What a Theory of Knowledge-How Should Explain

A Framework for Practical Knowledge beyond Intellectualism and Anti-Intellectualism

Andreas Bartels & Mark May

We argue against both intellectualist and anti-intellectualist approaches to knowledge-how. Whereas intellectualist approaches are right in denying that knowledge-how can be convincingly demarcated from knowledge-that by its supposed non-propositional nature (as is assumed by the anti-intellectualists), they fail to provide positive accounts of the obvious phenomenological and empirical peculiarities that make knowledge-how distinct from knowledge-that. In contrast to the intellectualist position, we provide a minimal notion of conceptuality as an alternative demarcation criterion. We suggest that conceptuality gives a sound basis for a theory of knowledge-how which is empirically fruitful and suitable for further empirical research. We give support to this suggestion by showing that, by means of an adequate notion of conceptuality, five central peculiarities of knowledge-how as compared to knowledge-that can be accounted for. These peculiarities are its context-bound, impenetrable and implicit nature, as well as the automatic and continuous forms of processing that are connected to it.

Keywords
(anti-)intellectualism | (non-)propositionality | Conceptuality | Disposition(ality) | Intuitive knowledge | Knowledge representation | Knowledge-how | Knowledge-that | Practical mode of thinking | Sensorimotor knowledge

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1 Introduction

In this paper, we shall argue against both intellectualist and anti-intellectualist approaches to knowledge-how,[1] for their failing to provide a suitable framework for empirical research on the subject of practical knowledge. Anti-intellectualists propose, following Ryle (1949), that intelligent action embodies "practical knowledge", which is distinguished from "theoretical knowledge" by its manifesting abilities or dispositions. Intellectualists, in contrast, claim that there is only one sort of knowledge that is characterized by having propositional content (e.g., Stanley 2011b). Practical knowledge, according to intellectualists, is rather distinguished by how propositional contents are *applied* in action. Whereas intellectualist approaches (e.g., Stanley 2011b), we shall argue, are right in denying that practical knowledge can be convincingly demarcated from theoretical knowledge by its supposed non-propositional nature, nevertheless they fail to provide a conceptual framework in which the peculiarities by which practical knowledge stands out could be made visible.

On the other hand, anti-intellectualists (e.g., Newen & Jung 2011) often present phenomenologically-motivated identifications of forms of practical knowledge with certain representational formats. Classificatory schemas without theoretical foundation—that is, without a general conceptual framework within which these classifications naturally emerge, and without any clear-cut specification of the explanatory tasks that have to be fulfilled by that classification—have only limited value as a manual for empirical research. Such schemas cannot even be judged according to explanatory productivity or completeness.

The first part of the paper (sections 2, 3, and 4) will be concerned with the shortcomings of both intellectualist and anti-intellectualist approaches, partly programmed by Ryle's famous, but also somewhat misleading, exposition of the subject. The perception of these deficiencies of both intellectualist and anti-intellectualist approaches leads us to the conclusion that a philosophical framework for practical knowledge, in order to provide a basis for further empirical research, has in the first instance to lay some firm meta-theoretical ground.

The second part of the paper (sections 5, 6, and 7) will provide necessary elements for such a ground by identifying some central behavioral peculiarities of practical knowledge that must be explained by any empirically-adequate theory of knowledge-how. As will be seen, this is, above all, its *context-bound*, *impenetrable,* and *implicit* nature, as well as the *automatic* and *continuous* forms of processing that are connected to it. These five peculiarities will, in turn, be illustrated by examples stemming from the realms of sensorimotor knowledge (Milner/Goodale), intuitive knowledge (Damasio), and expert versus novice knowledge (Anderson), among others. We proceed by proposing a possible realization for the explanatory tasks identified in the meta-theoretical part: here we will argue that it is not by recourse to (non-)propositionality in any of its different senses that the peculiarities of practical knowledge can be explained; instead, we shall argue, *conceptuality* is a more suitable criterion for demarcating practical from theoretical knowledge, and for explaining their respective peculiarities. By "explaining" the peculiarities of practical versus theoretical knowledge we do not mean a kind of logical "derivation". "Explaining" here is rather to be understood as showing how the realization of necessary conditions for the possession of concepts coincides with those conditions that have to be fulfilled in order to achieve the step from practical to theoretical knowledge, each characterized by their respective peculiarities. In other words, we search for *"how-possible-explanations"* of the peculiarities of practical versus theoretical knowledge. The driving role of conceptuality would also explain, in that sense, why the contents of practical knowledge cannot be easily verbally expressed, let alone abstractly represented. Such abilities only enter the scene, we argue, when knowledge reaches the conceptual level.

1 Ryle, in his seminal approach, uses the term "knowing how" instead of "knowledge-how". We don't follow his usage because we think, contrary to Ryle, that know how-phrases ascribe *genuine* knowledge, i.e., knowledge of truths (see section 2).

2 The shortcomings of intellectualist approaches

Ryle (1949), in his seminal work on knowledge-how, established a tradition of thinking that knowledge-how, as opposed to knowledge-that, is essentially characterized by its *non-propositionality*. That an action is intelligent, and thus embodies practical knowledge, comes not in virtue of its being "controlled by one's apprehension of truths", according to Ryle, but instead in virtue of its manifesting an ability or a disposition. Thus, Ryle's notion of propositionality of knowledge is from the start coupled with a specific model of knowledge-application. Since this model cannot be true, practical knowledge cannot be employed by applying propositions. Indeed, if a person, in order to apply knowledge had first to "consider a proposition", stored in his or her memory, this very act of considering a proposition would itself be an instance of practical knowledge and thus would be in need of a further act of considering a further proposition, and so on ad infinitum. Note that this means, at most, that practical knowledge cannot be manifested by virtue of *this* sort of application of propositions. But, as Fodor has remarked, "[if] the intellectualist says that, in tying one's shoes, one rehearses shoe-tying instructions to oneself, then the intellectualist is wrong on a point of fact" (1968, p. 631). Thus, in order to avoid the whole debate turning out as a non-starter, we first have to disentangle the claim of propositionality of practical knowledge from the Rylean model of knowledge-application. But in what other sense, then, could practical knowledge be propositional?

The answer is that practical knowledge could be propositional in the sense that a person has practical knowledge by virtue of there being a rule that has a symbolic, language-like ("propositional") representation, which is not accessible to consciousness, and which is not in need of being consciously "considered" in order to be applied in action. The knowledge embodied by this rule is instead applied in action by means of some kind of sub-personal processing of the representation. Fodor (1968) has defended such an intellectualist answer to Ryle's challenge by suggesting that the non-conscious representation governing the application of practical knowledge embodies "tacit knowledge"; since such tacit knowledge is applied by means of automatic mechanisms (not by intentional acts), it cannot fall victim to Ryle's regress argument.

If we ignore the vagueness of this reading with respect to the *units of processing* in which this symbolic representation should appear, the foregoing may be a good answer to the question of how practical knowledge could possibly be propositional knowledge. In the eyes of Stanley (2011b), a more general conclusion could be drawn. According to him, since this argument that knowledge-representations need some automatic mechanisms (and not something like "considering" a proposition) in order to be applied in action, is true irrespectively of the kind of knowledge involved, symbolically represented or not, all kinds of knowledge are completely *on a par* with respect to their representations—whatever they are—having to play some functional roles, mediated by an automatic mechanism, in order to be applied in action. Thus, Ryle's analysis, according to which practical knowledge has a *dispositional* nature, can be accepted, but only at the price of accepting it for all sorts of knowledge. As such, not only can practical knowledge be propositional, but the whole distinction between propositional and non-propositional knowledge turns out to be irrelevant for characterizing sorts of knowledge, and *a fortiori* cannot be used to ground the distinction between practical and theoretical knowledge.

