

Affective, cognitive, and ecological components of joint expertise in collaborative embodied skills

John Sutton

Macquarie University/ University of Stirling

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Abstract

To better understand the nature of joint expertise and its underlying processes, we need not only analyses of the general conditions for skilled group action, but also descriptive accounts of the features and dimensions that vary across distinct performances and contexts, such as sport and the arts. And in addition to positioning our accounts against current models of individual skill, we need concepts and lessons from work on collaborative processes in other cognitive domains. This paper examines ecological or situational components of expert joint action in practice, then offers a selective survey of some key cognitive and affective resources that shape and transform group performance.

1. Introduction: collaborative embodied skills

Many striking cases of expert performance are undertaken in and by small groups. Ethnographer Natasha Iskander describes one of the small teams of migrant construction workers in Qatar who built vast modernist edifices for the football World Cup under challenging conditions: they ‘hang from the sky’ on unprecedented, vertiginous scaffolding several stories high, working smoothly together, with no common language (Iskander 2021: 115):

Each scaffolder handled one ton of material every day. ... In the heat and din of the construction site, the pipes, planks, joints, and spanners were all manipulated wordlessly. The men relied on hand gestures and manual signals, like a twist to the pipe to convey the soundness of their grip to those passing the material or a tug to signal the direction in which they were moving the material.

This initial case reminds us that joint expertise need not be developed or exercised in the service of self-generated goals or as a shared expression of autonomy. Many phenomena and processes of social ontology are non-ideal, and even the smoothest coping can facilitate politically or morally unpalatable or troubling outcomes.

The primary focus of this essay, though, is on less risky environments in sport and the arts where we also engage in or observe joint intelligence in action. In the middle of a song they have played together many times, one of four professional musicians in a touring band suddenly extends its structure, improvising two transformed repetitions of the chorus line: despite the lack of warning, the other three musicians stay synchronized in their music and coordinated in their movements, continuing the performance more or less seamlessly (Geeves, McIlwain, & Sutton 2014). Experienced tango dancers move as one, constantly extending and playing with the basic ‘leader-follower’ dynamics of the genre: two dancers’ individual skills micro-modulate and mesh with each other’s movements across fluctuations in the embodied dynamics of the joint action (Kimmel 2016). Japan’s unfancied rugby union team beat mighty South Africa at the 2015 World Cup with extraordinary tries in which almost all fifteen team members created space from nothing over a few gripping seconds of action: such tightly-knit teams coordinate movements and decisions perfectly, acting for a time as if of one mind (Sutton & Tribble 2014).

In such collaborative performance, team members’ shared experience, intense practice regimes, and complementary skills animate joint action on the fly. Success is precarious: things can go wrong at any point. But outsiders marvel at the dynamic, improvisatory intelligence of such small groups. It is the envy of corporate culture and management science, where explicit training practices often fail to elicit innovative outcomes. Here I

focus on such forms of skilful embodied interaction in small groups. While we can learn much from recent attempts to *analyse* joint know-how or collective practical knowledge, so as to be able to distinguish genuine cases from other distinct phenomena, my project here is different. I hope instead to delineate some of the component processes involved in clear cases like those just described, to encourage diverse further research on collaborative performance in context at multiple timescales, from fast embodied coordination and alignment, through explicit collaboration when intentions in action can be shared and negotiated, to slower kinds of cooperation formed over careers in shared histories of culturally-embedded practice (Williamson & Sutton 2014; Bietti & Sutton 2015).

Philosophical and scientific theories of mind and action should throw light on the nature and mechanisms of shared skills in real-world practices. But work on 'embodied cognition' often proceeds at an abstract level, neglecting both the experience of specialists who commit themselves together over decades of practice, and rich bodies of research in fields like sport psychology and music cognition. It is a good starting-point to mention striking examples and anecdotes like those above, but it is not enough: in order to grasp the phenomena of joint expertise in collaborative embodied skills in their depth and complexity, we must tap more systematically into the abundance of applied work on collaborative skills that uses experimental, ethnographic, qualitative, practice-based, and phenomenological methods (McIlwain & Sutton 2015; Sutton & Bicknell 2020). I can't live up to this demand in this short essay, but I can point to a recent collection in which contributors deploy and integrate tools and methods from just this range of fields in examining case studies of thinking in action (Bicknell & Sutton 2022). In this essay, building on the momentum of that interdisciplinary work, I aim to pull out and identify a range of components of joint expertise which vary in telling ways across contexts, and to which it will be productive to attend as we seek to extend research on skill to address collaboration, and to apply research on collaboration to domains of embodied skill. In the embodied joint action of expert performers, the mind-body problem comes to life in social practice.

