: What are the most detailed descriptions under which subjects intend to perform bodily actions? According to Pacherie (2006), these descriptions may be found by looking into motor representations—action representations in the brain that determine the movements to be performed. Specifically, for any motor representation guiding an action, its subject has an *M-intention* representing that action in as much detail. I show that some M-intentions breach the constraints that intentions should meet. I then identify a set of intentions—*motor intentions*—that represent actions in as much detail as some motor representations while meeting the constraints that intentions should meet.

1. Introduction

Imagine a pianist playing a trill, as prescribed by her score, or a ballerina pirouetting within the context of her part in a ballet. On either occasion, the subject performs a series of (very complex) bodily movements. For example, a pianist playing a trill on a given occasion will alternate two piano keys using—say—thumb and middle finger in quick succession, because at that point of the piano piece the score prescribes a trill with a specific finger placement. In situations like these, what intentions may be ascribed to the subject performing the bodily movements in question? In the case of the pianist, we can certainly say that she intends to play the piano. Maybe we can say that she intends to play a trill, too. But can we also say that she intends to alternate two piano keys using thumb and middle finger in quick succession? Notice that the second intention represents the agent's action in greater detail than the first, and the

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third intention in greater detail than either of the first two. More generally, under what descriptions of a bodily action can we say that their subject has an *intention* to perform that action?

An influential answer to this question has been provided by Elisabeth Pacherie (2006, 2008). This answer is in line with the idea that, in scenarios such as those outlined above, it would at least *prima facie* make sense to suppose that a subject's actions are intentional under very detailed descriptions. Pacherie works on the assumption, shared by some of the most influential versions of the Causal Theory of Action (Bach, 1978; Searle, 1983; Mele, 1992), that intentions are mental states with a world-to-mind direction of fit that cause the actions they represent. She points out an interesting similarity between the notion of intention and that of motor representation, drawn from the neuroscience of action, that has the potential to shed light on the connection between intentions and bodily actions. A *motor representation* (Jeannerod, 1994, 2006) is the representation of an action in the brain that is apt to determine the pattern of movements that are going to be performed (more about this notion shall be said in Section 2). Pacherie's fundamental observation is that intentions and motor representations are very similar from a functional viewpoint, insofar as both are thought to cause bodily movements. She therefore hypothesizes that, for any motor representation guiding a subject's intentional action, the subject has an intention—specifically, what she terms an *M-intention* (this notion will be fully expounded in Section 4)—to perform the action in question.[1]

Pacherie's proposal, however, suffers from a major shortcoming. In order to accept it, we need to give up a number of assumptions (which will be spelled out in Section 5) that we should be holding on to if we think of the formation of intentions as open to reason—a precondition on that being, for instance, that what intentions represent should be consciously accessible. Showing that accepting Pacherie's answer has this consequence is my first objective in this article. The second objective is to show that there is still something importantly right in the central tenet of Pacherie's thesis: it is true that the possession of *some* intentions on the part of a subject may be entailed by the existence of *some* motor representations guiding her bodily movements. In other words, in answer to the central question underlying this article, I maintain that the descriptions of a bodily action under which we can say that their subject has an intention to do something are very detailed, and encompass the subject's bodily movements. I maintain that there are fewer descriptions than Pacherie allows under which we can say that the subject has an intention to do something. I shall propose the notion of *motor intention* as an alternative to that of M-intention, and will show that the notion of motor intention, while preserving a link with that of motor representation, does not give rise to the undesirable consequences that follow from Pacherie's notion of M-intention: contrary to M-intentions, motor intentions are genuine intentions.

[1] As I shall explain in Section 4, Pacherie (2006) is not explicit as to whether M-intentions should be identified with motor representations.

This article is structured as follows. First, I shall expound Pacherie's notion of M-intention, by giving the details of the link between M-intentions and motor representations (Sections 2-4). Secondly, I shall highlight problems with some M-intentions whose existence may be derived on the basis of Pacherie's theory: some M-intentions breach the constraints that we would expect genuine intentions to meet (these are illustrated in Section 5)—specifically, in section 6 I am going to provide an example of an M-intention that is problematic in this sense. Lastly, in Sections 7 and 8 I am going to put forward my own proposal, according to which it is possible to define a set of intentions—*motor intentions*—that represent the action in the same level of detail as the corresponding motor representations while at the same time meeting the relevant constraints that we would expect intentions to meet. I will show that what is represented by motor intentions provides the most detailed descriptions under which a bodily action is intentional.

2. Motor Representations and Their Role in Intentional Action

The notion of motor representation, born in the neuroscience of action, plays an essential role in bodily action. A motor representation may be understood as the representation of an action in the brain that is apt to determine the pattern of movements that the subject is going to perform in order to execute that action (Jeannerod, 1994, 2006). Reviewing some evidence that led neuroscientists to posit this notion might help understanding it better.

There are two main sources of evidence for the existence of motor representations (see Jeannerod, 2006, pp. 8-ff. for a review). The first comes from deafferentation studies. In particular, Lashley (1917, reported in Jeannerod, 2006) described a patient with a deafferented leg, who thus received no sensations from that leg, as able to bend his knee at a given angle, or to bring his foot to a given height that the experimenter had indicated. The absence of sensations from the deafferented leg excludes the possibility that the patient could be relying on sensory input from that leg for the production of the requested movement. The patient was also blindfolded, which rules out any contribution of visual feedback to his successful performance. Before these results came to light, one may have thought that actions do not need to be represented in the brain prior to their performance, but rather consist in a series of on-line adaptations to the given sensory stimuli. A compelling interpretation of the presented data, by contrast, suggests that there has to be an encoding of the action in the brain in advance that enables action performance independently of sensory input (even though, in normal cases, sensitivity to sensory input is going to play a significant role in the fine-tuning of bodily actions).

A second source of evidence in support of the notion of motor representation comes from the rapidity of many movements performed by typically developed subjects. When playing a musical instrument, it is possible to alternate one's fingers reaching the frequency of 16 strokes/s, something that makes the influence of any sensory feedback on the production of those movements impossible. Again, this

seems to exclude that these rapid movements could be constituted by on-line adaptations to sensory feedback. Hence, one may conjecture that the succession of those movements has to be encoded prior to action execution (Lashley, 1951, reported in Jeannerod, 2006).

