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Sensorimotor Norms and Social Norms: A Pluralistic Proposal

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Abstract
The performance of complex motor and craft skills is a norm-governed process, reliant on an agent's sensitivity to standards of correct and incorrect performance. Whilst norm-governed practical skills tend to be understood in terms of social norms, this paper proposes an alternative, pluralistic perspective, which recognises socially underdetermined normative dimensions in practical skills. Specifically, drawing on the enactive approach, we argue that sensorimotor norms, understood as situated patterns of sensorimotor organisation, constitute skill-guiding normative standards which are not fully captured by social rules and expectations. We demonstrate the value of this pluralistic perspective for the explanation of skill-related norms by showing how it delivers a better interpretation of a recent proposal about the skill-based evolution of social norms, namely Jonathan Birch's 'skill hypothesis'. Building on this discussion, we then elaborate on the explanatory benefits of our proposal for making sense of cases of norm change and innovation in the context of practical skills and highlight its potential to address challenges connected to the origins and development of social norms. We conclude that a pluralistic perspective which takes account of both sensorimotor and social norms is better suited to explain essential features of norm-governed motor and craft skills than a view which limits itself to the consideration of social norms.

1 Introduction

The performance of complex motor and craft skills like mountain-biking or the making and use of tools is a norm-governed process, reliant on an agent's sensitivity to standards of correct and incorrect performance. Norm-governed behaviours tend to

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be understood exclusively on the basis of social or cultural norms, i.e., standards of correctness deriving from shared practices of a community, ranging from social conventions to standardised techniques and craft skills (see e.g. Sripada and Stich 2007; Birch 2021b; Tomasello 2021a; Schmidt and Rakoczy 2023; Sterelny 2012; Peregrin 2021). From this perspective, here referred to as 'the standard view', the standards of correctness which are relevant to explaining the normative dimension of practical skills are essentially interactive and community-based phenomena, dependent on cognitive and behavioural capacities which only arise in social contexts.

Norm-governed behaviours and skills have, however, also been understood more widely as the operations of any organism capable of adaptively regulating itself in relation to a relevant standard of evaluation (see, e.g., Di Paolo et al. 2017; Di Paolo et al. 2018; García and Barandiaran 2025). From this perspective, here referred to as 'the pluralist view', practical skills often rely on sensitivities to multiple types of normative standards of performance, which include but are not limited to social norms. Following Di Paolo et al. (2017), here we examine the relevance of 'sensorimotor norms', i.e. norms which are implicit in the sensorimotor organisation of behaviour. Sensorimotor norms, we argue, capture normative dimensions of motor and craft skills which are underdetermined and thus not fully explained by social norms. Particularly in cases of motor and craft skill, we argue that recognising sensorimotor normative dimensions permits better explanations of the norms implicit in such skills than the standard view can offer.

As a basis for our argument, we first introduce a broad conception of a norm understood as a standard of assessment of behaviour. Following Haugeland (1998) we highlight that norms in this general sense demand two different kinds of explanations, one targeting the mechanisms underlying individuals' compliance with a norm, and one targeting the source of the norm's authority or force. With this in mind, we outline a broad conception of social norms, building on Westra and Andrews' (2022) notion of normative regularities, to characterise the standard view of norm-guided skills. We then argue that the standard view, in focusing only on social norms, underdetermines important normative dimensions of practical skills which are relevant especially for explaining innovative and idiosyncratic cases of skill performance. These dimensions, we suggest, can be captured by a conception of sensorimotor norms and techniques, which we develop by expanding on the embodied-embedded account of skills by Di Paolo et al. (2017).

In the remainder of the paper, we clarify the explanatory benefits of a pluralistic perspective which emphasises the differences and relationship between both sensorimotor- and social norms in the context of motor and craft skills. We do so, first, by arguing that our proposal offers a better interpretation of a recent hypothesis concerning the skill-based evolution of social norms and their cognitive basis, i.e. the 'skill hypothesis' by Jonathan Birch (2021a, b). Second, building on this discussion, we reply to objections to our proposal and further clarify its explanatory potential, especially in helping to explain cases of skill innovation, norm change and development in contexts which the standard view is predominantly interested in, i.e. practical skills embedded in social goals, conventions and rules. In summary, we conclude that a pluralistic perspective is not only important to capture socially underdetermined types of norms in practical skills. It also offers a rich framework for understanding how social

norms implicit in motor and craft skills relate to sources of normativity and sensitivities to standards of assessment of behaviour which the standard view neglects.

2 Normative Authority and Normative Compliance

Norms, in the most general sense, are standards of assessment which ground evaluative judgements of particular behaviours as, e.g., 'appropriate' or 'inappropriate' or 'correct' or 'incorrect' (Glock, 2022). In Haugeland's (1998, p. 305 ff.) words, norms are types of rules – he calls them 'governing rules' - which make intelligible a kind of (in)correctness *in what happens* (rather than in our description of it), such that if what happens does not unfold according to the rule, this reflects badly on what's going on, not on the rule itself. This possibility of an 'error in performance' (Anscombe 2000, p. 57) is a core aspect of what makes a rule or standard 'normative' in a broad sense. It is what makes room for a conception of what *ought* to happen as opposed to what, in fact, occurs.

Norms in this broad sense raise two kinds of questions, which Haugeland phrases as follows:

> First, where does the 'normative force' of governing rules [norms] come from? What is their 'authority' or their claim on compliance? And second, how does it come about that the phenomena do in fact accord with governing rules [norms] (to the extent that they do)? How is the 'force' brought to bear or made effective? (1998, p. 306)

Consider the norm of stopping at red lights. Part of explaining this norm is to specify how people come to *comply* with it, i.e. what brings about observable norm-following behaviour. To this end, one might specify the cognitive, behavioural, or social capacities by means of which individuals learn to stop at red lights, and detail how these capacities evolved and how stopping behaviour is instituted and maintained over time in a community. Such explanations correspond to what Witt calls 'causal explanations'. They 'address what we, in fact, do or will do, but they do not explain why we *ought* to do what we in fact do or will do' (Witt 2023, p. 2, original emphasis).

As Witt indicates, causal explanations leave a key aspect of norms unaddressed. This aspect is targeted by Haugeland's notion of normative 'force' or 'authority', and underlies a question by Elizabeth Anderson which sets off Witt's inquiry, namely 'how do shared standards of conduct ever acquire their normativity to begin with?' (Anderson 2000, p. 191). As Witt (2023; Ch. 1) highlights, Anderson's is a puzzle about the *source* of social normativity, namely how to explain what makes certain behaviours into socio-normative standards in the first place. Following Haugeland, however, this question does not only arise for social norms, but for *any* norm with some authority, i.e. which makes intelligible the notion of an error in performance. In each case, we can ask: where does the 'force' or 'authority' of the relevant norm come from? What is its basis or source? We will label accounts targeting this question as explanations of *normative authority*.