In other words, it is important to hold apart the thesis that knowledge is propositional in the sense of its being based on language-like representations, accessible to consciousness or not, from the empirically implausible Rylean model of knowledge application, which presupposes an act of "considering" a proposition. If we keep this distinction in mind, we find that propositionality *per se* does not provide a criterion for the theoretical versus practical knowledge distinction. Instead, all kinds of knowledge have to be "dispositional" in some sense, irrespective of their being based on symbolic, language-like representations or not.

Some anti-intellectualists, following Ryle, use the notion of "propositionality" of knowledge to refer to the fact that a person has *conscious access to linguistic propositional representations* (that is, that a person has sentences "in her mind"). Thus, for example, Michael Devitt, in a recent paper (Devitt 2011), argues that intuitively "to attribute any propositional attitudes to the ant [who has the skill of finding its way back to its nest by virtue of some neural processing] simply on the strength of that competence seems like soft-minded anthropomorphism" (Devitt 2011, p. 208). But the impression of anthropomorphism only occurs if we constrain the notion of a propositional attitude to refer to a conscious act by which a person relates to a linguistic propositional representation. The impression disappears as soon as we replace this interpretation of "propositional attitude" with a version in which the "proposition" is a rule, represented by symbolic encoding to which the ant is related by virtue of her neural mechanisms processing this encoding (or by virtue of her neural mechanisms being structured in such a way that they realize some implicit rule). That the ant "grasps a proposition" appears to be a strange description only under the presupposition that guidance by propositions implies the conscious possession of linguistic entities.

Moving from these "intuitive" considerations to arguments from the "science of knowledge-how" (cf. Devitt 2011, p. 207), Devitt identifies a "folk distinction between knowledge-that and knowledge-how" with the "psychological one between 'declarative' and 'procedural' knowledge" (2011, pp. 208-209). Now, declarative knowledge, according to Devitt, is characterized (according to what he sees as a consensus in psychology) by *conscious representation* of what is known (cf. Devitt 2011, p. 210). For example, a person has declarative knowledge of arithmetic rules only if she consciously represents those rules. Concerning procedural knowledge, Devitt refers to the distinction from computer science between "processing rules that govern by being represented and applied and those that govern by being simply embodied, without being represented" (2011, p. 210). Since there is, according to Devitt, no decisive empirical evidence to tell us whether skills involve representations of the governing rules or not, he takes the recent picture that psychology paints of procedural knowledge "as constituted somehow or other by embodied, probably unrepresented rules that are inaccessible to consciousness" (Devitt 2011, p. 213). Finally, he argues that empirical evidence from cognitive ethology confirms this distinction between declarative and procedural knowledge by indicating that the "surprisingly rich cognitive lives" of desert ants, western scrub jays, or bottle-nosed dolphins can be understood as based on forms of procedural knowledge (to be identified with the folk notion of "knowledge-how"), but not on declarative knowledge ("knowledge-that").

Thus, surprisingly, the anti-intellectualist Devitt and the intellectualist Fodor would agree to subsuming sub-personal knowledge, whether represented in explicit or implicit form, under the heading of knowledge-how. But the first would classify it as non-propositional, the latter as propositional knowledge. The real dissent seems to be about the question whether representations being *conscious* (and being accessible in linguistic form) or *non-conscious* makes a relevant difference for sorts of knowledge. We think that conscious availability/unavailability expresses a relevant difference for sorts of knowledge, but a difference *that can only be explained* by recourse to some fundamental distinction between practical and theoretical knowledge. Phenomena indeed indicate that the boundary between practical and theoretical knowledge coincides pretty well with conscious availability/non-availability. But Devitt's distinction just *repeats* this phenomenon, rather than explaining it.[2] What we look for is a deeper reaching distinction that would be able to explain phenomenal differences such as conscious availability/non-availability and, as a consequence, verbalizability/non-verbalizability.

2 In the same way, Adams (2009) argues for a knowledge-that/knowledge-how distinction on the grounds of empirical evidence that takes recourse to experimental findings showing that declarative and procedural memory can operate independently from each other. We think that such empirical phenomena constitute explananda of the searched-for distinction, but cannot provide decisive evidence for the existence of a fundamental difference between knowledge-how and knowledge-that.

Thus, the propositionality criterion appears again unsuited for drawing an empirically-interesting distinction between practical and theoretical knowledge. As far as the intended distinction concerns the *transfer of knowledge into action* (this aspect is exactly that to which Ryle's distinction refers), *ways of representing knowledge* seem to be "on a par" and thus insensitive with respect to the distinction.

According to Stanley, it is the *semantic* notion of propositionality, with respect to which all sorts of knowledge can be subsumed as "propositional" (knowledge-that), be they based on conscious or non-conscious representations, by explicitly represented or simply embodied rules. Thus, Stanley has argued that the way in which a piece of knowledge is *implemented* (or *represented*) has nothing to do with a distinction between two *kinds* of knowledge. Therefore, the distinction between "declarative" and "procedural" knowledge as it is widely used in psychology should not be misunderstood, according to him, as providing some ground for the knowledge-that versus knowledge-how distinction: "the latter is a putative distinction between two *kinds of state*, rather than a distinction between *two ways of implementing a state*" (cf. Stanley 2011b, p. 151). Paradigmatic examples of practical knowledge, in the sense of knowledge being manifested by intelligent conduct, could turn out to be represented in a language-like way (without any conscious mediating act of "considering a proposition"), whereas clear examples of theoretical knowledge could fail to have any language-like representational background.

Stanley's *semantic* reading of propositionality is concerned with the reference of "know how"-phrases by which we ascribe knowledge-how to persons. According to our best available linguistic theories, as Stanley argues, know how-phrases have to be understood to refer to propositions. But this fact, in the first instance, does not include anything about the role those propositions play in the intelligent action of a person who knows the propositions. In particular, it does not follow that such a person possesses language-like symbolic representations that guide the person's intelligent action, or that such a person "considers" the proposition in order to apply his knowledge in action. If the correct understanding of the semantics of knowledge-phrases, no matter whether it is theoretical or practical knowledge that is ascribed by them, is that they refer to propositions, then this propositional nature of knowledge, according to this reading, cannot be used to draw any distinction between theoretical and practical knowledge.

Now, someone could object that Ryle's distinction is concerned with the *nature* of knowledge, e.g., how knowledge is represented in a person, but not with what is involved in knowledge *ascriptions*. Thus the semantic reading of propositionality would be irrelevant for the theoretical versus practical knowledge distinction. But note that Ryle's analysis of practical knowledge actually starts by asking questions like: "When the person is described by one or other of the intelligence-epithets" (Ryle 1949, p. 28), what sort of knowledge is this description imputing to the person? That is, Ryle asks for the semantics of knowledge-ascriptions for typical cases of practical knowledge. Therefore, it is not at all clear that a semantic reading of propositionality is irrelevant for his analysis. On the contrary, the sense in which Ryle is concerned with the "nature" of knowledge is expressed, by him, by means of an analysis of the role that knowledge-phrases play in actual linguistic practice.[3]

It has now been shown that both possible readings of "propositionality", that is, the *representational* and *semantic* readings, are *relevant* for Ryle's proposed theoretical versus practical knowledge distinction, but neither is suited to grounding the distinction: Whether a piece of knowledge is a case of practical or of theoretical knowledge does not depend on whether it is supported by language-like structures or not; and, since *all* knowledge is semantically propositional (if Stanley is right) it does not depend on its semantic propositionality either.