The notion of motor representation has recently become central to computational models of action performance (e.g., Wolpert *et al.*, 2003). Elisabeth Pacherie (2006, 2008) has provided a theory that situates motor representations within a threefold framework for intentions—specifically, within the context of what she terms *M-intentions*—such that any of the subjects in my earlier examples can be said to have a series of M-intentions representing her complex movements (the specifics of the relation between motor representations and M-intentions will take until Section 4 to be expounded). Pacherie's threefold theory develops Searle's (1983) original distinction between prior intentions and intentions in action in the following way. Pacherie's *future-directed intentions* (F-intentions) are analogous to Searle's prior intentions, and are thought to have a role in practical reasoning. Where Searle saw just intentions in action, Pacherie further differentiates between *present-directed intentions* (or P-intentions) and *motor intentions* (or M-intentions—herafter I shall stick to the latter term, insofar as I reserve the former for the notion that I am going to introduce). Both P-intentions and M-intentions, according to her, play a role during action execution, and in particular have initiating, guiding, sustaining and monitoring functions (Pacherie, 2006, p. 149): they trigger the corresponding action (*initiating function*), guide the execution of the action (*guiding function*), sustain it until its completion (*sustaining function*), and monitor its effects (*monitoring function*).

Pacherie's contention is that guiding and monitoring functions can be performed at two different levels. The former, for which P-intentions are responsible, works at a time scale corresponding to conscious experience. The latter, for which M-intentions are responsible, is much more fine-grained, and responsible for the precision and smoothness of action performance (Pacherie, 2006, p. 151). The idea is that, whenever there is a motor representation guiding a person's intentional bodily movements, then the subject has an M-intention representing those movements.

Pacherie's theory has the potential of accounting for the performance of bodily actions, including the scenarios I outlined at the beginning, by offering a theoretical framework that bridges an agent's intentions with the motor representations underlying her actions, and it does so by positing that there is an M-intention for each motor representation, as will be illustrated in the next section. There is problem with this theory, though. Some of Pacherie's M-intentions fail to satisfy the constraints that intentions should meet if our ability to move is to be open to reason (these will be discussed in Section 5). In such theories (e.g., Bratman, 1987), intentions are subject to characteristic constraints both *qua* propositional attitudes and also, specifically, *qua* intentions. Before fleshing out my objections to the idea of M-intention, more needs to be said about this notion, and about the relation in which it stands with respect to that of motor representation. This is the job of the next two sections.

3. Different Levels of Generality and Corresponding Motor Representations

In the previous section, I presented Pacherie's overall view concerning different kinds of intention. However, in the rest of the article, within this overall view I shall be exclusively concerned with M-intentions, and it is with respect to those that I shall raise objections and propose an alternative theory. Therefore, in what follows I would like to present the notion of M-intention in detail. In order to fully understand Pacherie's proposal concerning the relation between motor representations and M-intentions, it is necessary to consider the idea that one and the same action may be described at various—as I shall refer to them—*levels of generality.*[2] I shall start by introducing the notion of an *action hierarchy* (Goldman, 1970; Shallice, 1988; Jeannerod, 1994; Grafton and Hamilton, 2007; Hamilton and Grafton, 2007; Csibra, 2008) in order to show that an action can be represented in greater or lesser detail depending on the hierarchical level under consideration. Later, on the basis of this idea, I shall bring evidence in support of the existence of a variety of motor representations representing one and the same action at various levels of generality.

Consider the following example (Csibra, 2008): I want to get hold of an apple, and this result may be achieved in different ways. For instance, I might want to grasp it with one of my hands, or with some other effector (e.g., mouth or foot). Suppose I choose to grasp it with my hand. Once again, there is room for performing this action in different ways, insofar as I may grasp the apple by means of a whole-hand prehension, or by means of a precision grip (the latter would be the case if I decided to grasp the apple by the petiole). So far, I have highlighted three levels of an action hierarchy: grasping the apple occupies the top one, the various ways of grasping the apple with different effectors are at a level below, and the two ways of grasping the apple with my hand (with whole-hand prehension or precision grip) are at an even lower level. It should be relatively uncontroversial that any token action may be described at different levels of a hierarchy along the above lines.

Each of the levels of an action hierarchy represents one and the same action at one of *different levels of generality*. The representation of a token action as a *grasping of an apple with a precision grip* represents that token action at a lower level of generality compared with a representation representing the same token action simply as a *grasping of an apple with one's hand*. The latter representation, in turn, represents the same token action at a lower level of generality with respect to a representation representing that token action as simply the *grasping of an apple*. A fundamental characteristic of action hierarchies as described above is that, as we climb down the

[2] Talk of different descriptions of one and the same action presupposes an account of events as individuals such as that suggested by Anscombe (1957) and Davidson (1963), and thus different from that of events as property instantiations proposed by Goldman (1970). While I do not wish to take a stand on this debate, my view is more easily expressed by adopting Anscombe's and Davidson's way of talking about actions.

hierarchy, we find that the action is specified in increasing detail (Goldman, 1970; Jeannerod, 1994; Hamilton and Grafton, 2007; Csibra, 2008).

There exists experimental evidence concerning the representation of actions at different levels of generality.[3] The one that is most relevant for my purposes lies at the neural level. It should have emerged from the previous section that the notion of motor representation is an eminently *functional* one. So far, that is, even while alluding to the idea that a motor representation is the representation of an action *in the brain*, nothing has been said about the neural implementation of motor representations. Research, however, has led to the idea that different action types are encoded by different neural populations in the premotor cortex, which, taken together, constitute a so-called *motor vocabulary*, or *vocabulary of motor acts* (Rizzolatti *et al.*, 1988; see Jeannerod, 2006, p. 12). Because of this connection between the functional characterization of motor representations and their possible neural implementation, based on the idea of a motor vocabulary, in what follows I shall make reference to data at the neural level that I take to count as evidence for the existence of motor representations of the kind I am about to describe.

Going back to the apple-grasping example: neurons in the premotor cortex—specifically, in the area F5—have been recorded (Rizzolatti *et al.*, 1988) that fire only in the case of *grasping with a precision grip* or of *grasping with a whole-hand prehension* (or, additionally, for so-called *finger prehension*). That is, neurons of these kinds respond selectively for one of the two grasping options highlighted in the apple-grasping example. In addition to these, neurons have been recorded that fire in correlation with grasping with the hand, independently of the kind of grip. These have been termed *grasping-with-the-hand neurons*, and the level of generality of this action description corresponds to the middle level in the apple-grasping example. In the same paper, Rizzolatti and colleagues report evidence to the effect that there are neurons firing in correlation with grasping regardless of the effector employed, be it the mouth or the hand. The latter kind of neurons (which Rizzolatti and colleagues term *grasping-with-the-hand-and-the-mouth neurons*), as well as grasping-with-the-hand neurons, can be considered evidence for the existence of motor representations representing actions at higher levels of generality.[4]

So, in conclusion, there is evidence to the effect that bodily actions are guided by a variety of motor representations, representing one and the same action at different

[3] Historically, research on motor representations has focussed on motor representations representing actions at very low levels of generality (Landauer, 1962; Jeannerod, 1994), namely corresponding to some of the lowest levels of an action hierarchy. But this kind of representations is not the only one seemingly at work in action production. Jeannerod (1994, pp. 200-201) refers to neuropsychology (Norman and Shallice, 1986; Shallice, 1988) as showing that detailed motor representations along the above lines do not exhaust the representation mechanisms that operate in action production, insofar as motor representations at the lower levels need to be supervised by broader-encompassing motor representations that represent long-term goals.