Causal explanations – what we will call explanations of *normative compliance* – typically do not address the question of normative authority. Psychological research on children's acquisition of social norms, for example, isolates cognitive processes without explaining where the authority of the acquired norms comes from (see e.g. Schmidt and Rakoczy 2023). Moreover, norms with *different* sources of authority may rely on the *same* mechanisms of compliance. To take Haugeland's (1998, p. 306) example, a cooking recipe draws its authority from its author, whereas traffic regulations have normative force thanks to public institutions issuing the relevant laws. Nevertheless, people's compliance with both types of rules relies on some form of explicit notation, e.g. street signs or written instructions, which explains (in part) how norm-following behaviour comes about.

Although more could be said about the distinction between normative authority and normative compliance, the important point for our purposes is that these notions call for different *types* of explanations, both of which are important for explaining norms of any kind. This insight will help us clarify how sensorimotor norms and social norms differ and how they are related.

3 Social Norms and the Standard View of Norm-Guided Skills

Prominent accounts of social norms specify a set of structural and psychological properties to isolate a category of norm-guided behaviours in socially interacting communities (see e.g. Sripada and Stich 2007; Birch 2021b; Tomasello 2021a; Schmidt and Rakoczy 2023). As Westra and Andrews (2022) argue, such accounts aim to identify a unified (and perhaps uniquely human) motivational and cognitive capacity underlying the cross-cultural diversity of normative behaviours. This capacity, if identified correctly, could provide a *marker* for distinguishing norm-governed behaviours from mere regularities. However, as Westra and Andrews point out, there is no agreement on which cognitive capacities are essential to understand and follow social norms. Consequently, different theorists regard different behaviours as socially normative (or not), depending on whether they are driven by the psychological processes favoured by their account (ibid.).

On Westra and Andrews' view, this lack of clear explananda of the cognitive science of social norms, owing to disagreement about what counts as normative behaviour at all, is symptomatic of the 'inside-out'(2022, p. 8) explanatory order of capacity-driven approaches, i.e. of isolating psychological capacities *in order to* isolate normative behaviours. Instead, they propose an 'outside-in' (ibid., p. 9) approach, specifying first the kinds of behaviours characterising social norms before considering their cognitive basis. To this end, they introduce the notion of a *normative regularity* defined as 'a socially maintained pattern of behavioural conformity within a community' (ibid.).

Normative regularities capture two widely accepted features of social norms. First, they define social norms as emergent patterns of *behavioural conformity* within a *community*, i.e. as prevalent ways in which individuals behave in a group. Consequently, one cannot describe an individual's behaviour as governed by a *social* norm without pointing to behavioural patterns that are regularly enacted within their com-

munity. Put differently, normative regularities are essentially *group-level phenomena*, which place the normative behaviour of individuals within the larger social context of their community. Moreover, as the emphasis on group-conformity suggests, the authority of normative regularities derives primarily from the community, not the individual. In Haugeland's terms, the normative authority of social norms derives from what a community does on the whole, it is 'essentially majority rule' (1998, p. 311). As we understand Westra and Andrews (2022), this does not exclude the possibility that *part* of the normative authority may derive from non-social, community-independent sources. But it means that, unless community-level behavioural patterns are at least a central part of the explanation, we are not dealing with a *social* norm or normative regularity.

Second, normative regularities characterise social norms as behavioural patterns which are *socially maintained*. As Haugeland puts it, 'compliance with social norms is induced in individual community members via the monitoring and interference of others' (1998, p. 312). Westra and Andrews' emphasis on social maintenance registers that social norms are acquired and reinforced in social interactions exerting peer pressure on individuals through positive and negative incentives (e.g. punishment or reward) (Sripada and Stich 2007; Schmidt and Rakoczy 2023). We understand this emphasis as placing a condition on *how compliance with a behavioural pattern must come about* for it to count as a *social* norm. That is, whereas previous accounts prioritise certain psychological mechanisms as essential to explaining social norm compliance, Westra and Andrews highlight the primacy of *social interactions*. That is, we are not talking about a *social* norm, on their view, unless social interactions form a central part of explaining how compliance with a normative regularity comes about.

To be sure, this does not exclude the possibility that 'non-social' mechanisms may contribute to explanations of social norm compliance. Indeed, according to Westra and Andrews' 'normative pluralism' (2022, p. 11), 'normative regularities are the products of a variety of different underlying cognitive, affective, and ecological processes of varying degrees of complexity' (ibid.). In our terms, their type of pluralism emphasises the *variety of mechanisms* which may underlie a community's *compliance* with a social norm. In contrast, our type of pluralism defended here – although compatible with their position – primarily concerns the *variety of types of norms or standards of assessment of behaviour* insofar as their sources of normative *authority* or force are concerned (this will become clearer below).

In summary, social norms understood as normative regularities are patterns of behavioural conformity whose normative *authority* derives, at least partly, from a *community* and whose normative *compliance* is maintained, at least partly, by *social interactions* between community members. This conception captures widely accepted features of social norms whilst skirting disagreements about their cognitive basis. Hence, in what follows, we will adopt it as a working definition of social norms.

With this in mind, we can describe 'the standard view' of norm-guided skills as the claim that the *only* kinds of standards of assessment which are needed to explain what makes motor and craft skills *normative* behaviours in a relevant sense are *social* norms. This view is at least implicit in influential work in psychology (Sripada and Stich 2007; Schmidt and Rakoczy 2023), anthropology (Birch 2021a; Tomasello 2021a) and philosophy (Rietveld 2008; Wittgenstein 1953). Below, we will question

this claim, not Westra and Andrews' (or any other) conception of social norms as such. Indeed, in arguing that the standard view neglects non-social (sensorimotor) norms, we do not mean to deny the evident relevance of social norms for explaining many instances of norm-guided skill. On the contrary, we hope to show that considering sensorimotor norms offers richer explanations of how different standards of assessment implicit in motor and craft skills shape and constrain each other, some (though not all) of which are socially constituted. However, to do so we must first explain what, we think, sensorimotor norms are, and how they differ from social norms.

4 Sensorimotor Norms

4.1 The Normativity of Practical Skill

In 1968, Dick Fosbury won the Olympics by using a new backwards-leaning high jumping technique, later dubbed the 'Fosbury Flop',[1] which marked a spectacular departure from the previously common straddle technique (Dapena 2002). Despite this departure, it was immediately obvious that Fosbury was doing something *right* or *correct* as far as high jumping goes. What kind of 'correct' are we talking about here?