3 Contrary to this, Noë (2005) argues that "Ryle's distinction is not a thesis about the sentences used to attribute propositional and practical knowledge, respectively". He claims that "Ryle was not an ordinary language philosopher". How then, would Noë, for example, understand Ryle's appeal to linguistic use in his deflationary account of the "will"?

Thus, it seems as if no criterion for the distinction between practical and theoretical knowledge could be available from the intellectualist point of view. But, we shall see that, from Stanley's revised dispositional analysis of knowledge, rather surprisingly a new possible criterion emerges. Let us, therefore, follow the path of this analysis, which is intended by the author to show how, contrary to Ryle, the (semantic) propositional nature of knowledge is compatible with its dispositional nature.

According to Stanley (2011b), even if we accept Ryle's general claim that knowledge has to be understood as dispositional,[4] "there still need to be automatic mechanisms that mediate between dispositions (and abilities) and the manifestation or execution of these dispositions and abilities" (Stanley 2011b, p. 26). What has to be true of theoretical knowledge, namely the existence of mechanisms that mediate the application of that knowledge, has to be also true of practical knowledge. The complex of dispositions on which the ability to catch the fly ball rests may be completely intact, even if the player sometimes does not succeed in catching the ball because he has become tired or has momentarily lost concentration. When that happens, his executing mechanisms can fail. As has often been identified in the debate on knowledge-how, having the right dispositions (and thus having the right sort of practical knowledge) does not always guarantee successful performance (cf. Snowdon 2004).

Even if, from the intellectualist point of view, all forms of knowledge—be they "practical" forms of knowledge or not—could be, and indeed have to be, analyzed with respect to their dispositional nature, the question seems, by the very phenomenology of practical knowledge, to be more urgent than for cases of theoretical knowledge: How can knowledge be dispositional and propositional at the same time? Stanley & Williamson (2001) have suggested that cases of practical knowledge can be captured by means of a "practical mode of thinking", by which a person who has practical knowledge has access to propositional contents. If, for example, a person knows *that a certain way of riding a bike is a way for her to ride a bike*, then her thinking of that proposition is in a peculiar way self-directed, it is a "first-person-way" of thinking the proposition. Stanley (2011b) has developed this suggestion further into a dispositional theory of knowing a proposition.

Gareth Evans (1982), in his analysis of "demonstrative knowledge", has provided a useful framework of first-person dispositions: My thinking is a demonstrative belief about a perceptually-presented object if I will be disposed to have changes in that object affect my belief (Stanley 2011b, p. 110). Thus, my thinking of an object in the world as "myself" involves a permanent disposition to let my thoughts and actions be determined by my own bodily perceptions. Now this schema seems to fit the practical way of thinking that occurs when it comes to propositions like "This way of riding a bike is a way to ride a bike for me": A person manifests knowledge of this proposition by, while riding a bike, manifesting the disposition to react to certain kinesthetic sensations mediated by her own bodily movements by means of adequate motor commands.

We accept this as an adequate way of describing the phenomenological peculiarity of "practical ways of thinking" a proposition. Indeed, when described in this way, practical knowledge can be propositional and dispositional at the same time. But this analysis does not tell us—and indeed is not meant to tell us—how the distinction between practical and theoretical knowledge can be grounded. That there is such a distinction seems obvious *inter alia* on the basis of the functional characteristics peculiar to practical knowledge, such as its domain-specific nature, its limited transferability, its non-penetrability, and so on. Stanley's

4 Contrary to what Noë (2005) has claimed, Stanley thus does not attack Ryle's identification of "knowledge how" with the possession of abilities *tout court*. What Stanley objects to is the supposed opposition between knowledge as the possession of abilities and propositional knowledge on which Noë, assuming that propositional knowledge necessarily entails understanding of propositions, insists. Even the earlier work (Stanley & Williamson 2001) tries to account for the dispositional nature of practical knowledge by introducing the concept of a "practical mode of thinking". On the contrary, any unrestricted identification of knowledge-how with abilities confronts the problem of how to account for cases in which practical knowledge survives the loss of ability. The distinction between dispositions and their manifestation by means of executing mechanisms accounts for this problem.

dispositional theory fails, at least at first sight, to deliver any resources for *explaining why* practical knowledge is distinct from theoretical knowledge on the basis of these functional characteristics. The main shortcoming of recent intellectualist approaches, in our opinion, is not that they simply neglect the peculiarities of practical knowledge. Rather they are deficient insofar as they do not provide an explicit positive demarcation criterion of practical versus theoretical knowledge that would go beyond capturing the well-known phenomenological peculiarities and make it compatible with the proposed fact that all knowledge is (semantically) propositional. Before we go back to Stanley's analysis, in order to show how some explicit demarcation criterion could possibly be drawn from it, we ask whether recent anti-intellectualist approaches do a better job of providing a demarcation criterion.

3 The shortcomings of anti-intellectualist approaches

The anti-intellectualist position has recently been supported by, among others, Toribio (2008), Young (2011) and Newen & Jung (2011). Newen and Jung assume that Ryle's distinction between knowledge-how and knowledge-that should be taken as referring to the *nature* of knowledge. From a naturalist point of view, the most general way to characterize knowledge is to say that it is based on mental representations. Thus the distinction between practical and theoretical knowledge, from that perspective, has to be spelled out as a distinction between *ways of representing* something, or between representational formats. Now, theoretical knowledge, according to Newen & Jung (2011), can be identified with the propositional representational format, whereas they hold that practical knowledge comes in two (non-propositional) varieties, one characterized by the format of *sensorimotor* representations, and the other by what they call *image-like* representations.

Concerning the first of these representational formats, namely the propositional format, we are confronted with the same problem we faced when considering Ryle's notion of propositionality. What does it mean to say that a representation is propositional? It should not mean that the content of the knowledge is or can be made available to the person in the form of consciously-accessible *linguistic structures*. Even if the property of *explicitness vs. implicitness* of knowledge is often used to distinguish between theoretical and practical knowledge, this merely descriptive criterion does not help to *explain* the theoretical versus practical distinction, but preferably should be explained by the more principled criterion we are looking for. If, on the other hand, we take "propositional" to mean that the kind of *processing* connected to a piece of knowledge has a language-like structure, how do we identify the units of processing to which this characterization is supposed to refer? Even if it were possible to precisely identify the level of processing that accounts for propositionality, it would be far from clear how the characteristics of theoretical versus practical knowledge could be explained by means of that supposed representational fact. As we have already pointed out in discussing Ryle's notion of propositionality: Why should it be the case that "theoretical" knowledge is necessarily connected to propositional representations, and, correspondingly, practical knowledge to non-propositional ones?

According to Young (2011), what we call "knowledge-how" may appear in different forms, which are accompanied by more or less comprehensive linguistic mastery of propositions. The sort of knowledge a guitar player manifests in his playing may be either such that he is able to *articulate* that, for example, G should be played rather than G#, or such that he may only be able to *experience* his performance as appropriate guitar playing (Young 2011, pp. 57f.). In the latter case, his knowing how to play guitar is constituted by specific dispositions to react in particular ways to the conscious auditory and motor experience of his own playing. Even this form of knowledge may be reducible to propositional knowledge, however, since the player is potentially able to instruct himself with the help of demonstrative pronouns denoting parts of his actual auditory experiences. Whereas

those forms of knowledge-how may, according to Young, be reducible to propositional knowledge, he thinks that there is a clear case of *irreducible* knowledge-how that is constituted by "purely" sensorimotor abilities, and that is exercised without being supported by any kind of propositional knowledge. Such kinds of sensorimotor abilities are exemplified, according to Young, by the case of DF in the Milner/Goodale-experiments.