[4] Examples of the correlation between different levels of generality of grasping actions and patterns of neural firing—in this case across primary motor cortex and ventral premotor cortex—may be found, e.g., in Umiltà et al., 2007 and Umiltà et al., 2008.

levels of generality. Influential computational models of action performance have it that these different motor representations are simultaneously present as a bodily action unfolds, and all play a role in bodily action performance (Haruno *et al.*, 2003; Grafton and Hamilton, 2007; Botvinick, 2008). Armed with the idea that one and the same bodily action is guided by a number of motor representations representing that action at different levels of generality, we can now turn to the specifics of Pacherie's notion of M-intention.

4. Pacherie's Proposal: An M-intention for Each Motor Representation

In the previous section, I emphasized the fact that there are a variety of motor representations supervising bodily action performance, which represent that action at different levels of generality. Now I would like to point out that intentions too may represent actions at different levels of generality. For instance, regarding the same token action to go to the New Year's Concert in a week's time, I might intend to go to the concert by car, or I might simply intend to go to the concert (regardless of the means of transport). I may well intend both, if I have already settled how to go to the concert (and the fact that I have does not make it any less true that I also intend to go to the concert, period). The point of this example is to illustrate that the former intention (to go to the concert by car) represents the given action at a lower level of generality than the latter intention (to go to the concert).

So far, then, two interrelated thoughts have been presented. First, in the course of the previous section, experimental evidence was brought in support of the idea that a subject's bodily action is usually guided by a variety of motor representations, which represent that action at different levels of generality. Secondly, in the course of the above reflection it was suggested that intentions also represent actions at different levels of generality. Given that a subject is guided in his bodily actions both by a variety of motor representations and by a variety of intentions (or so I have suggested), a question, then, naturally arises. Suppose that a subject's bodily action, at a given time, is being guided by (among others) a motor representation representing that action at a given level of generality *i*. Does it follow that the subject has an *intention* representing that action at the same level of generality *i*?

Let me introduce a further piece of terminology. Given a motor representation representing an action at a certain level of generality *i*, the *corresponding intention* is an intention representing that same action at the same level of generality *i*. Analogously, given an intention representing an action at a certain level of generality *i*, the *corresponding motor representation* is a motor representation representing that same action at the same level of generality *i*. My previous question can then be reformulated as follows. Does the fact that a subject's action is being guided by a motor representation representing that action at a given level of generality imply that the subject has a *corresponding intention*?

Pacherie's answer to this question is affirmative.[5] She points out that motor representations exhibit core functional similarities with intentions standardly conceived: like intentions, motor representations represent goals and means to those goals, they have a world-to-mind direction of fit, and a mind-to-world direction of causation, i.e. they cause what is in their representational content (see Searle, 1983; Pacherie, 2008, pp. 189-190, offers this reflection concerning her M-intentions, but her point carries over to motor representations). This is the rationale behind the following implication, that lies at the heart of Pacherie's proposal:

(1) $MR_{Ai} \rightarrow I_{Ai}$

to the effect that whenever an agent's bodily action *A* is being guided by a motor representation *MR* representing that action at a given level of generality *i*, it follows that the subject's action is also guided by a *corresponding* M-intention *I*, i.e. an M-intention representing the same action *at that same level of generality* (*i*).

It is this assumption that generates problems, as I am going to show in the next section, insofar as Pacherie does not impose any constraints on which motor representations can give rise to M-intentions. So, in her view, there is an M-intention for any motor representation guiding the subject's bodily action, no matter the level of generality at which the latter represents an action. The trouble arises from the fact that, for some motor representations, implication (1) produces M-intentions that fail to satisfy constraints that we would expect intentions to meet. I shall now explain what these constraints are and the motivation behind holding on to them.

5. What We Would Expect of Intentions, and Why

We would typically expect the ability to move that results from fulfilling intentions to be open to reason. Because of this, intentions are classically thought to be subject to a number of characteristic constraints—partly just by virtue of being propositional attitudes, and partly by being a specific kind of propositional attitudes,

[5] A strong version of this answer, which I shall not consider here, has it that for every motor representation there is a corresponding intention because motor representations *are* intentions. As a matter of fact, Pacherie (2000) can be taken to suggest something along these lines. She highlights functional similarities between intentions and motor representations, and puts forward the idea that motor representations may implement Searle's (1983) intentions in action. However, Pacherie (2006) does not specify whether motor representations are to be identified with intentions—in particular, with what she calls *M-intentions*. Still, we can safely interpret her threefold theory of intention as assuming at least that for every motor representation representing an action at a given level of generality there is a corresponding M-intention, despite it not necessarily being the case that motor representations *are* M-intentions. But the considerations that I shall put forward would still apply even if motor representations were to be identified with M-intentions.

namely intentions. As to the constraints that concern propositional attitudes in general, the following may be listed: at least in central cases,[6] propositional attitudes are amenable to integration with other propositional attitudes, and what they represent is consciously accessible. These features jointly make intentions open to reflection and to the possibility of identifying with them (see Frankfurt, 1988), rather than of being unreflectively guided by them. These features, however, are not sufficient for intentions to fulfil their functional role as tools for planning and causing actions: in order to achieve it, intentions should also be subject to specific rationality constraints.

The most plausible candidate for a rationality constraint that intentions should satisfy, by virtue of being propositional attitudes with a specific functional role, has been provided by Michael Bratman (1987): *qua* planning tools, intentions should satisfy the *strong consistency requirement,* which can be spelled out as follows. According to Bratman, since intentions are tools for planning, they should allow an agent to have a plan concerning future action that is *internally consistent*—i.e., all intentions featuring in it should be jointly consistent—and also consistent *with all of the subject's other beliefs*: e.g., if I believe that it takes at least half an hour to travel from point *A* to point *B*, in order for my plan to be effective I should only form intentions to travel from *A* to *B* that are consistent with this belief—and thus to the effect that I shall take at least half an hour.

It is to be noted that this is a *normative* requirement on intentions: *qua* planning tools, intentions ideally should satisfy the strong consistency requirement. However, human beings are limited and fallible, and irrationality is rife in human behaviour, both in natural and in experimental settings.[7] In natural settings, it is often the case that humans end up entertaining conflicting intentions, or intentions that conflict with some of the beliefs harboured by their subjects—e.g., even the most experienced academic will occasionally fall into the trap of intending to spend a leisurely day out, as well as intending to finish her paper on that very day, while these two intentions are openly in conflict.