The evaluation of Fosbury's technique as 'correct', 'right' or 'appropriate' indicates a normative dimension in his behaviour, i.e. a standard of assessment which applies to his actions within the context of high jumping. What makes Fosbury's case interesting is that his behaviour *instituted* a *new* norm or standard, allowing us to speak of errors of performance in the jumping of any post-Fosbury athlete who can use the Fosbury Flop but doesn't. In each case, 'You *should* have used the Flop!' is a valid reaction. Indeed, for any high jumper capable of executing the Fosbury Flop, using this technique is, arguably, what *ought* to be done.

As with social norms, a puzzle arises here about the source of normative authority of the Fosbury Flop. Again, the issue is not to explain how individuals learn and comply with this technique, as e.g. in Dreyfus' (2002) descriptions of skill acquisition. It is to understand what distinguishes it as a good, right, appropriate, or skilful behaviour in the context of high jumping, capable of instituting a normative standard of performance. Where does the normative authority of this type of practical skill come from? On what basis does it count as the appropriate or correct thing to do?

To our knowledge, this question has rarely been addressed explicitly. A notable exception is the notion of *situated normativity* by Rietveld (2008), elaborated in the *Skilled Intentionality Framework* (Rietveld et al. 2018; Rietveld and Kiverstein 2014). Following Wittgenstein (1953), Rietveld (2008) focuses on performance standards within *sociocultural* practices like tailoring or architectural design, where norms are socially established by a community.

However, in Fosbury's case, the normativity of technique cannot derive *exclusively* from shared social standards. Of course, the sport of high jumping is defined by sociocultural traditions and conventions expressed in explicit rules, specifying which

[1] This example is due to Hubert Dreyfus.

jumps count as *valid* (the bar must be cleared without falling off) and whose performance wins (the highest bar clearance) (cf. the competition rules by World Athletics, 2024). Furthermore, one may speak of standard techniques and training regimes which, though not demanded by the rules themselves, are used by the majority of athletes, as was the straddle before 1968 (Dapena 2002). These rules and conventions show that high jumping as a norm-governed practice *depends* on socio-normative standards.

Nevertheless, social norms do not *fully* explain the sense in which Fosbury was behaving correctly at the 1968 Olympics. For among these two sources of social normativity (implicit conventions and explicit rules), the first contradicts and the second underdetermines the relevant sense of correctness. From the perspective of previously conventional techniques, e.g. the straddle, Fosbury's behaviour qualified, if anything, as the *wrong* way to jump. Thus, such conventions run counter to our evaluative judgement of the Flop as being the correct way to jump. From the perspective of the rules, his technique counts as correct in virtue of enabling the highest jumps. However – whilst this is true and reillustrates the dependence of our evaluative judgement on social rules – it leaves an important question unanswered, namely *what it is about Fosbury's technique as opposed to other ways of jumping* that makes it the most adequate technique for competitions? The answer cannot simply be 'that it enables the highest jumps'. For this is uninformative in explaining the difference between Fosbury's and other techniques. Explaining this difference, however, matters for fully making sense of the normative authority of the Fosbury-Flop. Specifically, it matters for answering the question how Fosbury was able to innovate and thus change the social practice of high jumping by *instituting* a new normative standard by means of a more efficient technique. To be sure, social norms may be *necessary* to address this question, but they seem *insufficient* to answer it fully (see Sect. 6.2 for discussion). Hence, it seems there must be other relevant, non-social factors informing the normative authority of the Fosbury-Flop, which a focus on social norms overlooks.

4.2 Sensorimotor Organisation, Techniques and Normativity

A good starting observation for our proposal is the following: behaviourally speaking, the Fosbury Flop has a different *structure* from other techniques regarding how movements unfold in time and space, e.g. the curved run-up and backwards clearance. Thus, the Flop's normative authority – its being the right way to jump – seemingly has to do with the organisation of Fosbury's behaviour. To unpack this suggestion, however, we must specify what 'the organisation of Fosbury's behaviour' means.

Our aim is not to conduct a biomechanical analysis of Fosbury's technique (see e.g. Tan 1997; Dapena 2002), but to show how considerations about sensorimotor structure illuminate the normativity of practical skills. To this end, we draw on Di Paolo et al. (2017) analysis of behavioural skill in terms of *sensorimotor coordinations*, *sensorimotor schemes (habits)*, and *sensorimotor networks*, which underlie their notion of *sensorimotor normativity*.

Sensorimotor coordinations are regularities between motor and sensory processes which allow an agent to navigate the world by exploiting the interdependence of action and perception (O'Regan and Noë 2001; Noë 2006). To take Myin's (2003)

example, in squeezing a sponge to feel its softness you exploit the interdependence between the ease of contraction and pinching movement, which informs your perception of rigidity (Di Paolo et al. 2017, pp. 58 ff.). At a coarser level of description, a series of sensorimotor coordinations forms a *sensorimotor scheme*, i.e. a structured coordination pattern affording more complex sensorimotor tasks like grasping objects. Finally, complex, temporally extended *activities* like high jumping or taking a shower correspond to *sensorimotor networks*, i.e. collections of sensorimotor schemes (e.g. leg-lifting, pushing, grasping etc.) arranged such as to enable an agent to complete complex behavioural goals (e.g. jumping as high as possible) (ibid., p. 146 ff.).

Against this background, we can define *techniques* as specific patterns or *organisations* of sensorimotor schemes within a network, which are arranged in specific spatiotemporal relationships, thus characterising *a particular way* of performing an activity in a specific situation. The Fosbury Flop, for example, is typically broken into three phases (approach, take-off, and flight), each of which consists of a complex web of sensorimotor schemes which must be executed at *this* moment, with *this* distance and bodily orientation to the bar, and *this* coordination sequence (e.g. serial, parallel, overlapping) with other schemes (Tan 1997, p. 10 ff.). In short, techniques are context-sensitive strategies for performing a goal-oriented activity, characterised by 'behavioural signatures' or spatiotemporal profiles of sensorimotor organisation.

This conception of technique already puts some flesh on the idea that the structure of behaviour is a source of normative authority. It helps to articulate the intuition (apparent in Fosbury's case) that particular ways of doing things are *appropriate* or *to be done* in the context of certain goal-oriented activities. Thus, techniques understood in terms of sensorimotor organisation are linked to *instrumental* normativity (Korsgaard 2008; Schmidt and Rakoczy 2023; and Sect. 6.4 below). They are, so to speak, behavioural 'instruments' or spatiotemporal means-ends arrangements in sensorimotor space, for reaching the goal of one's activity. However, to fully characterise the norms involved in this sensorimotor conception of technique, we must consider their embodied and embedded structure.