Patient DF is impaired in her ability to recognize objects, despite showing intact basic visual processing abilities. Milner and coworkers presented to DF a letterbox in which the slot through which one inserts letters could be rotated to vertical, diagonal, or horizontal orientations. DF had problems when she was asked to visually match the orientation of the slot to different alternatives. However, when asked to actually insert a letter, she was able to reach towards the slot while orienting her hand in accordance with the spatial orientation of the slot. Thus, DF has the ability to use visual information in purposeful object manipulations without being able to consciously visually process or experience them. On the other hand, another patient, IG, showed conscious visual awareness of objects without being able to practically manipulate them. Apparently, then, there are two independent neural pathways for processing visual information: the ventral path, leading to visual identification and corresponding to conscious experience, and the dorsal path, used for non-conscious action control and execution. In pathological cases, one or the other (DF vs. IG) of these pathways does not work, whereas the other remains intact (Milner & Goodale 1995, 2008).

What is the reason for Young's assuming that the case of DF exhibits "irreducible" knowledge-how? The reason seems to be that DF is not able to use linguistic propositions—in whatever rudimentary form—to refer to aspects of the visual scene. She simply has no conscious access to the visual scene whatsoever. Young thus takes "propositionality" of knowledge to be constituted by conscious access to—possibly rudimentary forms of—linguistic propositions. But, as we already have seen, lacking conscious access to linguistic propositions accompanying the performance of knowledge-how does not exclude the "propositionality" of that knowledge-how in the semantic sense of "propositionality", and neither does it exclude the "propositionality" of that knowledge in the sense of being based upon symbolic language-like processing.

Toribio (2008) gives a similar argument against the possible propositionality of DF's knowledge. She argues that

> DF has no conscious awareness of this visual information [the information available on the dorsal route] and has no phenomenal experience as to the appropriateness of her own performance, but she has proprioceptive awareness of the features that govern her visually guided action in this particular task. (cf. Toribio 2008, p. 13)

This situation, according to Toribio, is relevantly different from the example of Hannah's knowing how to ride a bike. In the latter case, Hannah has not only proprioceptive, but also *conscious* awareness of the sensory information available. Why does this difference matter? It matters, Toribio suggests, because in order to make plausible that a person's knowledge-how is somehow "guided" by a proposition, this guidance has to be spelled out by a real process of "entertaining" or "contemplating" the proposition by the person. Suggesting a propositional reading of Hannah and DF's knowledge without being able to point out some possible realization of "entertaining a proposition" in these cases "threatens to make us lose our grip on what propositional knowledge is" (cf. Toribio 2008, p. 13). But Stanley & Williamson (2001), Toribio claims, are unable to provide such a possible realization in the case of DF:

> DF couldn't possibly entertain such a proposition because she cannot grasp one of its constituents – she cannot perceive the features, e.g. the orientation, that governs her motor behavior in the posting task, and hence couldn't recognize them as in any way constituting a reason for her action. (cf. Toribio 2008, p. 9)

We think that Stanley's elaboration on "practical ways of thinking a proposition" is able to overcome this objection. We can very well understand what it means that a person thinks a proposition *p* without being able to sensually identify the objects constituting *p*. Sensual identification ("grasping") is a precondition for *conceptual* apprehension of the constituents of a proposition, but it is not a precondition for non-conceptual attitudes to propositional contents, by way of proprioceptive information.

What the performance of DF in the Milner/Goodale-experiments indeed shows is that sensorimotor processing of visual information is sufficient for entertaining practical abilities and does not require any conscious processing, in particular no *linguistic* processing, if we suppose that linguistic processing is necessarily conscious.[5] This result does not imply that sensorimotor processing is independent of (and opposed to) propositional processing. Sensorimotor processing could use "propositional" representations, only if these propositional representations were not linguistic representations (cf. Fodor 1968). Thus, the case of DF cannot be understood as supporting the sensorimotor-propositional processing-classification of knowledge. There is still no indication that there are two independent types of cognitive processing, a propositional and a sensorimotor one, to say nothing about the possible explanatory virtues of such a distinction.

That the sensorimotor vs. propositional classification is lacking any theoretical foundation that could determine whether this distinction is already complete or has to be completed in certain ways becomes obvious when further classificatory distinctions are proposed. For example, Newen & Jung (2011) introduce, in addition to the sensorimotor and propositional format, a third representational format, called *image-based knowledge,* which they think can supplement the knowledge-how variety. An example of image-based knowledge, according to the authors, is a high jumper's generation of a mental image of his planned jump before his running up. The authors argue that the mental image can take the role of controlling the performance of the action. The action, in cases of image-like knowledge, is thus "guided" by an image, just as motor reactions to bodily experience supposedly guide actions in the case of sensorimotor knowledge, and propositions supposedly guide actions in the case of propositional knowledge. Now, we think that it is far from clear how mental imagery or real images can "guide" actions. Even if we could clarify what "guiding" here means, there is at least a possible alternative interpretation of the role of mental images in acting, namely a common cause interpretation, according to which the performance of the action and the occurring of a corresponding mental image have a common cause, namely the neural processing that is the real cause of the different aspects of the performance, which thus "guides" the action. If such an interpretation was correct, the mental image would not be a "guide", but would merely be an epiphenomenon of the processing that produces the action (cf. Pylyshyn 1984). That this alternative interpretation exists shows that there is no clear indication that "image-based knowledge" is an independent third kind of knowledge that would legitimately supplement the classification.

On the other hand, research in psychology and cognitive neuroscience indicates that it is possible for non-conscious and non-linguistic types of knowledge (e.g., intuitive knowledge) to guide actual behavior, and which cannot be classified as "sensorimotor" knowledge.[6] As long

5 Note that this does not necessarily mean that there is also no *conceptual* processing involved. As Stanley points out, declarative knowledge is sometimes defined as "knowledge that can be consciously and intentionally recollected", as opposed to procedural knowledge, which is taken to be "knowledge expressed through experience-induced changes in performance" (Stanley 2011b, p. 154). This reading of the procedural-declarative distinction proposes to fix it by translating it into the "explicit" versus "implicit"-distinction, where it seems to exactly match the distinction of two pathways of processing that are exhibited in the Milner/Goodale-experiments. But it cannot be taken as grounding the theoretical versus practical knowledge distinction. We agree with Stanley, who claims that practical knowledge can have a propositional content that is able to be verbalized—the subject can be able to linguistically express what she knows. Stanley's example is that of "physicians skilled at a procedure, who are also very good at describing to others how they do it"—they "possess explicit procedural knowledge" (2011, p. 159). Thus knowledge may be procedural in the sense of the above definition, and at the same time conscious and linguistically expressible.

6 A further type of practical knowledge that fulfills this criterion seems to be expert knowledge in areas that are not reducible to sensorimotor processing: e.g., chess or financial stock markets.

as there is no theoretical principle or framework from which the classification of possible forms of knowledge-how can be derived, there is in our opinion no reason to exclude such types of knowledge from the knowledge-how variety.

To give an example of non-sensorimotor knowledge-how: Bechara et al. (1997) examine the behavioral, subjective, and physiological states involved in intuitive decisions. Participants played a card game (known as the *Iowa gambling task*) in which they had to repeatedly (up to 100 times) pick cards from four different decks that could lead to wins as well as losses. In the long run, drawing from some decks led to smaller or larger winnings, and others to smaller or larger losses. The goal was to maximize one's play money on the basis of a $2000 starting sum. Unknown to the participants, the card decks were pre-organized so that all decks would lead to wins in the first few draws. During the game two good decks turned out to be relatively safe (i.e., small wins and losses) leading to an overall net win, while two bad decks turned out to be relatively risky (i.e., large wins, but also large losses) leading to overall net loss.