The strong consistency requirement is not blind to this characteristic of human beings. It just dictates that, in order for a plan to be rationally and effectively pursued, intentions should be strongly consistent (see Pacherie 2008). As a consequence, it further dictates that whenever intentions are not strongly consistent—as in the example just given, or in a case in which I formed an intention to travel from *A* to *B* in 15 minutes while believing that it takes at least half an hour—their subject is then guilty of irrationality. Notice that conscious accessibility and amenability to integration are also preconditions for either satisfying the strong consistency requirement or breaching it at the cost of the subject's rationality, insofar as, if one does not

[6] I am hereby excluding, for instance, *aliefs* (Gendler, 2008), that violate some of the constraints that apply to standard propositional attitudes, such as conscious accessibility.

[7] As far as the latter are concerned, experimental results point to the fact that humans (specifically, adults more than young children) choose to imitate certain actions by copying means that are causally irrelevant to the fulfilment of the objective of those actions (see, e.g., McGuigan et al., 2011). I am grateful to an anonymous referee for pointing this out.

knowingly hold inconsistent intentions or intentions inconsistent with some of one's beliefs, one cannot be held guilty of irrationality.

Aside from the considerations to do with openness to reason, another point in favour of thinking that intentions should satisfy all these constraints is that the latter are the strongest constraints that could be imposed on intentions. This makes it the case that, under any theory of intention that one may hold, for any mental states representing goals with a world-to-mind direction of fit, the satisfaction of all the above listed constraints is sufficient for such states to be intentions.

In summary, for the reasons outlined above, genuine intentions should satisfy all these constraints:

i. What they represent should be consciously accessible;
ii. It should be possible to integrate them with other propositional attitudes;
iii. They should either meet the strong consistency requirement, or breach it at the cost of the subject's rationality.

The problem with some of Pacherie's M-intentions is that, due to the characteristics of the corresponding motor representations, they do not meet the above illustrated constraints. Let us see why.

6. Why Some of Pacherie's M-intentions Cannot Be Intentions

An experimental result (Fourneret and Jeannerod, 1998, reported in Pacherie, 2006, p. 156) brings to light features possessed by some M-intentions that are at odds with what we would require of intentions for the above expounded reasons. In this experiment, subjects were asked to move a stylus to a visual target. They could only see the stylus trajectory in the form of a line on a computer screen. A bias was then introduced on the line appearing on the computer screen, in such a way that there was a discrepancy between the visible line and the one actually traced by the subject. Whenever the amount of discrepancy between the line actually traced and that visually perceived by the subject was small, subjects automatically adjusted the trajectory of their hand to it.[8] When asked, subjects declared that they thought their hand had moved towards the target, but seemed to be unaware of the actual movements that their hand had performed (Jeannerod, 2006, p. 51).

This result can be taken to simultaneously show two things. Recall that, working on the assumption of Pacherie's theory, whenever there is a motor representation guiding a certain action, it follows that there is a corresponding M-intention, i.e. an intention representing the same action at the same level of generality. In particular, in the above described scenario, there is an M-intention, call it *M1*, which represents

[8] It has also been shown that when the bias exceeds a mean value of about 14°, subjects change strategy and begin to use conscious monitoring of their hand movements to correct for the bias and reach the target (Slachewsky *et al.*, 2001, reported in Pacherie, 2006, p. 159).

the hand action at a sufficiently low level of generality that it encompasses the details of the hand trajectory of which the subject is unaware. First, from the results of this experiment it emerges that what *M1* represents was not consciously accessible.

As a matter of fact, while fully acknowledging that her usage of the term *intention* for M-intentions is to some extent unorthodox,[9] Pacherie generally conceives of M-intentions as having a content that is not always consciously accessible. She has it that this, in part, has to do with the timing of the action: for an action to take place quickly and smoothly, corrections need to be made at too fast a pace to be consciously accessible (Pacherie, 2008, p. 188). M-intentions take care of these fast and automatic corrections, in contrast with those corrections typical of rational control that are a function of what she terms P-intentions. However, conscious inaccessibility is in contrast with what we would expect of standard propositional attitudes, previously mentioned as the first constraint on intentions.

Secondly, consider that we can interpret the given experimental scenario as one in which, in addition to *M1*—the M-intention specifying the details of the hand adjustments—the subject also has a belief *P* to the effect that he is tracing a line following a certain trajectory, which is different with respect to the one he is actually following. Then, the propositional content of *M1* is inconsistent with that of *P*.[10] This, in turn, can be taken to simultaneously show two things. First, the subject's M-intention *M1* breaches the strong consistency requirement. This, however, does not issue in the subject's being guilty of irrationality, as it would normally happen with an intention, because the subject is not consciously following an intention in contrast with one of her beliefs. Secondly, we could say that *M1* is not integrated with the rest of the subject's propositional attitudes, insofar as *P* is not sensitive to it.

In conclusion, there is a problem with some of Pacherie's M-intentions: some of them, like *M1*, do not satisfy the constraints we would expect intentions to meet, both *qua* propositional attitudes as well as, more specifically, *qua* the kind of propositional attitudes that they are, i.e. intentions. Even though Pacherie suggests that we still have reasons for thinking that these mental states are intentions (for example, their similarity with intentions from a functional viewpoint—see Pacherie, 2008, pp. 189–190), if we hold a standard view about intentions, or if we buy the considerations that I made in Section 5, we would find it hard to accept these reasons as compelling.

As we saw, M-intentions are generated by assuming implication (1), to the effect that for any motor representation representing an action at a given level of generality there exists a corresponding M-intention. Given that at least some M-intentions (e.g., *M1*) exhibit characteristics that are in contrast with what is classically required

[9] For example, she writes: 'One may worry that what I called M-intentions […] do not really deserve to be called intentions. I agree that M-intentions lack some of the features traditionally associated with intentions—for instance, […] we may not be aware of them or have only partial access to their content' (2008, p. 189).

[10] See Nanay, 2013.

of intentions, we may reach the conclusion that implication (1) should generally be forbidden, because any mental state behaving like a motor representation will not satisfy some of the constraints that we would expect intentions to meet. But would that be right?

7. Motor Intentions: Preserving the Link with Motor Representations while Meeting Constraints on Intentions

Thinking that being guided by a certain motor representation never implies possessing the corresponding intention, as it happens, would be unwarranted. I shall show that the mere fact that a mental state behaves as the corresponding motor representation, and therefore represents an action at the same level of generality as a motor representation, does not by itself imply that that mental state is going to breach any of the constraints that we would expect intentions to meet. I am going to suggest that what I term *motor intentions* are genuine intentions, while representing actions at the same level of generality as some motor representations.