As Di Paolo et al. (2017) and others have stressed, practical skills depend on bodily properties such as strength, size, or flexibility as well as environmental scaffolds, as in Kiverstein's (2018) example of distinctly shaped glasses used by bartenders for complicated orders (cf. Haugeland 1998; Ch. 9). This embodied-embedded structure of practical skill informs the normativity of technique in that *skilful* agents must integrate their techniques with specific aspects of *their* body and environment to achieve performance goals in a way that works *for them* (cf. Section 5.3). Skilful employments of technique are thus strongly situated achievements, taking different forms in different agents and environments. For instance, a specific technique may be appropriate for one agent but not for another, due to differences in their embodiment. As Dapena (2002) notes, the Fosbury Flop might not be the best technique for *all* jumpers, depending on their strength of free-limb movements at take-off. Thus, mastering a technique does not necessarily amount to behaving in the most skilful way, e.g. if the technique's sensorimotor profile does not match an agent's current

situation or bodily constitution. However, the situated (embodied-embedded) nature of *skilful* executions of techniques does not compromise their status as bearers of normative authority. Rather, it means that situation-specific bodily and environmental constraints on sensorimotor organisation matter for explaining how techniques have normative force in determining which behaviour is appropriate in a specific situation. In principle, once situation-specific constraints are properly described, we can expect a clear answer as to which technique is most appropriate for a given task.

In summary, we can characterise *sensorimotor norms* as standards of assessment of behaviour which apply in the context of goal-directed activities performed in specific situations, which include aspects of an agent's body and environment. Techniques, understood as spatiotemporal organisations of networked sensorimotor schemes, are specific ways of performing an activity which may (or may not) be appropriate for an agent given their situation and performance goals. As such, they are sources of normativity, capable of explaining why particular ways of behaving are *to be done* in specific situations. We can roughly describe a *skilful* agent as someone able to select and perform the most suitable technique(s) in specific situations, being sensitive to the sensorimotor norms in place in each situation and capable of regulating their behaviour accordingly.

Although more could be said about sensorimotor norms, our discussion should make intelligible their normative authority as regulating standards of behaviour constituted by situated patterns of sensorimotor organisation.[2] Importantly, to explain the normative authority of sensorimotor norms, it is not sufficient (nor always necessary) to appeal to community-level, socially maintained patterns of behavioural conformity (i.e. social norms). Sensorimotor normativity derives from fundamentally embodied and sensorimotor organizational constraints on individual behaviour, which exert their action-guiding force independently of how other individuals or a group of agents behave. Therefore, since socially constituted standards are not necessarily part of an explanation of sensorimotor norms, the latter are not social norms as defined earlier (we elaborate on this point in Sect. 6.2).

5 Examining the Skill Hypothesis

Proponents of the standard view might remain sceptical towards our proposal. Are sensorimotor norms really *norms* in a relevant sense? Are they not dependent on social norms? What do they contribute to explaining norm-guided skills, especially in socio-cultural contexts characteristic of human communities? In what follows, we hope to address these questions through the lens of Jonathan Birch's (2021a; 2021b) 'skill hypothesis' (SH), which provides an interesting background for our discussion by relating the normativity of skill explicitly to the cognition and evolution of social norms.

[2] See Di Paolo et al. (2017) and Mojica and Gastelum Vargas (2021) for discussion.

5.1 Summary of the Skill Hypothesis

The SH combines two claims to shed light on the evolution of normative cognition or 'the micro-regulation of one's own behaviour and the behaviour of others to maintain conformity with norms', as (Birch 2021b, p. 2) puts it.

(1) 'In modern humans, complex motor skills and craft skills, such as toolmaking, are guided by internally represented norms of correct performance.'

(2) 'The capacity to internally represent action-guiding norms of correct performance evolved as a solution to the distinctive problems of standardizing, learning and teaching complex motor skills and craft skills, especially skills related to toolmaking.' (ibid.).

Claim (1) draws a *psychological* link between normative cognition and certain practical skills, whereas (2) suggests that this link reflects an *evolutionary* connection visible in the archaeological record. The two-step formulation of the SH conceptually prioritises the claim that complex practical skills are *guided by internally represented norms of correct performance* in (1), which is the target of the evolutionary point made in (2). Hence, we will begin with an analysis of this claim to clarify *what* precisely Birch thinks has evolved under the label of 'normative cognition'.

Considering first the psychology of skill, Birch stresses that practical skills like mountain biking or toolmaking require 'adapting a learned technique in the face of anticipated, emerging problems that are unique to *this* situation' (2021b, p. 5, original emphasis). Skilled agents must strike a balance between unreflective, automatic modes of coping (Dreyfus 2014; Ch. 5) and cognitively demanding modes of action-control by integrating 'downstream' sensorimotor activity with situation-specific demands (e.g. the shape and texture of a stone) and past learning experience. Drawing on Christensen et al. (2015), Birch argues that agents achieve this balance by having a well-calibrated 'cognitive-control model' (CCM), i.e. a representation of the causal structure of a situation, allowing them to adapt their performance to anticipated obstacles and predicted sensorimotor feedback during skill execution.

As Rietveld (2008) has stressed, skilful agents *care* about what they are doing in norm-guided performances. Following Rietveld, Birch suggests that CCMs must be coupled with affect to enable practical skills to be guided by *norms*. More specifically, he sees *norms* of correct performance as 'encoded implicitly in the pattern of mismatches between model prediction and actual behaviour that would, if made, make the performance feel wrong to the agent' (Birch 2021b, p. 8, emphasis omitted). Thus, if a high jumper during run-up registers her straying off course from the trajectory which her CCM predicted and if this triggers a feeling of discomfort urging her to correct her movements, and if such prediction-error-triggered, affective corrections *continue* to guide her behaviour in the unfolding run-up and take-off, we are, on Birch's view, dealing with a skilful performance guided by a *norm* implied in a pattern of felt prediction-errors. It is in this sense that Birch sees practical skills as 'guided by internally represented norms of correct performance'. More generally, on Birch's account, an agent with a CCM which is affectively integrated to guide performance has the necessary ingredients for normative cognition.

5.2 The Normative Silence of Cognitive Control Models

Let us, for the sake of argument, accept that norm-guided practical skills rely on model-based cognitive control. Still, CCMs seem *insufficient*, by themselves, to establish that skill performances are guided by a *norm* or a 'standard of correct or appropriate behaviour' (Birch 2021b, p. 1). For to explain norm-guided performance, CCMs must be 'well-calibrated' (ibid.: 7) to represent only those performance parameters which encode the *correct* or *appropriate* acts in a specific context, e.g. the CCM of a skilful mountain-biker must be correctly calibrated to guide her to put *this* amount of force on the breaks at *this* distance to an obstacle to slow down enough to ride it smoothly – and likewise for other challenging situations (Christensen et al. 2015, p. 243 ff.). But what does 'correct' or 'appropriate' mean in this context? What distinguishes a *well*-calibrated model from one that *wrongly* guides performances in specific contexts?