Some clarifications will sharpen the focus. First, I am thinking here primarily of small groups doing things together that cannot be done by individuals, as in the examples above. I do not feel the force of the charge that an account of joint expertise in dyads and small groups acting together is incomplete if not clearly applicable to larger-scale and diffuse groups (Habgood-Coote 2022: 187). Of course understanding much larger corporations or social movements is also important, but the dynamics and mechanisms may be so different as to require another kind of social ontology. Second, similar processes may be involved when activities or tasks that *could* also be accomplished by an individual are in fact jointly performed, and I mention such cases below: but for the most part it is clearer to focus on 'Hutchins-style' tasks for which more than one person is needed (Hutchins 1995). Third, I concentrate on cases involving embodied activity because it's easier to see the range and variety of the component processes that participants have to deploy and mesh. This does not, however, assume a sharp distinction between cognitive skills and motor skills, and I do draw lessons below from forms of collaborative cognition in other domains. Fourth, remembering the example above from Iskander's work in Qatar, I am aware that my focus on sport and the arts runs the risk of reinforcing what Aagaard (2021) calls 'the dogma of harmony' in research on embodied and distributed cognition, the tendency to offer 'an overly idealized picture' of coordination and collaboration, and neglecting cases of socio-technical or socio-cultural interaction in the service of oppressive or brutal enterprises (compare Slaby 2016); it will be a task for other occasions to show that the same conceptual tools and frameworks can also throw useful light on such cases. Finally, I am not here interested in problems about the attribution or recognition of expertise, but in examining domains where the existence of expert performance is manifest and uncontested, to try to improve our understanding of its nature and basis. Neither in ordinary language nor in the current state of science do we have anything like natural kind-like terms to pick out our topics in these domains – we don't need to treat 'expertise' or 'know-how' or 'practical knowledge' as labelling well-defined phenomena or abilities, or to be delayed by worrying at the edges of

applicability of these labels, in order to get on with the job of saying something illuminating about cases where they clearly do apply.

To proceed, I first assess some recent philosophical accounts of joint know-how, to help orient my different kind of enquiry. In section 3, to address the challenges of integrating research on skill with research on collaboration, I consider concepts and lessons from the philosophy and psychology of collaborative cognition and small group research that can inform our thinking on joint know-how. The rest of the essay selectively surveys features and dimensions of joint expertise that are embodied in the kinds of professional, artistic, and sporting performance contexts mentioned above. In section 4 I discuss situational components of joint know-how in practice in the form of ecological and bodily factors. Section 5 examines some of the affective and socio-cognitive capacities and processes salient when collaboration succeeds or fails. I conclude in section 6 with some programmatic notes on what the approach suggests about the mechanisms of complementarity operative among heterogeneous group members. This is an impressionistic, high-level survey of rich, under-explored but challenging research terrain, and all of my pointers and recommendations need to be tightened and deepened in application to specific contexts and cases.

2. Joint know-how: analyses and approaches

S. Orestis Palermos and Deborah Tollefsen (2018) offer a pair of non-reductive proposals of joint know-how, analyzing it by reference to joint intentionality and distributed cognition respectively. While they take inspiration for these two approaches from distinct accounts of individual know-how, they plausibly suggest that pluralism may be appropriate here, to accommodate a range of cases and of forms of mutual responsiveness. Sometimes group members do make and rely on explicit or semi-contractual commitments which then guide their actions in the form of ‘collectively known propositional knowledge’ (2018: 119, 127); on other occasions, more implicit or dynamic interdependence between individuals, involving reciprocal and continuous interactivity, allows them to keep monitoring performance (2018: 123-4). While noting that the hypothesis of distributed cognition on which the latter account rests ‘is being widely debated’, Palermos and Tollefsen hope that it opens paths towards more detailed explanations of the sense in which group know-how can emerge from the complex interactions between individual members rather than resulting from the mere summation of all the individuals’ knowledge states (2018: 117, 125).