I use the expression *motor intention* differently with respect to both Jeannerod (1994) and Pacherie (2006, 2008). Over the next sections, I am going to contrast motor intentions with Pacherie's M-intentions, and therefore the difference between my notion and hers shall become clear. The difference with Jeannerod's use of the term can be summarized as follows. Jeannerod (2006, p. 16) takes motor intentions to be responsible for the production of 'one-step actions embedded within a larger action plan'. On Jeannerod's conception, motor intentions 'are part of an automatic process which, by definition, should not be open to conscious choice or deliberation' (2006, p. 70). Presumably because of this, in some places (e.g., 1994, p. 190), Jeannerod seems to use motor representation and motor intention interchangeably.[11] By contrast, my stance leaves open the possibility that some motor representations could be intentions, but does not commit to this idea. That is to say, I am committed to a version of implication (1) running from the existence of some motor representations to that of corresponding intentions (the details of which shall be given in the course of the next three sections), but not to the idea that some motor representations *are* intentions.

In spite of its previous usage, I am keen to preserve the term *motor intention* for my proposed notion insofar as it is the most natural expression for capturing the following twofold characterization. On the one hand, motor intentions have a strong link with motor representations, due to their match with motor representations in terms of what is represented. But on the other hand (and here, I take it, lies the

[11] It may be worth noticing that, with the notion of motor intention, Jeannerod (2006, p. 15) is interested in capturing 'the proximity of the intention to its direct consequence, a goal-directed movement', as well as doing justice to 'the notion of "intention" as it is generally used by physiologists and neuroscientists to designate the early stages of action generation.'

main disagreement with both Jeannerod and Pacherie), motor intentions are also conceived as genuine intentions by the most demanding philosophical standards. In order to qualify as genuine intentions, motor intentions should be such that what they represent is consciously accessible, it should be possible to integrate them with other propositional attitudes and they should either satisfy the strong consistency requirement, or breach it at the cost of the subject's rationality. To obtain the set of motor intentions, I shall propose to adopt implication (1) seemingly at work in Pacherie's theory, running from motor representations to corresponding intentions, but with the following modification. The domain of motor representations to which the implication may be applied shall be restricted in such a way that the resulting intentions, motor intentions, satisfy the constraints that we would expect intentions to meet (I am going to explain exactly how the restriction should be made in the course of the next three sections). In the light of the previous example involving *M1*, though, one may suspect that the restricted set of motor representations such that the corresponding intentions will meet the relevant constraints could be empty. Let us now see whether my proposal can be made to work, and, contextually, verify that the set of motor representations apt to generate motor intentions is not empty.

7.1 Conscious Accessibility

In the light of the constraints spelled out in Section 5, the first restriction that needs to be made on the set of motor representations apt to generate motor intentions is that what they represent should be consciously accessible. To this end, let me report evidence to the effect that there exist motor representations with this characteristic.

It has been established that what some motor representations represent can sometimes be consciously accessed through the phenomenon of motor imagery, namely 'the ability to generate a conscious image of the acting self' (Jeannerod, 2006, p. 24). Motor images are mental images of the unfolding of an action that the subject imagines herself executing (Jeannerod, 1994, 2006, pp. 23-ff.). As such, they involve a conscious content, which they share with mental images in general. This conscious content provides the agent with an access to very fine levels of description of the action that the agent imagines herself executing, to the extent that a number of parameters of the corresponding overt action are preserved in the imagined action. For instance, it has been shown that imagining oneself saying a sequence of numbers aloud takes approximately the same time as actually doing it (Landauer, 1962). In conclusion, it is not the case that all motor representations represent something that is consciously inaccessible: the previous reflection shows that there are motor representations such that what they represent *is* consciously accessible.

A qualification is now in order. The underlying thought of the previous reflection is not that motor images are motor representations. The relationship between motor images and motor representations is not straightforward. Jeannerod speaks of motor imagery as 'part of a broader phenomenon (the motor representation) related to intending and preparing movements' (1994, p. 189). He hypothesizes 'a continuum between motor preparation and motor imagery' (1994, p. 190) motivated

by the following reflection. Motor representations, by definition, are involved in the preparation of bodily movements. This preparation process is typically unconscious. Yet, for example, amputees appear to 'have a clear image of the intended action' (Jeannerod, 1994, p. 190), and patients with deafferented limbs are capable of greatly detailed descriptions of the actions they would like to perform. In short, there are situations in which the execution of an action is not possible, and yet the action seems to have been prepared. According to Jeannerod,

> [t]hese data suggest that if the action were actually executed, the content of the motor representation would not reach consciousness because it would be cancelled as soon as the corresponding movement was executed (perhaps by the incoming signals generated by execution itself). By constrast, if only motor imagery occurred with execution deliberately blocked or delayed, the representation would be protected from cancellation and would become accessible to conscious processing (1994, p. 190).

Because of this link, Jeannerod (1994, p. 187, 190; 2006, p. 23) supports the study of motor imagery as a method for investigating the content of motor representations. And this is why I have adopted motor imagery as evidence to support the idea that what some motor representations represent may be consciously accessed, while not assuming that motor images are motor representations.[12]

Now I would like to bring attention back to the experimental scenario presented earlier, involving subjects moving a stylus towards a target. I interpreted that scenario as involving guidance by a motor representation such that what it represents is consciously inaccessible. I shall show that, at least in that scenario, there is another motor representation representing the action at a different—specifically, higher—level of generality, such that what this other motor representation represents can be consciously accessed.

Jeannerod (2006, pp. 45-47) draws a useful distinction between being aware of having a goal, e.g., the goal of reaching a certain place, and being aware of how the goal is being reached, e.g., the movements that my legs should perform in order to reach a certain place. One may well be aware of the former, but not of the latter—as a matter of fact, this is usually what happens when one intends to walk to a certain place.[13] Think again of the experimental result reported previously. Subjects always reached their target, but were not always aware of the movements they had performed in order to achieve that goal. Jeannerod (2006, p. 51) describes situations of this kind as ones in which subjects were aware of the target of their action and were able to reach for it, but did not know, or had partial and/or incorrect information as

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[12] I am grateful to anonymous referee for inviting me to clarify this point.

[13] In a similar vein, Marcel writes: 'We frequently lack explicit awareness of subgoals in achieving a goal. […] When I pick up something from a low table I may be quite unaware whether I intend to do it by bending at the waist or at the knee' (2003, p. 60).

to how this had been possible. But there are descriptions of what the agent is doing in more general terms, however, that are represented by motor representations and are also such that the subject may well consciously access that level of description of the action—for instance, *reaching towards the visual target* (see Filimon *et al.*, 2007, on human cortical representations of reaching acts).[14]

The idea that I am pushing is that there exists a description of what the agent is doing for which, on the basis of Filimon and colleagues' (2007) work, we have reasons for thinking that there is a motor representation, and agents may consciously access that level of description. This, however, does not imply that the location of the object to be acted upon must be part of the content of that consciously accessed description. To be more precise, in the experimental scenario investigated by Fourneret and Jeannerod, the content of the putative motor intention of the subject should be something like 'reaching towards the visual target *wherever that visual target may be*'. And it is certainly going to be true that a subject in the Fourneret and Jeannerod experiment intends this much, if she is to comply with the experimenter's instructions.