Nothing in the predictive architecture of CCMs suggests an answer to this question. As Railton observes in his commentary on the SH, '[a] model of actual or possible causal relations for actions and circumstances would appear to be silent on the question of which actions are the ones *to be chosen* by the agent' (2021, p. 244, original emphasis). Railton traces this 'normative silence' of CCMs to their descriptive content. That is, the kind of error associated with predictive models is *misrepresentation* (e.g. when a performance does not unfold as expected) which is an error that reflects badly *on the model* rather than on one's actions (ibid.). However, as noted earlier, the notion of error needed to attribute *normative* content to a CCM is that of an *error in performance*, where the error is 'attributed to the action, not the norm' (ibid.)

Even without sharing Railton's deeper scepticism as to whether CCMs capture failures of norm-guidance in the relevant sense at all, it seems clear that positing a CCM, by itself, does not tell us *why* certain actions are appropriate or correct in a specific context. In our view, this is because a CCM provides at best what we have called an explanation of normative compliance (at the individual level), not normative authority. The model aims to explain *how* an agent is able to follow an action-guiding standard, not what establishes this standard as a *norm* in the first place. However, an account of norm-guided skill should address the question of normative authority to explain the relevant sense in which practical skills are normatively guided (see Sect. 2). Thus, even if CCMs are necessary for normative cognition in Birch's sense, they are not sufficient to explain in which sense practical skills are guided by norms. However, this is not to say that Birch remains silent on the sources of normativity of skill-guiding normative standards, as we shall see.

5.3 Which Norms Are We Talking About?

As Christensen et al. stress, in complex skills like mountain-biking, the effect of any particular action, e.g. braking, on overall performance is 'influenced by many factors, including features of the environment like surface topography (e.g., rough, smooth, steep, flat); surface type (e.g., loose sand, rock, slippery tree roots); equipment features (e.g., tire type, tire pressure, quality and condition of the brakes); and braking

technique, dynamic shifts of body position to distribute weight evenly between front and rear tires, and in some cases drive weight down through the tires, providing better grip.' (2015, p. 344). Thus, to achieve specific performance goals, e.g. riding a tricky obstacle, an agent must be sensitive to the multifactorial causal structure of the skill, knowing how aspects of the environment, equipment, and technique are causally relevant and related, to execute fluent, coordinated movements. It is this 'complex parametric structure' (ibid.) which leads Christensen et al. to posit CCMs as underlying complex practical skills. Similarly, Birch (2021b, pp. 3–7; 12) highlights the role of cognitive control in enabling agents to meet *situation-specific* demands by adjusting a learned technique to highly contextual parameters, corresponding to the structure of *this* obstacle, *this* piece of stone, etc. From this perspective, a *well*-calibrated CCM represents those contextual aspects of a situation which are *relevant* for achieving a particular goal (cf. Birch 2021b, p. 4). But what does 'relevant' mean in this context?

This question is important to make sense of how CCMs encode *norms*, since *specific aspects of context* which guide an agent's behaviour will distinguish appropriate from inappropriate performances in particular situations. Although the particular aspects of a situation will vary between cases, following Christensen et al. (2015) we can generally say that, for practical skills like mountain-biking, what is relevant is determined by the structure of an agent's environment, body, and behaviour, as well as the causal relationships between these factors. Thus, if skills like mountain biking are guided by standards of correct performance, their normative authority depends at least partly on embodied and embedded features of particular situations and how those features bear on the achievement of an agent's goal(s).

If that is correct, it seems that Birch recognises cases of normative cognition which are not fully guided by *social* norms. For many standards of correctness involved in practical skills like mountain-biking are not socially maintained patterns of behavioural conformity within a community. Of course, as with high jumping, mountain-biking as an activity depends on socially determined goals. Furthermore, athletes tend to adopt similar techniques in similar situations and their skill learning often depends on others (e.g. fellow athletes, trainers etc.). However, this socio-normative scaffolding is not sufficient to understand why a particular technique is appropriate for a particular task and situation, e.g. riding a difficult obstacle. For this, we must consider the multifactorial structure of a situation and how it bears instrumentally on the achievement of an agent's performance goal(s). In this sense, some behavioural standards underlying normative judgements of skill performance do not seem to be fully socially constituted.

Birch's discussion of Acheulean toolmaking, which figures mainly in part (2) of the SH, suggests a different conception of skill norms. There, Birch characterises normative cognition as the evolutionary solution to the cognitive-affective demands of skilful tool manufacture. The consistent production of symmetric shapes seen in Acheulean bifaces, Birch argues, required not only the cognitive capacity to adapt a learned technique to anticipated, situation-specific demands. It also depended on an intrinsic motivation to master complex toolmaking skills and, more importantly, to align one's technique with members of one's community (Birch 2021b, p. 14 f.). Shipton and White (2020), for example, identified distinct subtypes in Acheulean handaxe assemblages found across Britain. This variance, they argue, points to site-specific

normative expectations of handaxe shape. Building on this and related studies, Birch argues more generally that the demands of coordination and cross-generational transmission of toolmaking skills drove the standardisation of technique, selecting for (groups of) agents motivated to internalise what he calls 'technical norms – *our ways* of executing practical skills' (2021b, p. 15, original emphasis). On Birch's view, once such shared, skill-guiding standards were in place, the normative domain could expand to increasingly more abstract kinds of norms, targeting e.g. fairness, reciprocity, ritual and kinship (2021b, pp. 17 ff.).

Thus, when considering the role of toolmaking in the evolution of normative cognition, Birch seems to think of norms exclusively as socially constituted standards. For the normative authority of 'technical norms' in Birch's sense is dependent on a *community* of agents, without which it makes no sense to speak of 'our ways' of executing a skill correctly. Indeed, for Birch (2021a, p. 196) – and Shipton and White (2020) – standardised toolmaking techniques qualify as *norms* only to the extent that they indicate *non-instrumental* constraints guiding skill execution, meaning that agents are intrinsically or 'non-selfishly' motivated to adopt group-wide performance standards. Hence, as far as the question of normative authority is concerned, the sense of 'norm' involved in part (2) of the SH contrasts with that in part (1) concerning cognitive control at the individual level: whereas in a skill like mountain-biking, at least some standards of performance derive their normative authority from community-independent considerations, standardised toolmaking techniques (in Birch's view) depend on conditions of correctness which are socially determined.