In Jonathan Birch’s ‘active mutual enablement’ account (2019), joint know-how in a dyad is ‘an interlocking package of individual know-how states ... each agent knows how to perform his role in an actively coordination-enabling way for the other agent while predicting, monitoring, and making responsive adjustments in response to the other agent’s behaviour’ (2019: 3339). Aiming to put flesh on Bratman’s (2014) notion of ‘mutual responsiveness in action’, and on psychological statements of minimal conditions for joint action (Vesper et al 2010), Birch suggests that such monitoring and adjusting, on the part of each individual in such a dyad (or group), actively enables their coordination: in particular, key kinds of adjustments arise when one agent – as a result of predicting and monitoring the other agent’s actions in real time – can avert the failure of the joint action (2019: 3336-8). In one sense this is a reductive account, in that joint know-how is analysed by reference to the mutually compatible knowledge states of the distinct individuals in the dyad or group. But the relations between individual know-how and joint know-how are not simple or summative: Birch stresses that neither individual need know how to perform the action in question as a whole or to perform *both* component roles, and that thus the joint know-how may be genuinely distributed across the dyad (2019: 3333, 3346). For our purposes, it is notable that Birch acknowledges that the exact forms that such ‘actively coordination-enabling performance’ will take ‘will depend a great deal on the nature of the action in question’ (2019: 3338).

Finally, Joshua Habgood-Coote (2022) develops a broader view intended to apply to larger collectives as well as dyads and small groups, while acknowledging that the approaches provided by Birch and by Palermos and Tollefsen have some appeal when we consider small-scale groups ‘with a tight pattern of mutual engagement’ (2022: 186-7). His view is inspired by considerations about the semantics of how-to questions. Group members may each have fragmented practical knowledge of answers to parts of larger practical how-to questions: group know-how then requires them to be able to exercise their interrogative capacities together to generate effective answers to such questions in the course of acting together (2022: 191-3). Habgood-Coote also notes that in the case of larger groups, some such answers may be embodied in the institutional design and structure, or distributed across sub-groups who do not need to collaborate directly (2022: 194).

In developing these distinctive and promising accounts of joint know-how, these authors all acknowledge its context-specificity (compare also Martens 2021, Pino 2021). Yet they aim, like most philosophers, at analyses that are general enough to cover many different cases and kinds of case. Such abstraction gives these analyses their generalizing power, in applying across contexts. But the concrete and specific can’t be left behind if we want to know more about just *what* experts know, what some of the answers to difficult why-questions might be, or just *how* experts generate answers to them or coordinate by interactively monitoring each other such that their sub-plans continue to mesh. While I too have generalizing ambition, mine is directed not towards analysis but at establishing toolkits to be applied differently in different cases and contexts – sets of factors and dimensions to which we as researchers can develop sensitivity as we examine varying forms of group expertise.

In hoping to motivate attention to under-noticed features of joint know-how, I note that accounts of the sort just sketched operate at a fairly abstract level, deliberately abstracting away from aspects of collaborative performance that (I suggest) matter greatly. My alternative approach aims not to replace but to supplement and complement these more standard philosophical projects, in the three specific directions that I address in turn in the next three sections. While they are rightly concerned to align their proposals with current approaches to individual skill, whether intellectualist or not, they are less engaged with research on collaboration. While they do acknowledge in principle the importance of systemic or structural support for group performance, they do not directly focus on technological or ecological scaffolding (for example) in shaping what group members do together. And since these analyses are not intended to dig down into the specific interacting cognitive and affective processes which individuals engage in together, there is ample room to point to research on the entangled roles of emotion, perception, attention, memory, and more in dynamic interaction. Overall, the aim is gently but firmly to nudge philosophers of skill and collaboration towards a more integrative and insistent interdisciplinarity in which experimental and ethnographic methods and results both hold a significant place.