Of course, some descriptions of the subject's action at a lower level of generality will have to take into account the location of the target, given that her intention eventuates in an actual movement. My point, however, is that there exist levels of description of a subject's action that are represented by motor representations and are consciously accessible, while not including some of the characteristics of the action target object—for example, its actual location.[15]

The qualification I have just given is what enables us to make sense of further dissociations between consciously intended versus actually executed movements. Marcel (2003, pp. 62-67; see Wong 2010, 2015), for example, reports an experiment run by him and his colleagues that is based on the following phenomenon: vibration at certain frequencies of a muscle tendon at the joint of a limb induces a reflex movement of that limb. However, when subjects undergo this kind of stimulation in one of their arms, preventing that arm from moving produces an illusory movement of that limb in the opposite direction of the reflex, and, consequently, an illusory experience of the position of that arm—especially when the arm is occluded from sight. In Marcel and colleagues' experiment (reported in Marcel, 2003, pp. 64-66),

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[14] There are interesting connections between the notion of motor representation on the one hand and the common coding framework (see Prinz, 1990), or the more recent Theory of Event Coding (see Hommel *et al.*, 2001), on the other hand. Jeannerod (2006, p. 134) notices that a shared assumption is that actions are represented prior to action performance. One difference, however, is worth noticing. Jeannerod (2006, p. 134) points out that his framework is not limited to object-oriented actions. He further suggests that representing the goal of an action does not suffice for answering the question as to how the action should be performed. In line with the latter idea, my emphasis throughout my treatment of motor intentions is on the specification of motor parameters of the intended movement.

[15] Thus, my proposal does justice to Jeannerod's idea that 'generating a motor response of a stimulus and building a perceptual experience of that same stimulus can be considered as distinct processes' (2006, p. 47).

the subject's stimulated arm was fixed to a swiveling armrest, that could be either held still or released to allow the forearm to move in an arc on a horizontal plane. The stimulated arm was occluded by a horizontal screen on which a series lights were planted in an arc, following the possible trajectory of the occluded hand. One condition in this experiment is especially relevant for my purposes. In that condition, the subject's occluded arm, while held still, received vibro-tactile stimulation. Then, on the occluding screen, a light went on. At that point, subjects were required to draw with their other, free, hand the trajectory that their occluded hand would have to follow in order to be placed under the light. Subsequently, following a signal at which the armrest was released, they had to move their occluded hand under the light. In this condition, subjects drew the trajectory of their intended movement in a direction and to an extent that was compatible with the illusory felt location of their occluded arm. Subsequently, they performed an arm movement in the opposite direction with respect to the drawn one, and with an extent that was appropriate to the actual location of their arm. In my framework, subjects in this experiment can be interpreted as having a motor intention to reach in a certain direction (recall that there is evidence in favour of motor representations of reaching), compatible with the illusory limb position, and also as having a motor representation that takes care of their actual movement, which is not consciously accessed.

Let me show why the original Pacherie's account should be rejected when it comes to the dissociations that show up in those experiments. Pacherie's idea (as expounded, for example, in Pacherie, 2006, p. 154) is that the conscious experience of the target object can contribute to the formation of a P-intention, whose content, however, may fail to match with that of the M-intention that ensues (more on the difference between my motor intentions and Pacherie's P-intentions in Section 8). In the Fourneret and Jeannerod's experiment, Pacherie would say that a P-intention to move the stylus towards the target is flanked by an M-intention which takes care of the postural adjustments that are not consciously accessed. However, that interpretation has the undesirable result that the subject in question unknowingly holds two inconsistent intentions, thus breaking the strong consistency requirement without being irrational—something which is in contrast with standard conceptions of intentions as expounded in Section 5. My account (the full characterization of which will have to wait until the end of Section 7), on the other hand, avoids this consequence by positing that there is just one (motor) intention (to reach towards the visual target—see end of Section 7.1) there, supplemented by a motor representation. What the motor intention represents is not consistent with what the motor representation represents, but this is not in contrast with what we would expect of intentions.[16]

[16] In the case in which subjects start to consciously monitor their hand adjustments—i.e., when the bias exceeds 14°, as reported by Slachewsky *et al.* (2001, see fn. 8)—the interpretation according to my account would be that the original motor intention to reach towards the visual target is supplemented by a further motor intention (or further motor intentions) that enable one to adjust one's movements consciously.

Likewise, in the experiment reported in Marcel (2003),[17] it is likely that an interpretation in terms of Pacherie's framework would have the dissociation between conscious intention and actual movement accounted for in terms of a P-intention, whose content is reflected in the trajectory drawn by the subject, and an M-intention, whose content is reflected in the actual subject's hand movement. This interpretation would have the same undesirable consequence as that of the experiment by Fourneret and Jeannerod, whereby a subject would hold two inconsistent intentions unknowingly, and thus without charge of irrationality. This is why I think an account in terms of P-intentions and M-intentions had better be rejected.

One may think, however, that Pacherie's framework is apt to capture the idea that the motor system should be immune to certain perceptual illusions. In response to this worry, I would like to suggest that my account has the advantage of being sensitive to the following complication. When it comes to perceptual illusions, timing seems to be an essential factor: as highlighted by Marcel (2003, p. 63), in his experiments on vibro-tactile illusions, immunity to perceptual illusions lasts about 4 or 5 seconds, after which the (illusory) experienced location of the limb takes over the control of movements.

Pacherie is clearly aware of these complications as she writes (e.g.): 'specification of motor commands by the motor system is, *initially at least*, relatively insensitive to perceptual illusions, both visual and tactile' (2008, p. 187, my emphasis). With my proposed notion of motor intention, I want to emphasize these complications even further by showing that the divide between consciously accessible and not consciously accessible action descriptions is orthogonal to the divide between action descriptions represented by motor representations and those not represented by motor representations. In line with this idea, motor intentions rely on the motor system for what they represent, while being occasionally subject to perceptual illusions.

Having made these clarifications, it is a further question well worth investigating how low down a hierarchy conscious accessibility can reach[18]—specifically, among action descriptions represented by motor representations. Doing justice to this question would lead me too far afield, but the following reflection should provide a good starting point. The criterion for drawing the line between consciously accessible and not consciously accessible levels of action description is subject-relative, and is given by how good a subject is at awareness of her own movements. Because of this, there are going to be interesting inter-individual differences as to how fine-grained the consciously accessible descriptions of one's own action can be. Ballet dancers and

[17] This experiment is discussed by Pacherie (2008, pp. 200-201) as a further reason for favouring an account in terms of P-intentions vs. M-intentions.