6 Discussion

6.1 Two Ways of Reading the Skill Hypothesis

Our discussion so far suggests two possible ways of understanding skill-guiding norms as they figure in the SH, which – corresponding to the standard view and our proposal – we will call the standard reading (SR) vs. the pluralistic reading (PR).

o (SR): The only source of the normativity of skill-guiding norms is the social domain. Standards of correct behaviour, e.g. specific toolmaking techniques, are socially constituted by a community.

o (PR): There are multiple sources of the normativity of skill-guiding norms, some of which are underdetermined by the social domain. Some standards of correct behaviour, e.g. specific toolmaking techniques, are not (fully) socially constituted by a community.

It is not entirely clear to us which reading represents Birch's own view, an ambiguity which is reflected in previous commentaries on the SH (see e.g. Tomasello 2021b; Railton, 2021; Westra and Andrews 2021). Nevertheless, in line with the standard view, most commentators seem to side with SR. This reading is supported by the evolutionary part of the SH, which makes sense given that Birch's main concern is to explain the evolution and cognitive basis of social, group-specific norms. However, SR fails to capture the sense of 'norm' involved in the first part concerning the structure and representation of skill-norms. As we have argued, many standards of cor-

rectness which govern the execution of skills like mountain-biking or toolmaking are not (exclusively) socially determined. To explain why Kath's slowing down at *this* stretch of the curve by pulling the brakes with *this* amount of force is the best way *for her* to ride the obstacle *in this situation*, it is not sufficient to appeal to mountain biking competition rules or to how others navigate the same obstacle. Again, we agree that institutional, social factors may be essential to understand the context in which Kath's skill-execution is subject to normative evaluation, e.g. by specifying shared goals such as 'ride down the trail as fast as possible'. But this is compatible with our main point, namely that social factors do not fully determine the sense in which her way of meeting these shared goals, by means of adopting a specific technique in a specific situation, is correct or incorrect. It is in this sense that community-based standards cannot be the only means for explaining the normative authority of some skill-guiding performance standards or techniques.

In light of this, PR seems to provide a more consistent interpretation of the SH. Indeed, some commentators (Railton, 2021; Tomasello 2021b) read Birch similarly as describing a transition from instrumental- to social norms, where instrumental evaluative standards are understood as individual or non-social. As Tomasello puts it, 'what "correct" means here is instrumentally effective for the individual in achieving her goal' (2021b, p. 219). However, this conception of a non-social norm as being 'simply the imagined outcome, as in all goal-directed behaviour' (ibid., p. 220) presupposes that we know what 'instrumentally effective for the individual' means. But this is not a trivial question. On pain of emptiness, it cannot simply mean 'whatever action enables the individual to reach her goal', nor is it sufficient to describe the imagined outcome itself as the 'norm'. If Wayne and Kath both complete a difficult section of the trail, but Wayne must get off his bike whilst Kath rides it smoothly, they would both be following the same 'norm' of completing the section.[3] However, as far as mountain biking goes, one clearly does it more efficiently than the other, and it seems odd to say that what both are doing is equally 'correct' in being instrumentally effective (even if this is true in a trivial sense).

We propose that sensorimotor norms offer a more substantive account for spelling out the socially underdetermined norms assumed by PR. As defined earlier, sensorimotor norms are standards of assessment of behaviour which apply in the context of specific goal-directed activities performed in specific situations. The normative authority of such standards derives from patterns of sensorimotor schemes characterised by specific spaciotemporal relationships, which roughly correspond to techniques like the Fosbury Flop or a particular way of riding an obstacle. Thus, sensorimotor norms provide a concrete answer to the question of what is instrumentally effective for an individual. Kath, in being more skilled at mountain biking than Wayne, can select and execute a much larger range of techniques which are appropriate for different situations. To this extent, she is better able than Wayne to follow the sensorimotor norms which govern skilful riding and thus can behave in the correct way at a difficult section.

The embodied-embedded structure of sensorimotor norms seems especially useful for making sense of the SH. As explained earlier, Birch's argument emphasises

[3] See Christensen et al. (2015, p. 340) for this example.

the highly situation-specific structure of norm-guided skill-performance. As Westra and Andrews observe, this focus on the situated nature of individual skill execution provides a fresh perspective on the evolution and cognitive basis of normative behaviour, given that 'the kind of normativity seen in skilled craft performance is transparent, embodied and concrete in a way many social norms are not.' (2021, p. 206). Our proposal naturally incorporates these features of skill norms given that sensorimotor norms are *essentially* embodied and embedded standards of correct performance. There is no way of fully specifying the normative authority of sensorimotor normative standards without considering the bodily and environmental situation of the agents whose behaviour they constrain. Thus, if some of the normative standards implied in skilled craft performance, e.g. toolmaking, are at least partly constituted by the sensorimotor organisation of behaviour, and if, as Birch suggests, social norms first emerged within the context of collaborative practical skills such as toolmaking, then *of course* the earliest kinds of social norms were transparent, embodied and concrete. For in this case it would be futile to try to explain how toolmaking techniques might have constituted normative standards of correct performance without considering the ways in which adherence to these standards manifests in the sensorimotor organisation of specific behaviours, agents and environments.

Thus, in sum, by incorporating the notion of sensorimotor norms, PR provides a more consistent and comprehensive reading of the SH, which offers a substantial conception of the socially underdetermined norms neglected by SR and which highlights the situated and concrete nature of skill-guiding norms.

6.2 Reply to Objections

Our main purpose in discussing the SH is not to criticise it, but to exemplify how a view of norm-guided skills which takes account of sensorimotor norms offers a better interpretation of an influential proposal about the origin of norm-guided skills than the standard view which focuses on social norms. Expanding on this discussion, we will now consider some objections to our proposal to further clarify its explanatory value in relation to the standard view. A first doubt might run as follows.

Practical skills like high jumping, mountain biking or toolmaking take place within communal or institutionalised social practices. Without this social context, normative assessments of specific behaviours as correct or incorrect are unintelligible, e.g., the Fosbury-Flop only counts as the most appropriate technique in virtue of enabling the highest bar clearance, which is a goal standard agreed upon by the athletic community. Thus, the normative authority of Fosbury's technique depends on the social environment. It is only 'correct' or 'efficient' in relation to a standard that is fixed by a community. Thus, why should we think that the normative authority of practical skills is constituted by anything other than social norms?