3. Collaborative cognition and group process

Our target phenomena are cases of clear expertise in joint performance, in domains including sport, the arts, and professional teamwork in action domains. Working together successfully is far from easy: this is not only because the individual skills involved are challenging, but also because of the extra demands of collaboration, encapsulated in the slogan that a team of experts is not inevitably an expert team (Eccles & Tenenbaum 2004; Gaffney 2015). This is a natural point on which to look to research on collaborative cognition in domains other than movement or action. People often hope that sharing cognitive resources with others will be beneficial: we brainstorm in search of creative ideas, we pool our views in committees or with friends in making important decisions, and we often enjoy remembering past experiences together. If collaborative success required only that the group would perform better (according to any agreed metric in assessing either process or output) than any one individual working alone, we would be justified in identifying regular ‘process gains’ through working together. But in most contexts that is too low a threshold. Instead researchers typically evaluate group performance while collaborating against the *sum* of the same number of individuals working alone and then

pooling their (non-redundant) outputs, in what is known as a *nominal* group, 'a group in name only' (Weldon 2000: 92). Against this more challenging bar, we find that the conditions for collaborative success are surprisingly fragile, and that 'collaborative inhibition' and other forms of 'process loss' are more typical (Harris, Paterson, & Kemp 2008; Meade et al 2018).

Many research traditions across the disciplines engage with such findings and seek to identify factors that may disrupt or enhance group performance. One useful broad-brush way to arrange such factors is by asking how 'higher-level' and 'lower-level' cognitive states and processes interact. As I have argued in the context of sport (Williamson & Sutton 2014; Sutton & McIlwain 2015), higher-level states including beliefs and attitudes, intentions and plans, and 'shared mental models' of a changing task domain are

'to a first approximation, the kinds of things that team or group members can talk about, ... that can be rendered explicit, as in the use of written or verbal information sharing, or even deliberate, iconic bodily cueing, like pointing or hand waving. These processes can be plans, strategies or instructions made and shared before or after a match, or changed and adapted during play, but they can also include more immediate verbal cues or directions used on the fly to signify an intention or to influence the attention of a team member. In some contexts, they can also include the use of formalized or formalizable game plans, visually represented for instance through diagrams, video footage or on-field/ court reenactment'.

In contrast,

'lower-level processes are those that are not immediately, easily or perhaps ever able to be tapped by talk. They include gestural, bodily and movement-based forms of information-sharing and cueing, often driven by skillful and honed perceptual and attentional processes. These processes are often thought of as implicit and non-deliberative. They can be fast and adaptive, but they are also developed and shaped through practice and performance history. Broadly, lower-level processes are those processes that rely on non-verbal forms of communication and information-sharing: anticipating and responding to the bodily presence of a team member, the direction, speed and shape of a team member's run, the feel and rhythm of the team's movement' (Williamson & Sutton 2014).

The roles of higher-level cognitive states and processes in collaboration are highlighted in various ways in formal and conceptual approaches in social ontology in philosophy, in behavioural economics, and in experimental research on collective intelligence, collaborative recall, and transactive memory systems in cognitive and organizational psychology. I draw on results from these fields below in pointing to some natural features of collaborative process to which research on joint expertise might look. But like Palermos and Tollefsen (2018), I want in pluralist spirit both to acknowledge that such higher-level states can play significant roles even in dynamic action contexts, and to deny that they are sufficient to ground and explain successful performance in embodied collaborative movement. Groups often have to innovate together in responding spontaneously to unpredictable circumstances (Preston 2012): these on-the-fly adjustments occur at rapid timescales that do not allow for explicit modification of shared strategies, but seem to involve interactions driven by dynamical factors that are harder to access, articulate, and reflect on. Such factors include patterns of gaze and fast information pickup or changes in body movement, rhythm, or affective expression, as typically highlighted in 'alignment studies' and research on joint improvisation in ecological psychology, phenomenology, and sports psychology (Tollefsen, Dale, & Paxton 2013; Williamson & Cox 2014). Such lower-level processes are of course also operating when people collaborate in making decisions or remembering the past, but the salience of subtle, multi-channel modes of communication in joint know-how is even more obvious in sport and other action contexts where slower, more measured plan execution and verbal interaction can play only a minor role if any. In mining studies of collaborative cognition in other domains, we want to track anything that shapes the dense and complex interplay between higher- and lower-level processes (Williamson & Sutton 2014).