[18] How low down *intentions* can reach for a given action token is provided by the most fine grained action description represented by a motor intention. A complete account of the notion of motor intention shall take to the end of Section 7.

pianists are likely to have conscious accessibility for action descriptions at very low levels of their own action hierarchy that outstrip, say, those of the average armchair philosopher. For example, it is possible that a pianist could consciously access the level of description of her own action in terms of *alternating two piano keys using thumb and middle finger in quick succession*. Let me add that it is in principle possible that some levels of description of a given action type may be consciously inaccessible for everyone, regardless of the aforementioned interindividual differences. For example, it is likely that not even a pianist or a doctor could access the level of description of her own action in terms of (e.g.) *activating the First Dorsal Interosseous muscle followed by the Abductor Pollicis Brevis muscle*. This, however, seems to me to be an open empirical question, and nothing I discuss in this article hangs on being able to answer to that question.

Thus far I have brought evidence for two ideas. First, some motor representations are such that what they represent is consciously accessible. Secondly, consider motor representations such that what they represent is not consciously accessible. These will occupy a certain place in an action hierarchy. It is sometimes the case that somewhere else in that hierarchy—usually higher up—it is possible to find motor representations such that what they represent *is* consciously accessible. In the experimental scenario proposed by Fourneret and Jeannerod, an example of the latter is given by the representation of *reaching towards*. Let us then assume the intention to reach towards the visual target as a candidate motor intention. So far, I have pointed to evidence that it has a corresponding motor representation (Filimon *et al.*, 2007) and I have suggested that it is plausible that one may consciously access what it represents. I am now going to check that it satisfies the rest of the constraints that we would expect intentions to meet.

7.2 Integration of Motor Intentions with Other Propositional Attitudes

The second constraint on the set of motor representations apt to generate motor intentions is that it should be possible to integrate the generated mental states with other propositional attitudes. In order to verify that the appropriate set of motor representations is not empty, let us return to the candidate motor intention identified in the course of the previous section—the intention to reach towards the visual target—and see whether it can be integrated with other propositional attitudes, for instance, by being incorporated in a piece of practical reasoning.

In the given experimental scenario, subjects receive a set of instructions from the experimenter, which include moving a stylus towards a given visual target, or, equivalently, reaching towards the visual target with a stylus. A plausible element in this scenario would have the subject reasoning along these lines:

(1) I intend to comply with the experimenter's instructions;
(2) In order to comply with the experimenter's instructions I have to reach towards the visual target, so
(3) I intend to reach towards the visual target.

Thus we can see that the intention to reach towards the visual target may be the conclusion of a piece of practical reasoning. Therefore, the intention to reach towards the visual target can also be integrated with other propositional attitudes, e.g., by being the conclusion of a piece of practical reasoning. So it also satisfies the second constraint that we would expect intentions to meet. Let us now turn to the third one, and verify that it meets that one too.

7.3 Strong Consistency and Its Infringement

Lastly, the third constraint to impose on the set of motor representations apt to generate motor intentions is that the generated mental states should either satisfy the strong consistency requirement, or infringe it, therefore making the subject guilty of irrationality. If I can show that the candidate motor intention to reach towards the visual target meets the strong consistency requirement, or breaches it at the cost of the subject's rationality, I will have shown that it meets all the required criteria for being a genuine intention. I will thereby have shown that the set of motor representations apt to generate motor intentions is not empty. So, let us check that the intention to reach towards the visual target does satisfy the strong consistency requirement and that, if it did breach it, this would be at the cost of the subject's rationality.

If, in the above described experimental scenario, the subject forms a motor intention to reach towards the visual target with a stylus, her motor intention is consistent with her belief to the effect that she should be doing so in order to comply with the experimenter's instructions. For all we know about this scenario, this motor intention is neither in contrast with any of the other subject's intentions, or with any of her beliefs. Thus, the motor intention in question does not breach the strong consistency requirement.

Now, as I said before, a genuine intention should either satisfy the strong consistency requirement, or breach it at the cost of the subject's rationality. So, one thing that still needs to be shown is that if the motor intention to reach towards the visual target with a stylus infringed the strong consistency requirement, this would be at the cost of the subject's rationality. Suppose now that the subject of the previously described experiment was asked by the experimenter to move the stylus *in the opposite direction* of the visual target. Suppose, however, that she formed the intention to reach *towards* the visual target, while at the same time believing that the experimenter's instructions require an action which is in open contrast with her intention. I have already shown that the intention to reach towards the visual target with a stylus matches a motor representation in terms of what is represented and is consciously accessible. So, in this second scenario the subject is guided by an intention whose content she can consciously access, which is in open contrast with her belief as to what she should do in order to comply with the experimenter's instruction. In this situation, it is easy to see that, in the absence of a motivation that accounts for her refusal to comply with the experimenter's instructions, she would then be guilty of irrationality.

This was the last step needed to show that the set of motor representations apt to generate motor intentions is not empty. I have thus produced the example of a motor intention—the intention to reach towards the visual target—such that it has a corresponding motor representation, what this motor representation represents is consciously accessible, the intention can be integrated with other propositional attitudes, and it either meets the strong consistency requirement, or breaches it at the cost of the subject's rationality. Contextually, in this section and the previous two ones, I have produced the three constraints that should be imposed on the set of all motor representations in order to obtain a subset of motor representations apt to generate motor intentions.

Now we are ready to see what was wrong with implication (1) presented in Section 4:

(1) $MR_{Ai} \rightarrow I_{Ai}$

The example constructed on the basis of Fourneret and Jeannerod (1998) has shown that it is not the case that implication (1) holds for *all* motor representations—a counterexample has been produced, namely the motor representation encompassing all the details of the hand trajectory, including those of which the subject is unaware. By contrast, the example of the intention to reach towards the target has shown that it holds for at least *some* motor representations—for instance, the motor representation of reaching towards. So, the first achievement of the argument developed throughout the previous sections is that in implication (1) the universal quantifier should be substituted with an existential quantifier, to the effect that there exist motor representations such that (1) holds.

But the previous reflection has also shown something more precise than that, namely that implication (1) should be modified by restricting the domain of the motor representations to which it may be applied thus:

(1*) $MR_{Ai} \rightarrow I_{Ai}$

for all MR_{Ai} such that:

i. What MR_{Ai} represents is consciously accessible;
ii. It should be possible to integrate the generated I_{Ai} with other propositional attitudes;
iii. The generated I_{Ai} should either meet the strong consistency requirement, or breach it at the cost of the subject's rationality.

8. A Possible Objection: Either Standard or Demonstrative Content

The notion of motor intention has now been legitimized in the following way: a motor intention is a genuine intention that matches the corresponding motor

representation in terms of what is represented—namely, an action described at a certain level of generality—while satisfying the constraints that for a number of reasons we would expect intentions to meet. It is the tight link with motor representations that picks out motor intentions within the realm of intentions. At this point, though, one could raise the following objection. There is no need to mention motor representations in a theory of intention, insofar as what I have been calling *motor intentions* can be explained away either as consisting simply of intentions the existence of which could have been straightforwardly derived from any standard theory of intention, or as consisting of intentions that make reference to a series of bodily movements by means of a demonstrative—e.g., the intention to move my stylus *thus*. In neither case do we need to appeal to motor representations.