The hidden win-loss dynamics and relations between the outcomes allowed the researchers to separate different periods of card-drawing behavior (standing for different knowledge states) during the game. A first *pre-punishment period* stood for the phase of early wins, a second *pre-hunch period* for the phase in which subjects started to get a feeling that there were differences between decks in terms of safety vs. risk-taking, a third *hunch period* for a phase in which subjects started liking or disliking certain decks without exactly knowing why this was the case, and a last *conceptual period* in which subjects were able to articulate their preferences and the reasons for these preferences between different decks. Not all participants reached the *hunch* or the *conceptual* period of the game.

Of foremost interest were observations made in the *pre-hunch period*. Normal participants, as opposed to participants with prefrontal damage, began to develop behavioral preferences for the good and less riskier card decks during this phase, and also showed anticipatory skin conductance responses (reflecting minimal perspiratory reactions standing for fear responses) when planning to draw from riskier decks, although they were not consciously aware of these preferences, or of any physiological reactions during this phase of the game. Showing these non-conscious and involuntary responses during the *pre-hunch period* was prerequisite for subjects to advance to the *hunch* as well as the later *conceptual period*. A control group of prefrontally-damaged participants[7] did not show any of the described physiological skin responses during the experiment, and their card-drawing behavior as well as their subjective reports showed no sign that they had developed knowledge of the riskier behavior associated with picking cards from certain decks.

The intuitive knowledge that is reflected in this study makes up for a further possible form of knowledge-how (for other examples of intuitive knowledge see Myers 2004; for intuitive core knowledge about geometry, numerosity, and ordering see Spelke 2000; for intuitive knowledge of experts see Dreyfus & Dreyfus 1986). Instead of adding new forms of knowledge-how in some arbitrary way, we think that it is more promising to look for a general criterion for knowledge-how that has the potential to explain the salient characteristics of knowledge-how, and at the same time is suited to give a framework for the possible surface forms in which knowledge-how may appear, including the sensorimotor and intuitive forms described above. We suppose that the most promising candidate for such a criterion is *non-conceptuality*.

4 How can propositional knowledge be non-conceptual?

How can it be true that the knowledge held by a person is "propositional" in its semantic sense[8] without being conceptual? Would not the per-

7 Several studies (e.g., Barch et al. 2001; Bechara et al. 2000; Halligan et al. 2004; Stuss & Alexander 2007) indicate that lesions of the prefrontal cortex can lead to a number of cognitive and affective problems, most notably working memory problems, deficits in executive functioning such as planning, goal selection, task monitoring, deficits in inhibiting thought and action impulses, problems in outcome anticipation, and risk-taking behavior.

8 Note that we have accepted Stanley's thesis that all knowledge is propositional in *that* sense.

son necessarily need a grasp of the concepts a proposition is "composed of" in order to have knowledge of that proposition? The answer is that in order to have *conscious* knowledge of a proposition given in *linguistic* form it is necessary to have a grasp of the concepts of which the linguistically-given proposition is composed. But Stanley's notion of knowing a proposition is not restricted to linguistically-given propositions. For example, if Hannah knows the proposition that "this way is a suitable way for me to ride a bicycle", her way of knowing this proposition is a *practical* way of knowing that does not include knowledge of linguistic entities, but shows up by manifesting dispositions to react to certain kinds of bodily experiences. Thus, as much as knowledge-how is involved, it is possible to have knowledge of a proposition without being able to grasp the concepts the proposition is "composed of" when given in a linguistic form. The case can be made plausible by looking again at the Milner/Goodale-experiments: although the patient DF knows "how to put a card into a vertical slot"—and thus knows a proposition—due to a defect in her ventral pathway she is not able to have a conceptual understanding of the linguistic components of that proposition.

Stanley (2011b) has formulated objections to conceptions of non-conceptual content, at least when they are directed against propositionality *tout court*, as for example in Dreyfus (2007), according to whom "embodied skills [...] have a kind of content which is non-conceptual, non-propositional, non-rational [...]" (p. 360). His main argument is that ascriptions of knowing-how create opaque contexts (Stanley 2011b, p. 168). But this argument does not seem very strong, if seen from Stanley's own perspective of a dispositional reading of ways of knowing a proposition in the case of knowing-how. How the objects occurring in the propositional content are conceptualized does not make any difference to the subject's knowing the proposition, namely his being disposed to react to his own bodily experiences in a certain way (think of the guitar player). Thus, the dispositional reading of propositional knowledge is simply not compatible with the proposed fact that propositional contents are individuated by concepts. Instead, it implies that, in case of knowledge-how, persons have propositional knowledge that is indeterminate with respect to any conceptualization of the objects occurring in the propositional content. We therefore object to Stanley's claim that "I cannot be said to know how to ride a bicycle if I have no clue what a bicycle is" (Stanley 2011b, p. 170). Someone can be able to manifest a well-determined disposition with respect to riding a bicycle, whatever conceptual understanding, if any, he has about bicycles.

In face of the DF-case in the Milner/Goodale-experiments, Stanley admits that:

> [...] DF cannot accurately report on the orientation of the slot, whereas the normal agent can. DF's knowledge of how to put a card into a slot is propositional knowledge that is based on a non-conceptual understanding of the orientation of the slot, understood here in the sense of an understanding of the orientation of the slot that is not available to conscious apprehension. She is able to have propositional attitudes about a way of posting a card into a slot in virtue of this non-conceptual understanding of orientation, yielded by her intact dorsal processing pathway. In contrast, the normal agent does have consciously available knowledge of the orientation of the slot before she acts. This is a difference between DF and the normal agent, but not one that can be used to deny that DF's action is guided by propositional knowledge of how to put a card into a slot. (Stanley 2011b, p. 172)

In the remaining sections, we will follow the path opened by the suggestion that knowledge can be propositional without being conceptual. Whereas we hope to have shown that the propositional/non-propositional-distinction is not fruitful for explaining practical knowledge, we argue that the conceptual/non-conceptual distinction does have this potential. The idea, following Stanley's proposal, is that knowledge-

how is, in general, knowledge of propositions by way of non-conceptual understanding. But we do not stick to the definition of "conscious apprehension" that in the DF-case indeed coincides with conceptual grasp. There can be conceptual grasp even in the absence of conscious apprehension (as it seems to be the case for certain animal species where the presence of consciousness is at least doubtful). Instead we take recourse to a minimal conception of "conceptuality" that has been developed by Newen & Bartels (2007) in the context of animal concepts. This minimal conception does not depend on consciousness. First, however, we shall explore the already-noted peculiarities of practical knowledge. It is these peculiarities that a fruitful conception of knowledge-how, based on the contrast between "conceptuality" and "non-conceptuality" needs to be able to explain.

5 The peculiarities of practical knowledge

An adequate meta-theory of human knowledge should be able to account for empirical differences observed when people use practical rather than theoretical knowledge in the most general terms, and be able to deliver an explanation for these differences. The starting point for the need to distinguish between practical and theoretical knowledge is the behavioral and neurological differences or dissociations in performance in different sensory, motor, or cognitive tasks, e.g., performance differences between experts and novices, between normal and prefrontal patients, between DF and IG. In actual research observed behavioral or neurological differences and dissociations are often accounted for by describing them in terms of polar opposite knowledge attributes or effects. In our understanding this is a first step in the direction of a theory of knowledge-how, even if it is still short of delivering a satisfactory explanation of the observed behavioral and neurological differences.