In cognitive domains like memory and decision-making, researchers systematically vary the kinds of tasks employed and the measures used to assess performance in groups of different sizes, durations, and structures (Larson 2010; Laughlin 2011). They want to see if the significance of materials or tasks to group members, or their motivation and interest, may affect collaborative processes and results (Marion & Thorley 2016). Yet cases of collaborative *facilitation* – when working together produces benefits beyond the pooled performance of individuals working alone – remain rare. In the case of memory, for example, disruption to cognitive mechanisms seems to occur even if groups are offered extra incentives for success. But when we review the experimental studies that have produced these robust results, we find that many use convenience groups of strangers rather than real groups with common interests or shared history, and that many do not encourage densely interactive processes of communication in working together (Harris et al 2014). Looking for lessons to bring back to research on collaborative embodied skills, we can briefly examine factors relating to the nature of groups and the microprocesses of communication in turn.

Michelle Meade and colleagues (2009) first showed collaborative facilitation among domain experts. The key result is not that expert pilots perform better than non-experts when (and only when) remembering material related to their domain of expertise, but that expert pilots do better when working *together*, in a collaborative group, than when left to work individually and having their performance pooled as a nominal group. The specific members of the collaborating expert groups in this study did not have a history of working together, though they had been trained in communication as well as in the first-order skills of aviation. This result casts doubt on a recent claim by Katherine Sweet that ‘participants must *already* have an existing relationship to collaborate well’ (2023, 2, original emphasis). Where a group has shared history, as I note in a moment, this *may* indeed support collaborative benefits. But this is not inevitable. Such shared history is neither sufficient nor necessary for good collaboration, as Meade’s study confirms: where it does make a positive difference, it likely does so by way of other factors such as shared domain knowledge and effective collaborative process. Alongside ongoing empirical research on the effects of expertise on collaborative creativity, problem-solving, and memory (Nokes-Malach et al 2012; Malone & Woolley 2020; Rosenberg et al 2022), and with dyads and small groups like long-term couples who have built rich systems of cognitive and affective interdependence over time (Harris et al 2017, 2019), philosophers of expertise and skill can consider broader cognitive, emotional, and communicative processes that may be affected or transformed in the course of long-standing interactions between familiar individuals in shared social or professional contexts and ecologies.

In these domains, certain specific microprocesses of communication have been identified as among the mechanisms by which shared history animates collaborative performance. Celia Harris and colleagues, for example, find factors consistently associated with effective and ineffective collaboration in memory (Harris et al 2011, 2019). Group-enhancing factors include the provision of cues – even if they do not successfully stimulate retrieval – and the acknowledgement or mirrored repetition of another member’s contributions, whereas strategy disagreements, asymmetric assignments of expertise, and corrections are among factors that seem to diminish group performance. These results are based primarily on analyses of verbal interaction, and are not intended to capture embodied or environmental aspects of communication between group members. Preliminary ethnographic work in our experiments with older couples shows that even in tasks where only verbal output is typically counted towards measured success, a range of factors like gaze, touch, posture, humour, and shared responsiveness to familiar environments mediate the operation of such communicative interaction (Bicknell, Harris, & Sutton, in progress). The significance of bodily and non-verbal processes is likely even greater when we consider the fast action domains in which many kinds of collaborative skill are exercised. The remainder of this essay aims at selective initial identification of some of the diverse ecological, social, bodily, cognitive, and affective resources and factors that seem likely to be involved in the successful group performance of collaborative embodied skills over time.

4. Cognitive ecologies of skill: ecological and bodily components

Expert individuals and expert teams alike, in many skill domains, seek to extend their capacities to perform successfully in different, challenging conditions. Going, as they say, beyond their comfort zone, they resist excessive automation or proceduralization of their grooved skills (Ericsson 2006, 687), and instead aim to expand their region of expected expertise (Sutton et al 2011; Christensen et al 2019). They can transfer their techniques and skills to novel situations, within an envelope of performance possibility, even though development is fluctuating and uneven, given human imperfection and the vanishingly rare chances in many domains of winning every time (Christensen et al 2016; Bicknell 2021). If such ongoing development is one mark of expertise over time, if skill acquisition never stops, then the environments of performance – sometimes and in some fields more reliable or stable, sometimes more volatile and unpredictable – are not merely external settings in which the real expert action unfolds, not just stimuli to performance, but in many respects are intrinsic and active components of complex and heterogeneous systems: *ecologies* of skill (Bicknell & Sutton 2022).