Community-based standards of correctness (social norms), we agree, provide a *necessary* condition of intelligibility for the normative assessments of many skill performances. That is, the normative authority of many techniques depends on a social environment. However, our point is that reference to social norms is *not sufficient* to explain central dimensions of techniques which matter for explaining our normative judgments of them as 'skilful', 'correct', 'appropriate' etc. Thus, in Fosbury's case,

we argued, neither previously conventional techniques nor high jumping rules fully explain why his technique is more appropriate than others. This suggests that there are constraints acting on his behaviour which are normatively significant, i.e. which make a difference to our normative judgments concerning its correctness or appropriateness, but which are underdetermined by facts about the social environment. Accordingly, the appropriateness of his behaviour must derive partly from sources of normative authority which are to some extent independent of community-based patterns of behavioural conformity. We propose that sensorimotor norms are such a source.

Since we are interested in the difference and relationship between sensorimotor and social norms, we have focused on cases of practical skills – high jumping, mountain-biking, and toolmaking – where these norms are 'entangled' (see Sect. 6.3 below). As this makes it harder to separate them conceptually, it may help to point out that there are many norm-governed skills in animals in which, plausibly, social norms play little to no role in regulating action. A falcon's stoop, a cheetah's sprint or a bear's attack on a beehive depend on sensitivities to highly context-sensitive, situated and embodied techniques and performance standards, many of which must be learned and practiced for years. Such behaviours are norm-governed in a relevant sense (see Sect. 2), since they imply the possibility of *errors* in performance in relation to an agent's goal, e.g. securing food, despite the fact that they aim primarily at satisfying individual preferences and needs, rather than social standards. If one is happy to accept – as many, including proponents of the standard view (e.g. Tomasello (2021b), do – that in such cases of norm-governed skill, social norms are insufficient (and perhaps unnecessary) to explain the normative authority of the techniques which constitute such skills, it would seem ad hoc to suppose that, when it comes to (socially scaffolded) human motor and craft skills, non-social standards of correct performance cease to play a role in evaluative judgments of skill performance.

In reply, proponents of the standard view might agree that there are socially underdetermined, sensorimotor constraints acting on norm-governed skills. However, they might say, such constraints are *inessential* to fully explain the kinds of standards which they regard as 'norms' in a proper sense, i.e. social norms, and thus may be bracketed in an analysis of normative behaviour. From this perspective, what we have called 'sensorimotor norms' are better seen as embodied, situation-specific constraints on the implementation of norm-governed skills, which, however, themselves do not bear on whether a performance counts as correct or not. Thus, since they do not contribute to explaining the normative authority of the relevant standards, which are socially determined, they should not be regarded as 'normative' in the relevant sense.[4]

It is not our mission to insist on what should or should not be called a 'norm' in the context of practical skills. What is essential to our argument for a pluralistic perspective is that, in many cases, sensorimotor norms (as we defined them) *do* make essential contributions to explaining the normative authority of socially constituted, skill-guiding standards, and thus should be taken into account when explaining the kinds of standards which, by the lights of the standard view, are 'norms' in a proper

[4] We thank an anonymous reviewer for raising this point.

sense, i.e. social norms. We have already illustrated how a pluralistic perspective provides a better reading of a hypothesis concerning the origins of social norms. Building on this discussion, let us clarify why we think that sensorimotor norms are not just 'implementation details' for the meeting of socio-normative standards, but have a distinctive kind of normative authority which can shape and change what counts as 'correct' or 'incorrect' within a community.

6.3 Explanatory Benefits: Innovation and Norm Change

One upshot of a pluralistic view is that individual behaviours can be seen as subject to multiple kinds of standards of correctness at once which, given the underdetermination of sensorimotor vis-à-vis social norms, can shape and change each other. This view better captures some aspects of norm-guided skills which the standard view sometimes acknowledges but does not fully explain. In the case of toolmaking, for example, there are factors which determine the site-specific conformity of handaxe shapes which have little to do with social expectations, but rather derive from (what we would call) sensorimotor norms. For example, in line with Gowlett and Crompton (1994), Shipton and White (2020) report that 'constraints of hand size were an important influence on handaxe shape, such that longer pieces must necessarily be relatively narrow' (p. 5), suggesting that site-specific variance is grounded partly in bodily features of the agents and how they relate to the size of a stone. The standard view would not regard such embodied constraints as themselves exercising a normative force on which handaxe shapes count as correct or incorrect *unless* the production of these shapes is socially maintained and adopted by a majority of the community. Thus, if Alfi produces a long handaxe which is unfit for the job because it's too large to hold, this would count as an error in performance *only because* it fails to match the techniques and handaxe shapes of other group members. On this view, what determines what counts as an error in performance is the community, not anything about Alfi or his relationship to the stone.

Alternatively, a pluralistic view captures a relevant step in the order of explanation of Alfi's error which the standard view overlooks. From our perspective, Alfi's performance is wrong primarily because it fails to accord with basic sensorimotor normative constraints on how to make an efficient handaxe. These constraints derive from features such as the agent's hand size and grasping strength, which themselves have little to do with what a community does overall. Nevertheless, such constraints can give rise to a socio-normative standard, presuming that the skill-performances of most community members are subject to similar sensorimotor norms, e.g., if most individuals within a community have similar hands, behavioural repertoires and needs, there is normative pressure at the community-level to produce handaxes that most community members can handle properly. In our view, this can be explained as the emergence of a social norm (i.e. a community-wide pattern of behavioural conformity) which is shaped by standards of correctness which themselves are not primarily determined or maintained *by* the community as such, but derive from bodily constitutions, environments and capacities which most community members happen to share. This explanation is compatible with the idea that, over time, shared sensorimotor norms become socially reinforced by means of interactions or institutions. But

it places an explanatory priority on the consideration of socially underdetermined, embodied norms which, we think, provides a better account of how certain socially maintained patterns of conformity emerge and stabilise in the first place.

A related benefit of a pluralistic perspective is that it enables more detailed explanations of skill innovation and norm change in cases where established social norms are being challenged or reinterpreted. Recall the striking impact of the Fosbury-Flop in changing, overnight, the 'standard technique' used by high jumpers today. To make sense of this kind of skill innovation, one must explain the source of two normative judgements which are in tension with each other: (a) what it is about the Fosbury-Flop that makes it the correct or most efficient technique in the context of high jumping, and (b) what it is about the Fosbury-Flop that violated and yet replaced preexisting social conventions. The standard view would explain both judgements by appealing to different types of *social* norms: the Fosbury-Flop is correct or most efficient *from the perspective of the rules*, despite being a violation from *the perspective of existing conventional techniques*, both of which are socially determined standards.