In the cognitive science and psychological literature, one finds the following polar opposite ascriptions of attributes of knowledge-how as opposed to knowledge-that:

A. Context-bound versus context-free knowledge. Knowledge-how is specific to the domain or the situation of its use, whereas knowledge-that is not. In other words, knowledge-how is about *situational* skills, while knowledge-that is about *general* facts (e.g., Clark 1997; Clancey 1997). For example, throwing a javelin and anticipating its movement when it leaves the hand is a case of context-bound knowledge, whereas calculating the biomechanical forces needed for optimal performances (e.g., the ballistics of an optimal flight trajectory) is an instance of context-free knowledge. Chess experts as compared to novices have superior context-bound knowledge of constellations of chess figures, which helps them to reproduce specific shortly-presented board situations from memory. However, their superior knowledge does not help expert chess players to reproduce random constellations of chess figures from memory, as their skill for applying context-bound perceptual chunking mechanisms on meaningful constellations of figures does not prove beneficial.

B. Impenetrability versus penetrability of knowledge. Knowledge-that is penetrable by other cognitive processes or meta-processing, whereas knowledge-how is impenetrable (Pylyshyn 1984, 1990). Impenetrability means that use of knowledge-how is not changed by internally (e.g., beliefs, goals) or externally (e.g., distracting stimuli) triggered cognitive processes. One example is subitizing, i.e., the rapid, accurate, and confident estimation of the number of displayed elements (e.g., stones), which works fine and is robust against internal or external distractions. In contrast, the use of knowledge-that to determine the number of regularly arranged objects by counting them or doing mental arithmetic (e.g., adding over rows of elements 3+5+4+2+...) is prone to interferences from internally- or externally-activated cognitive processes. If athletes change the order of different sensorimotor sub-processes (e.g., in technical sport disciplines such as high-jumping or hitting a golf ball), they can encounter considerable problems and might need additional time and effort to build up new

knowledge-how. Not so well-trained movements (e.g., dancing steps in beginners) can be more easily rearranged.

C. Implicit versus explicit knowledge. Use of knowledge-how takes place largely outside of awareness and hence cannot be verbalized, while knowledge-that is to a large degree consciously available and can be verbalized. In the last decades psychological research has made substantial progress in distinguishing between implicit and explicit forms of human learning, memory, and information processing (e.g., Dijksterhuis & Nordgren 2006). People learn the grammar of natural language or internalize their society's norms implicitly, that is, without conscious knowledge of the principles that guide their language use or their social behavior (e.g., Reber 1989). Implicit memory is, for example, displayed in cases of amnesia, in which patients are not able to explicitly recall previously-presented items or events from memory, while performances on tasks that do not require explicit memory such as perceptual priming or sensorimotor skills are undisturbed and virtually normal (e.g., Tulving & Schacter 1990).

D. Automatic versus effortful processing. Use of knowledge-how is automatic in the sense that it requires little attentional monitoring or guidance, and in the sense that that its demands on working memory are quite low (Bargh & Chartrand 1999). Use of knowledge-that is generally more effortful, and can be shown to require significant attentional as well as working memory resources (Hasher & Zacks 1979). Good examples of the distinction between the automatic and effortful use of knowledge can be found in the domain of spatial cognition: Blindfolded navigators (animals as well as humans) complete triangles by returning to the starting point on the basis of automatic vestibular and kinesthetic path-integration mechanisms (knowledge-how), while only humans are able to use effortful geometrical calculations (knowledge-that) to find their way back to the origin of the outbound travel. Experiments show that simultaneous secondary tasks (e.g., to-be-ignored spatial movements vs. counting operations) differentially affect the one or the other type of knowledge processing (May & Klatzky 2000). To give another example from research on spatial cognition: Wayfinding on the basis of multimodal sensory inputs from the surroundings and from automatic updating is very different from the quite effortful and highly disturbable use of knowledge-that that results from listening to verbal route-descriptions or maps (Montello 2005).

E. Continuous versus discontinuous processing. Use of knowledge-how expresses itself in smooth and continuous processing, while knowledge-that is normally reflected in step-by-step processing along a discontinuous path of intermediate knowledge states. Recent dynamic systems accounts of the sensory, motor, and cognitive processes underlying human knowledge use describe these differences in terms of different attractor landscapes of mental or neural state spaces (Spivey 2008). Research into children's cognitive development, for example, reveals that there are two levels of spatial location coding in memory. In a first phase, children learn to code the metric distance between locations (e.g., allowing them to find previously hidden objects in terms of distance from the sides or the corners of a rectangular sandbox). In a second phase, children attain the ability to impose organization on their spatial knowledge (e.g., allowing them to divide the spatial layout in hierarchical subsections or regions). The shift from the first to the second level reveals itself in changes in the types of spatial errors (discontinuous vs. continuous distributions) children commit when locating hidden objects (Newcombe & Huttenlocher 2000).

This list of opposing attribute pairs is probably not complete, but seems a good starting point for our purposes. It can be thought of as a general description and characterization of practical knowledge in contrast to theoretical knowledge. Not every single case of knowledge use will be easily describable by means of the list, or will even require a full description along all opposing attribute pairs. However, chances are good that the overwhelming majority of cases will be adequately described by using such a set of opposing attributes, and, generally, the profile over the five attributes will correctly apply. We will ar-

gue that this list of attribute pairs, together with their predominant assignment to the one or other knowledge variety, is what an adequate and fruitful theory of knowledge-how vs. knowledge-that should be able to account for.

6 Conceptuality as a demarcation criterion for knowledge-that versus knowledge-how

We propose conceptuality as a demarcation criterion for knowledge-that in relation to knowledge-how that is able to account for the peculiarities of both knowledge types outlined in the last section. In order to show that conceptuality can do the job, we have, in a first step, to establish a notion of *concept* that does not *presuppose* in an obvious way characteristics of knowledge-that, i.e., the notion we look for should not entail that concepts are essentially linguistic entities enabling persons to verbally express knowledge-that. What we then need, in a second step, is a notion that entails some fundamental and (hopefully) non-contentious assumptions about necessary conditions for concept possession in terms of abilities. Characterizing concepts in the form of abilities necessary for concept possession should enable us to show that having those abilities necessary for concept possession is exactly what is needed for the subject to overcome the peculiar limitations accompanying knowledge-how, and thus to gain access to the level of knowledge-that (see section 5).

In shaping the sought-for notion of conceptuality we take recourse to work by Allen & Hauser (1991), Pylyshyn (1990), and Newen & Bartels (2007). Allen and Hauser have claimed that, from the perspective of interpreting the behavior of systems including human and animal organisms as much as artificial systems, the ascription of genuine concepts requires "evidence supporting the presence of a mental representation that is independent of solely perceptual information" (Allen & Hauser 1991, p. 231). The criterion of independence, as called for by these authors, is that it enables the system to show flexible behavior, in contrast to the performance of rigid mechanisms:[9]

> [I]ndependence in this sense entails that the responses of the animal to a certain stimulus are not just 'driven by' that stimulus, and are also not to be explained as cases of stimulus generalization, i.e., discrimination by a mechanism responsive to a single basic stimulus. (Newen & Bartels 2007, p. 287)

If the reactions of a system to a given stimulus can be modified by the presence of additional stimuli representing the peculiarities of the situation in which the reaction occurs, the system will be first able to *generalize*—as rudimentary as that ability may be—the information received. It is then that we can legitimately ascribe the possession of concepts: "First, an organism whose internal representations are concept-like should be able to generalize information obtained from a variety of perceptual inputs and use that information in a range of behavioral situations" (Newen & Bartels 2007, p. 287).