The first part of the objection can be extended and reformulated in the following way: who would have doubts as to the existence of intentions such as the intention to reach, in the first place? Another way to push this worry would be to ask whether and to what extent the motor intentions that I propose differ from what Pacherie has termed *P-intentions.* After all, as you may recall from Section 2, P-intentions are thought to perform guiding and monitoring functions at a time scale corresponding to conscious experience, and the sort of control they exert over actions is defined as rational control. *Prima facie*, then, motor intentions may just seem to reduce to P-intentions.

While it is true that, as far as the aforementioned characteristics go, motor intentions and P-intentions have definitely something in common, there is also a major difference. I have said that motor intentions represent actions at a level of generality that is consciously accessible, that they may be integrated with other propositional attitudes, and either meet the strong consistency requirement or breach it at the cost of the subject's rationality. In addition, they also represent an action at the same level of generality as some motor representation. The latter characteristic is absent from the notion of P-intention—although, as it emerged from Section 7.1, the notion of P-intention is occasionally applied to levels of action description represented by motor intentions—and at least *prima facie* it poses a potential problem for intentions standardly conceived (P-intentions included).

To put this potential problem into focus, recall the example proposed at the outset, showing an M-intention—*M1*—potentially at work within the experimental scenario set up by Fourneret and Jeannerod (1998). I showed that *M1* breaches a number of constraints we would expect intentions to meet. I also pointed out that, on the basis of this example, the following doubt may ensue: maybe *any* alleged intention that represents an action at the same level of generality as a motor representation is going to breach the constraints we would expect intentions to meet. At least *prima facie*, this was a reasonable doubt. This is why I needed to show that the set of motor representations apt to generate motor intentions is not empty. And this is why the existence of motor intentions does not straightforwardly follow from any theory of intentions we may have previously assumed, and also why motor representations cannot be assimilated to P-intentions.

Let me now consider the second part of the objection, according to which at least some of what I have been calling *motor intentions* could be explained away simply as intentions with demonstrative content. What need would there be to bring in motor representations in a theory of those intentions? In response to this question, I limit myself to endorsing a solution proposed by Butterfill and Sinigaglia (2014). They provide a convincing account according to which intentions involving demonstratives that make reference to bodily movements—such as 'the intention to move my stylus *thus*'—represent a certain action outcome by deferring to a motor representation representing that outcome. Because of this, such intentions as matter of fact *do* involve motor representations.

9. Conclusion: Intentional Bodily Movements and the Reasons behind Them (or What Motor Intentions Are Good For)

I started out from Pacherie's (2006, 2008) M-intentions, which are supposed to be intentions that represent actions at the same level of generality as some motor representations. I highlighted that, according to Pacherie, for any motor representation representing an action at a given level of generality, there is going to be an M-intention representing that action at the same level of generality. I showed that, assuming this implication, it follows that some M-intentions breach a number of constraints that we would expect intentions to meet (such as those spelled out by Bratman, 1987). These constraints have it that intentions are propositional attitudes, and as such are consciously accessible and amenable to integration with other propositional attitudes, and, *qua* intentions, they either satisfy the strong consistency requirement, or infringe it at the cost of the subject's rationality.

I have argued that this should not force us to altogether give up the idea that some motor representations may match some intentions in terms of what is represented. I have shown that we can isolate a set of motor representations such that what they represent can be consciously accessed, and such that the corresponding intentions, which I termed *motor intentions*, can be integrated with other propositional attitudes, for instance by featuring in a piece of practical reasoning, and either meet the strong consistency requirement or breach it at the cost of the subject's rationality. This ensures that the ability to move provided by fulfilling motor intentions is open to reason, and that motor intentions meet the strongest constraints that could be asked of intentions.

Once the notion of motor intention is in view, it becomes possible to answer the question that motivated this article: under what descriptions of a bodily action can we say that their subject has an *intention* to do something? How detailed can they possibly be? It should be now clear that the performance of intentional bodily movements implies the existence of a series of motor representations guiding them. I have argued that some of them—those satisfying the constraints spelled out in implication (1*)—have corresponding motor intentions. So the most detailed descriptions of an

action under which the latter is intentional are provided by what the relevant motor intentions (or, equivalently, the corresponding motor representations) represent.

The notion of motor intention does something more, though, insofar as it enables us to make better sense of activities involving the intentional performance of very complex bodily movements—piano playing or ballet dancing—that I mentioned at the very beginning. Let me explain why. Whenever we act, the event constituting our action may be described in various ways. Suppose that a ballerina is pirouetting. She may be described as such, or as chasing away a nearby fly, or as moving a lot of air molecules (a similar consideration is made by Searle, 1983). As pointed out by Moran,

> in referring to some event as an intentional action, we are constrained to descriptions that will capture 'what happened' as something that the agent had a *reason* to make happen […]. (2004, p. 59).

Now, what some motor representations represent precisely corresponds to what an agent would describe herself as doing at a given time. It is very likely that the pirouetting ballerina is going to think of herself as performing a series of specific bodily movements, which she *has a reason* to perform on the basis of, say, what her part in the ballet prescribes.

Motor intentions, in other words, provide an extension of the reach of an agent's reasons into very detailed descriptions of her bodily action—descriptions that encompass specifications of her bodily movements. The notion of motor intention, therefore, has not merely to do with accounting for the control of goal-directed movements, but is by all means relevant to the proper characterization of intentional action. It is to be acknowledged that Pacherie's aim in presenting her threefold theory was to explain actions also in their most minimal manifestations, which sometimes have little to do with full-fledged intentional action (or, at least, so one may argue). My proposal concerning motor intentions aims to uncover the hidden potential of Pacherie's theory. It shows that the notion of motor intention, which draws on that of M-intention with the provisos examined at length, is very relevant for full-fledged intentional action (and that is why my disagreement with Pacherie is substantive and not just terminological).

This is because, with the notion of motor intention in hand, it becomes clear that, occasionally, the descriptions of our actions that capture what happened as something that we had a reason to make happen will make reference to what the relevant motor representations represent. When this happens, for each of those motor representations, we can say that the subject has a *motor intention* to perform a certain action. Suppose that the relevant motor representation exists, what it represents is consciously accessible and the corresponding intention can be integrated with other propositional attitudes, and that it either meets the strong consistency requirement or breaches it at the cost of the subject's rationality. In that case, then, we can say that the pianist in my opening example has a *motor intention* to alternate two piano keys using thumb and middle finger in quick succession. What is represented by this

motor intention will provide one of the most detailed descriptions under which this bodily action is intentional.

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