Although this explanation is not wrong in principle, it depends on some account of *why* Fosbury's technique is the correct or most efficient style of jumping. As stressed before, established social rules offer only a trivial answer to this question, e.g. by saying that the Fosbury-Flop is correct because it enables the highest bar clearances (a socially determined goal). Sensorimotor norms, in contrast, can underwrite a more substantive account by focusing attention on the situation-specific patterns of behavioural organisation (including aspects of the athlete's body and environment) which constitute Fosbury's technique as the most efficient way of clearing the bar as high as possible. From this perspective, we can explain the tension between (a) and (b) as not merely a conflict between different social norms, but – more accurately, in our view – as primarily a tension between different *kinds* of norms with different sources of normative authority, i.e. the *sensorimotor* norm implicit in Fosbury's technique versus the *social* norm implicit in previous conventions. In this way, by capturing in more detail what it is about Fosbury's technique that makes it more efficient than other jumping styles, we can provide a substantive account of the innovative aspects of his behaviour, which explains why his technique was able to establish a new standard. Again, the social rules of the discipline are clearly relevant to this explanation in making intelligible what 'most efficient' means in the context of high jumping.[5] However, a view of norm-guided skills which restricts itself to the consideration of social norms is unable to fully capture relevant kinds of normative tension which underlie such cases of skill innovation. In our view, this is because socio-normative standards involved in motor and craft skills underdetermine the space of possible ways of meeting them (since they tend towards behavioural conformity and coordination at the expense of individual differences). Yet, within this space of possibility, there are normatively significant differences between individual behavioural styles and techniques which the standard view neglects. Sensorimotor norms offer a way of capturing these differences as well as an account of how they may effect changes and innovations to behaviours and techniques adopted at the community level.

[5] We thank an anonymous reviewer for emphasising this point.

6.4 Future Directions: Origins and Norm Development

Before concluding, we wish to briefly highlight potential interventions of our proposal in ongoing debates about the origins and ontogeny of social norms in the context of practical skills to be developed in future work.

A familiar challenge facing origin-stories of social norms is how to provide a non-circular explanation of the evolution of 'normative' from 'non-normative' behaviour without presupposing that social norms are already in place (see e.g. Brandom 1994; Peregrin 2022). This circularity problem also arises at the ontogenetic level, given that the learning of social norms is itself a norm-governed process (Haugeland 1998, p. 311). That is, one cannot explain (without regress) how children learn to comply *correctly* with a social norm by positing other social norms as being already understood. Thus, in Haugeland's words, 'at least some of the learning rules must be nonsocial, and at least some not explicit' (1998, p. 311). One prominent way of addressing this conundrum is by appealing to functional (biological) norms and dispositions explained in terms of natural selection (see e.g. Millikan 1984; Haugeland 1998, p. 311 ff.). However, functional norms in the evolutionary sense seem too broad to capture subtle but important differences in standards of correctness which characterise the social, cultural and linguistic life of communities (see e.g. Peregrin 2022). By providing an account of skill-guiding standards which are underdetermined by, but can be *integrated with* social norms, sensorimotor norms can contribute to spelling out the relationship between biological and social norms in a more fine-grained way, which is central to explaining the gradual evolution and transmission of culture across generations (Sterelny 2012).

Secondly, as mentioned earlier, many proponents of a standard view recognise (at least implicitly) non-social types of norms, typically understood in terms of instrumental rationality, e.g. as implicit in children's understanding of the effectiveness of others' movements (Gergely and Csibra 2003; Schmidt and Rakoczy 2023). However, what constitutes 'instrumentally effective' actions or techniques is typically taken for granted by the observer. Yet, especially for more complex behaviours that go beyond isolated reaching movements such as the Fosbury-Flop, it is not trivial to explain why – considering an agent's environment, body, experience and behavioural repertoire – certain spatiotemporal organisations of movements are more effective than others to reach a goal. The notion of sensorimotor normativity is well-placed to address this explanatory demand and thus to illuminate in more detail the embodied foundations of instrumental rationality norms and their role in cognitive development (see e.g. Juvrud and Gredebäck 2020; and Di Paolo et al. 2017, p. 158 ff. for discussion).

7 Conclusion

In this paper, we argued for the benefits of a pluralistic perspective on norms for explaining normative standards of performance involved in motor and craft skills. To spell out our proposal, we drew on previous authors to emphasise the importance of being mindful of different types of explanations of norms, some concerning the

mechanisms underlying agents' compliance with a norm, others concerning its source of authority. Building on this distinction, we outlined a broad conception of social norms (inspired by Westra and Andrews' (2022) notion of normative regularities) as patterns of behavioural conformity whose normative authority derives, at least partly, from a community and whose normative compliance is maintained, at least partly, by social interactions between community members. This conception enabled us to characterise a widespread and, in our view, problematic assumption, according to which social norms are the only relevant standards of assessment to take into account in order to explain what makes motor and craft skills norm-guided in a relevant sense. This 'standard view' is limited, we argued, because it is unable to fully explain dimensions of practical skills that are normatively significant, i.e. which make a difference to our evaluative judgements about whether someone's performance is (in)correct, (un)skilful, or (in)appropriate, and which thus should be accounted for in an explanation of norm-guided skills. Engaging Fosbury's feat of behavioural innovation in the context of high jumping, we showed how this explanatory gap can be traced to the fact that community-wide expectations, rules and conventions underdetermine the space of normatively significant differences in the way in which specific techniques of skill execution are more or less correct or appropriate. Expanding on the enactive account by Di Paolo et al. (2017), we proposed a conception of sensorimotor techniques and norms, understood as embodied and embedded standards of assessment of behaviour which apply in the context of goal-directed activities performed in specific situations. By providing a grasp on a type of normative authority that is essentially underdetermined by social standards, sensorimotor norms are well-placed to bring out normative dimensions of skills which escape the explanatory scope of the standard view.

In the remainder of the paper, we discussed the explanatory benefits of a pluralistic perspective (compatible, though not to be confused with Westra and Andrews' pluralism, see Sect. 3) which considers both sensorimotor- and social norms in relation to each other, for addressing questions about the origins, evolution and development of norm-guided skills. We demonstrated how a pluralistic reading offers a more comprehensive and consistent interpretation of Birch's 'skill hypothesis' than a reading which restricts its focus to social norms. Generalising from the particulars of Birch's account, we then clarified why a pluralistic perspective does not deny the importance of social norms for explaining types of norm-governed skills that are dependent on socially structured environments and expectations. On the contrary, we illustrated how paying attention to socially underdetermined, sensorimotor normative dimensions can contribute to explaining cases of norm emergence, norm change, skill innovation and -development which allow socio-normative skills and practices to stabilise and evolve over time. In summary, to advocate a pluralistic perspective is not to say that the predominant focus on social norms is, strictly speaking, false or unjustified in the context of motor and craft skills. It is to acknowledge that a wider and more nuanced view, which considers the multiplicity of different types of norms involved in practical skills, enables better explanations of key phenomena which a focus on social norms implies, but does not fully explain.

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