We thus arrive at a *criterion for conceptuality*, which can be called, following Allen (1999), the "transcendence of particular stimuli" or, in terms given by Pylyshyn (1990), the "criterion of informational plasticity". Essentially the criterion requires the "possibility of the modification of a response in the light of additional information" (Allen 1999); the kind of response has to depend, crucially, on other sources of information (cf. Newen & Bartels 2007, p. 287).

The criterion considered above is still not sharp enough. As long as we do not further specify the "modification of a response" occurring "in the light of additional information", each sort of extension of the processing capacities of an individual would count as reaching the level of "conceptuality" if only this extension enables the individual to integrate some additional

9 One example of a "rigid mechanism" is the behavior of ants responding to the presence of acidic byproducts from the decomposition of dead con-specifics: in tests they rigidly remove anything from the nest that is painted with oleic acid, even live con-specifics.

source of information into its behavioral repertoire. Thus *diversification* of processing capacities could then not be distinguished from *transition* from non-conceptual to conceptual processing capacities.

To get a criterion for conceptuality it is required that the "modification of a response" mentioned above concerns *classificatory* behavior. The "additional stimulus", in that case, not only has to work as a switching point, opening one or the other pathway for a response *within* a non-conceptual behavioral pattern, it also has to stand for a *category*, according to which the actual behavioral pattern can be classified.

One example of additional stimuli characteristics standing for a category has been described by Newen & Bartels (2007) with respect to the conceptual abilities of the grey parrot Alex (Pepperberg 1999). In order to be able to form elementary color concepts, for example the concept "green", Alex should not only be able to generalize over a class of similar stimuli and thus to identify a sample of different green objects, but should additionally be able to represent green *as a color*. Only then could we ascribe to him the ability to classify green objects according to a well-determined class concept.

The test items by which Pepperberg examined the classification abilities of the animal were, for instance, "What color?" or "What shape?". These questions should

> [...] determine if he [Alex] could respond not only to specific properties or patterns of stimuli [e.g., to green objects], but also to classes or categories to which these specific properties or patterns belong [...]. Could he, for example, go beyond recognizing what is, or is not, 'green' to recognizing the nature of the *relationship* between a green pen and a blade of grass? (cf. Pepperberg 1999, p. 52)

It happened that Alex was indeed able to classify the given "key" stimulus, e.g., a green, round object, visually presented to him, as "green" or "round" according to different dimensions (e.g., color or shape) represented by additional auditory stimuli. His choice of response ("green" or "round") turned out to depend crucially on the "additional information" given in form of the auditory stimulus. As such, Newen and Bartels concluded that "Alex was able to represent different properties while having only one and the same visual input of an object."[10]

With this example in view, Newen & Bartels (2007) formulated the following requirements for the possession of concepts—for instance, the concept "red": A cognitive system has the concept "red" only if (i) it has relative stimulus independence such that it depends on some additional mechanism—which detects and weighs stimuli other than the key stimulus of redness—to determine that the system focuses on redness while perceiving a red square, in contrast to some other property; and (ii) the property of being red is represented as an instance of the dimension "color".[11]

Note that the above-mentioned definition of conceptuality does not only require the existence of some "additional stimulus" to which the individual has to be responsive, but that there has to be some additional internal *mechanism* of processing by which the individual is able to "detect and weigh" a specific additional stimulus as standing for a *category* (e.g., "color"). The responsiveness of the individual to that stimulus shows up when it focuses its attention on those aspects of a scene, or to those items of a behavioral pattern, which exemplify the respective category.

Another example would be the balancing of coffee cups by a waiter in a restaurant. Let us assume that the waiter for some time possesses the ability to balance cups of different shapes without spilling coffee, and without consciously attending to a particular cup, or the

10 Cf. Newen & Bartels (2007), p. 293. That the auditory stimuli "What color?" or "What shape?" were really understood by Alex as asking for the respective category was tested by Pepperberg using additional auditory signals of the form "What's same?" and "What's different?" The correct response would be the label of the appropriate category, e.g., the mastery of categories could be verified in the sense that Alex successfully identified the essential functional role of category terms like "color" or "shape" as dividing the objects of the world into "sameness" equivalence classes.

11 Cf. Newen & Bartels (2007), p. 296. These conditions are only two of a total of four conditions. But only these two matter with respect to our discussion.

shape of a particular cup that he is currently dealing with. At some point he is told that there are essentially two different kinds of cups, one high and cylindrical, and the other flat and bowl-shaped (this information is the "additional stimulus"). The waiter "detects and weighs" the additional stimulus by focusing his attention, from that time on, to his own specific handling of cups, depending on the sort of cup a particular exemplar belongs to. He might then detect that he had previously managed to deal with both kinds of cups efficiently and without spilling coffee without even noticing that liquids in both reacted in different ways to his movements. The waiter's behavior has switched from a former "non-conceptual" dealing with coffee cups to a form of behavior that is "conceptual" in the sense of exhibiting an additional ability, namely the ability to classify his own performance in balancing coffee cups according to a category (in this case the cups' shape).

How does such a notion of conceptuality relate to Evans' notion of non-conceptual knowledge in terms of first-person dispositions that we made use of in sections 2 and 4? If the possession of concepts is constituted (in contrast to non-conceptual cognitive processing) by the gaining of additional abilities, it should be made plausible how those additional abilities connect to a non-conceptual basis in Evans' theory.

In our treatment of his theory, we followed an interpretation of Evans' work as implying that non-conceptual knowledge relies on the disposition to have one's own motor reactions be determined by sensory and kinesthetic information that is mediated by either some external object or by one's own body. Again, the waiter dealing with the coffee cups may help to illustrate the point. The waiter's experienced handling relies on a disposition to have his motor actions determined by the multimodal sensory information that is mediated by holding coffee cups in his hands. The waiter's knowledge-how to balance the cup might be completely independent of any conceptual reference to coffee cups. He could be the experienced waiter that he is—at least with respect to his balancing ability—without even knowing in a conceptual way "what a coffee cup is". Reference to the objects he is dealing with was accomplished only by being able to react in a coordinated way to sensorimotor information originating from handling these objects.

At the time he is told that coffee cups come in two different shapes, his cognitive system enables him to use that information such that he begins to rely on a category (i.e., a cup's shape) in order to refer to coffee cups, and to classify his own balancing behavior according to the objects thus categorized. He reaches, in some minimal way, the level of conceptual knowledge, since he now begins to identify both, that is, the objects and his behavior with respect to these objects, by conceptual means.

7 Explaining the peculiarities of knowledge-how by means of conceptuality

Equipped with an adequate notion of conceptuality, we now proceed to show that concept-possession is exactly what is needed for a cognitive system to overcome the specific limitations associated with knowledge-how, and hence be able to gain access to the level of knowledge-that. Why exactly is it necessary for a system to possess concept-like representations in order to have knowledge-that as opposed to knowledge-how?