Some domains require a wider range of such forms of scaffolding, and within each domain individuals and groups may vary greatly in the extent to which, and the ways in which, they interact with these resources. But attention on behalf of skill researchers to such material, environmental, technological, and institutional factors is not an optional sociological extra on top of direct investigation of embodied decision-making and performance (compare Becker 2008, 8). Just as, in sport, music, and professional action domains, equipment and terrain, crowds or observers, locations and weather, can all disrupt effective performance, so coping with troubles or unexpected changes in these components strongly contributes to (or sometimes just *is*) success in action. Each item of technology and each physical space of performance has its own history, its own dynamics, its own ways of challenging or facilitating skilled coping. Many elite performers across domains reasonably try to focus only on what they can control, so as not to waste energy or intensify anxiety by worrying over aspects of the performance ecology that are outside their spheres of influence. But over time some also seek to expand that sphere of influence and to gain at least some familiarity with or even control over a broader range of ecological components. Elite sports teams may not be able to regulate the weather or to choose whether they're playing at home or away, but in some contexts they can and do seek indirectly (and fallibly) to affect what the media focus on, the mood of the crowd, or the specifications of or regulations on the available equipment.

In teamwork and joint expertise in particular, interactions with the resources of these ecologies of performance occur in various forms of combination within the group. One of the great potential benefits of collaboration, when things go well, is to be able to develop and tap specialization, to cultivate and implement effective divisions of labour among group members. Such specialization may emerge in relation to the component actions each member performs within broader group endeavours, and may also involve cognitive and emotional divisions of labour. Over time, the pooling of distinctive capacities can help generate a more explicit 'we-awareness' and a sense of the collective (Sutton & Tribble 2014). Even in those action domains like certain forms of rowing which appear to require more homogeneity among team members and their activities, the sense of togetherness has to be laboriously nurtured and sustained, as rhythm can remain elusive across a group of individuals with subtly distinctive physical, stylistic, and emotional profiles (King & De Rond 2011).

In the professional worlds of many elite team sports, institutions and training systems are exquisitely calibrated to respect, hone, and support the unique physiological and technical needs of each team member. There is no perceived tension between the driving overarching performance goals of shared success as an integrated team, and the highly differentiated bodily regimes – spanning diet, pain management and medical care, strength and conditioning programs, and aspects of technical support – required by each distinctive team member. In the next section I shift attention to examine affective and cognitive components of joint expertise, domains in which individual differences are often not so easily acknowledged, despite lip-service paid to the importance of 'the mental game'. But first I note the bodily and technical factors which differentiate collaborating performers in

many domains. In classical orchestras and jazz bands, for example, and in some team sports like cricket and rugby, it is an essential feature of joint expert performance that the individuals involved are – often dramatically – distinctive, both in terms of the capacities open to them by way of their physical make-up (their height, for example), and in the roles and styles and skills they bring to their different specialist parts in the shared activity as a result of their backgrounds, their training, and their experience.

Individual team members with these distinctive embodied capacities thus each *bring* something different *to* group performance. Interacting with each other in the course of action, in many domains they each also therefore *do* something different *in* that group performance. As we learned from considering collaboration in other cognitive domains above, that interaction does not inevitably bring benefits: some groups are notoriously *less*, in action, than the sum of their parts, as when groups of highly skilled individuals fail to gel with or complement each other, or to settle in effectively to a novel performance ecology. But the hope is always that beneficial forms of emergent outcome will result over time, that members mesh well with each other and together develop the right networks of resilient interaction across whole systems.