1. *Context-bound versus context-free knowledge.* For this polar contrast the answer, in short, will be that conceptual representations are precisely those representations which make the subject able to generalize information over a range of different behavioral situations. Conceptual representations are, as we have seen above, representations whose functional role is to classify aspects of a scene, or items of a behavioral pattern, according to a certain category. This is the reason why only conceptual knowledge (whether verbally expressible or not) can enable overcoming the limits of situationally-bound use. Intuitively sampling objects, for example, on the basis of some salient similarity criterion, is a manifestation of knowledge-how, because it depends on situational features—for instance

that the situation represents some sort of average type to which the corresponding behavior is adapted. To overcome such situational limitations, categorical distinctions have to be introduced that enable the subject to transfer his or her knowledge partly to new situations that deviate, for instance, with respect to the objects that have been treated in standard situations. For example, a waiter who starts to work in a new restaurant using only coffee cups of one type, that is slightly higher than the large type used in the former restaurant, might fail in balancing the cup as long as he only takes recourse to his knowledge-how; but he might be more successful if he relied on a conceptual understanding of a distinguished large-cup-technique. In the same way, anticipation of the flight of a javelin is a situation-bound ability, since it depends on relatively rigid processing of visual information and proprioceptive mechanisms that are well-adapted to a range of standard cases, but fail for cases outside that range. If the case is exceptional (e.g., strong wind from behind), the subject can only attain success by analyzing the influence that this particular external condition will have on the standard performance. The same applies for knowledge-how expert chess knowledge, which fails in cases of random constellations because the experts' expertise in evaluating the scene is dependent on average situational features. The occurrence of "new" constellations requires extracting general properties from the scene, and thus has to be done by means of conceptual representations.

2. *Impenetrability versus penetrability of knowledge* is a contrast almost built into the notion of conceptuality that we propose. Non-conceptual representations are non-receptive for additional stimuli that could yield classificatory behavior. They have to be non-receptive ("impenetrable") in order to avoid interferences that could disrupt the more or less rigid mechanisms by which some well-defined type of behavior is regularly produced. Impenetrable knowledge-how, for example, is manifested by navigating ants calculating their way home according to some rigid computational processes that are deployed on the basis of a small number of parameters. If the experimenter interferes with the process by repositioning the ant, the mechanism still works as it would have done without relocation, with the result that the ant misses the nest by exactly the distance and direction to which it has been repositioned by the experimenter (see Bartels & May 2009). In contrast, conceptually-based processing has to be penetrable in order to guarantee that categorical information can be extracted from the scene according to specific stimuli (in this case the repositioning stimuli) and used in evaluating the result produced by rigid processing up to the time of repositioning.

3. *Implicit versus explicit knowledge.* This distinction refers to whether or not the knowing organism has knowledge of the *rules* governing its knowledge application. For example, people learn the grammar of their natural language or internalize their society's norms implicitly, that is without knowledge of the principles that guide their language use or their social behavior. In such cases people represent rules only *indirectly,* by means of dispositions to have their reactions determined by the linguistic or social information in a way that can be recognized by their fellow subjects as to be in accordance with the rules. In contrast, explicit knowledge requires *direct* representation of rules, objects, or properties. The waiter in the restaurant, for example, after having achieved knowledge-that about his balancing of coffee cups, is able to refer directly to two sorts of cup shape, the high and cylindrical or the flat and bowl-shaped, respectively. In other words, he must be able to represent properties; if so, the waiter would, for instance, be able to draw inferences from the contents of his knowledge. Now, a person's ability to produce attribute-representations of objects presupposes the ability to apply *categories* to his or her own experience. For example, the waiter is able to represent coffee cups as high

and cylindrical objects because his capacities include the ability to apply the category of shape to the objects he is balancing. Thus, a person's possession of *conceptual capacities* is a condition that has to be fulfilled for his or her knowledge to be explicit. Moreover, given that the additional conditions for *conscious* processing of cognitive representations are fulfilled, the subject would then be able to consciously think about and to draw conscious inferences about the objects. In addition, *verbalizability* of knowledge depends on the presence of this conscious form of explicit knowledge.

4. *Automatic versus effortful processing.* As we have argued in (B), conceptuality entails openness to penetration. Now, if cognitive processing is receptive to penetration, additional costs in terms of attention and additional processing necessarily occur. If the ant's navigation mechanisms were receptive to a certain type of repositioning, it would have to use additional computational pathways for processing "repositioning information" and would be in need of additional calculation to determine the influence of the particular repositioning on the result produced by rigid calculation of the expected path back home.

5. *Continuous versus discontinuous processing.* Knowledge-that is characteristically used in a step-by-step manner with intermediate knowledge states (discontinuous), whereas knowledge-how appears to be grounded in smooth and fluent processing without intermediate states (continuous). The difference can be accounted for by the fact that knowledge-that is grounded in concept-based processing allowing for and instantiating discrete inferential steps, whereas knowledge-how is based on concept-free processing without clearly-defined intermediate knowledge states. An observable consequence of the continuous nature of knowledge-how is that lapses in knowledge use result in graded errors, or continuous distributions of errors (e.g., gradual precision losses of sensorimotor movements), while lapses in use of knowledge-that express themselves in categorical errors, or discontinuous error distributions (e.g., switches of categories or total failures to come up with a result).

It is beyond the scope of the present article to give an outline of a research agenda for empirically confirming and underpinning the present account of knowledge-how compared to knowledge-that. Different examples of potential research areas and experimental paradigms have been pointed out in the preceding sections (e.g., numerosity judgments, spatial memory, intuitive knowledge use). The most convincing way to support the adequacy of the conceptuality criterion for distinguishing between knowledge-how and knowledge-that will be to run new experiments in these or other research areas that reveal behavioral and/or neural dissociations that comply with the distinction between concept-driven vs. concept-free knowledge-use along the lines of the different peculiarities of practical knowledge outlined above.

8 Conclusion

We have shown that *propositionality* is, in none of its three main senses, an adequate and useful demarcation criterion between knowledge-how and knowledge-that.

First, in its *semantic* sense (e.g., Stanley 2011a), propositionality applies to both knowledge-how and knowledge-that, and thus *a fortiori* cannot be successfully used as a demarcation criterion.

Second, in its *"language of mind"*-sense, propositionality applies to knowledge representation. As we have shown, the way in which a particular piece of knowledge is represented is independent from the type of knowledge exemplified by this piece of knowledge. Thus, again, this sense of propositionality is not useful as a demarcation criterion.

Third, propositionality in the sense of *linguistic, consciously available propositions* is without doubt a central phenomenological trait of knowledge-that as opposed to knowledge-

how. On the one hand, this sort of propositionality offers a rather trivial demarcation criterion. On the other hand, as a mere replication of a well-known phenomenological distinction, it can in no way be used to *explain* the different peculiarities characteristic of knowledge-how versus knowledge-that. *Anti-intellectualists* have tried to fill the void corresponding to non-propositionality, according to this third sense of propositionality, by declaring specific knowledge formats such as *sensorimotor or image-like* knowledge (Newen & Jung 2011). In our view, it is doubtful whether, with such an eclectic way of characterizing knowledge-how, a satisfactory and complete classification of knowledge-how could be achieved. We have, for example, argued that "intuitive" knowledge would be a further legitimate candidate for the list, and that it is, in all probability, not the only further candidate. Identifying different forms of knowledge-how without any well-grounded theoretical basis for the different forms will probably be of limited use for empirical research in cognitive science, neuroscience, and psychology.

In sum, "propositionality" can in none of its different senses provide a useful demarcation criterion for an empirically-fruitful theory of knowledge-how. Therefore, we go with the *intellectualists*, at least with respect to rejecting the propositionality criterion, but we depart where intellectualists fail to provide positive accounts of the obvious phenomenological and empirical peculiarities making knowledge-how distinct from knowledge-that. In contrast to the intellectualist position, we have provided a minimal notion of *conceptuality* as an alternative demarcation criterion. We suggest that conceptuality gives a sound basis for a fruitful theory of knowledge-how, and we have tried to provide support to this suggestion by showing that by means of an adequate notion of conceptuality, five central peculiarities of knowledge-how as compared to knowledge-that can be accounted for. Future research will have to show whether the framework for practical knowledge described here fulfills the empirical promise we think it has.

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