5. Cognitive ecologies of skill: affective and cognitive components

We can start with affective components of the ecologies of collaborative embodied skills. As with all the factors I discuss in this section, different domains of expertise have many different norms and requirements on the roles of emotions, moods, motivation, and arousal in practice and in performance. And within single domains, different cultures enforce or recommend different ways of regulating or harnessing affective dynamics. Though it's clear that the possibilities for and operations of emotion expression in action for professional tennis players are quite unlike those at play among members of a symphony orchestra or in the cockpit of a long-haul aircraft, we can still be surprised at just how much variability there is in these domains in practice across styles and cultures. Not all orchestras conduct their business in the same way; you don't always have smooth 'plug-and-play' modularity, even if experienced musicians can often quickly adapt to a new setting. The point of surveying these components of joint expertise is obviously not that they all play equally important roles in all cases, but that sensitivity to their presence and dynamics, and to the shifting balances among them within and across contexts, improves our understanding of effective and ineffective collaboration in action.

Operating at a range of timescales (from fleeting occurrent affective processes through to explicit emotional work over a lifetime) and at a range of levels, affective phenomena play vital roles in many group performances. As for all the factors in this section, there are rich bodies of theory, backed by extensive empirical data, on affect, mood, and emotion in individuals, but considerably less research on how they work in small groups such as expert teams. One striking evocation of the affective dimensions of team dynamics in elite football has recently been offered by John Protevi. In '*Esprit de Corps* and thinking on (and with) your feet' (2023), Protevi works outwards from a detailed analysis of one celebrated, marvellous goal in the 2011 Women's World Cup. Alongside an inventive integration of conceptual frameworks that tap relational autonomy, collective intentionality, and enactive phenomenology into 'a bio-neuro-social-subjective approach' to team performance, Protevi pushes each such framework towards firmer and fuller acknowledgement of the centrality of affect in action. At the general level of mutual engagement and awareness, 'the constraints on player action — what constitutes them as team players and allows the emergence of a team — are primarily affective: the players must reward the trust their teammates put in them as team players, or they risk criticism' (2023, 7-8). More specifically, the looping resonance that emerges among players who know each other so well is underpinned or constituted primarily by a variety of affective embodied interactions over time: both through direct interactions in touch, drill, rhythmic movement, and shared effort, and in the joyous affective mediation of successful joint attention and joint commitment (2023, 8). Protevi brings this framework to life in a phenomenological analysis of a retrospective report by Megan Rapinoe, who provided the inch-perfect time-pressured cross from the left for Abby Wambach

to score. In reading Rapinoe, Protevi catches the shifting affective intensities involved at each stage of this incredibly fast team movement, from awareness of the crisis situation in which a goal was urgently needed, through the embodied anticipation driving the selection of an action to afford opportunity to a deeply trusted teammate, to the disbelieving joyous rush as Wambach scores (2023, 11-13; compare Bicknell's analysis of a report by cyclist Chloe Hosking in Bicknell & Sutton 2020, 200-202).

Of course not all emotions in performance are positive or easy to manage. Teamwork can also elicit, and can be supported by, the full spectrum of feelings, from boredom to rage, uneasiness to misery. In professional practice the challenges of mood- and emotion-regulation, which also take on a different cast at the group level, are as readily acknowledged as positive emotions. Recent accounts of socially distributed affectivity and of emotion-regulation as extended across brains, bodies, and world can inform applied research on emotion in team performance (Colombetti & Krueger 2015; Salmela & Nagatsu 2017; Thonhauser 2022; Rimé & Páez 2023). Some discussions of emotion in sport, music, and organizational psychology focus heavily on cases of trouble and breakdown, as the mental health challenges of elite performance – and the corresponding need for improved systems of emotional support – are at last more widely acknowledged. This significant cultural shift should not, however, sanction ongoing neglect of emotion-regulation when things are going well. It can be a highly sophisticated skill to tune and regulate emotion experience and emotion expression in and around performance: this is more challenging in group contexts where experts who know each other well are constantly influencing each other. Sometimes, subcultural norms require strong feelings, especially negative ones, to be masked or muted to protect fellow performers, but over time many practitioners come to be able to adjust their own affective dynamics more or less effectively in and through the social and institutional contexts of performance.

Deep entanglements between emotion, perception, and attention are in play here. Depending on the domain, experts harness and work *with* emotions to help them shift energy and attention as required to what is salient, when needed. Managing difficult feelings effectively helps both in switching off to recharge and in then tuning back in to the cues that matter: knowing what, when, and how to feel can be a vital component of the capacities to pick up task-relevant information and think on your feet in selecting and performing actions in response. The years-long processes of enculturation into the world of a specific professional action domain involve an education and reorientation of perceptual attention so as to attune to cues across multiple modalities at a range of timescales – to be able to detect them, help set them up, and respond fast to them when necessary (Goodwin 1994; Grasseni 2004; Bicknell 2021). When it is a domain of *group* performance, the sociality of such enculturation is intensified: not just in apprenticeship learning and in ongoing openness to instructional nudges and other input from peers and trusted coaches or leaders, but also in explicit reflection on and redesign of interaction processes, and then faster, in effortlessly distributing attention to team-mates or colleagues within the larger ecology of performance in the moment.

With more space we could work through more of the other cognitive processes which drive group action, and which may themselves be transformed in the context of ongoing collaboration. I mention just a few here. Distinct forms of *memory* operate to track and direct joint action over time in light of shared past embodied experience (Sutton & Williamson 2014). Action *control* can be more or less distributed: as individual experts may rapidly adjust different meshing combinations of integrated cognitive and automatic control processes (Christensen & Sutton 2019), so teams of experts may be able rapidly to reallocate the weights or influence of different members' contributions as situations change and evolve. And – again, depending on the domain and the task structure – more implicit and more explicit forms of shared or joint *metacognition* may operate to monitor performance over time: the group must *together* be able to discriminate among emerging evaluative feelings about ongoing activity, to interpret those feelings, and as appropriate to broadcast them to all and only those who need to know (cf Shea et al 2014).

All of these affective and cognitive processes, considered at the level of the small group, involve various forms of communicative interaction. Our pluralism requires us not to overemphasise either the slower, more explicit forms which are harder to deploy on the fly in some fast action skills, but which may be vital in managing trouble or realigning grooved patterns, nor the dynamic, implicit forms which operate seamlessly when all is going smoothly together. It is easy to overegg or romanticise the intensity and bandwidth of intrateam dynamics when we consider those rare occasions on which group behaviour seems to arise fully-formed in perfect unfolding sequence just as the changing conditions demand. Not only are there many familiar occasions on which things do *not* fall into place quite so easily: even when there is emergent harmony in joint action, this need not require entirely mutual participatory co-regulation equally among all members. Some studies of the reciprocity of attention in effective football and basketball teams, for example, suggest that direct real-time cognitive-perceptual couplings between team-mates are relatively rare: shared experience may mean that ‘expert interactors probably do not need to pay as much attention to their co-agents during ongoing task performance’, instead allowing them ‘to adopt a parsimonious but effective structure of regulation of the intra-team coordination’ (Bourbousson & Bourbousson 2016). Indeed co-regulation may best loop out in ‘indirect’ or ‘extrapersonal’ modes as individual performers attune not to *all* of their own familiar colleagues, but to instructive features of the ecology of stimuli from the cue environment or the competing players (Millar, Oldham, & Renshaw 2013; Gesbert, Durny, & Hauw 2017). Likewise, it’s not essential that the affective bonds that underpin trust in action must extend beyond the task domain. After examining two very particular collaborations – Watson and Crick in science, and Rodgers and Hammerstein in music – Sweet argues that ‘if collaborators are constantly on the verge of estrangement from one another, then it is unlikely that they are collaborating well’ (2023, 19). This is too strong: in sport, the arts, and in professional action domains alike, there are cases in which team members are indeed emotionally or personally estranged from one another yet retain the requisite mutual responsiveness in action.

The point of this tentative sketch of some affective and cognitive components of joint expertise was to begin identifying some of the ways that shared history can colour the operation of collaborative embodied skills. It is not by any means inevitable that small groups or teams will develop more effective modes of interaction over time. But when they do, the idea is, such benefits are likely mediated by transformations in some of these emotional and cognitive processes across the interacting members.

6. Mechanisms of complementarity

In line with our pluralist stress on multiple levels of processing in joint expertise, I finish with a brief cautionary note on the complexity of interdependence in typical human collaborative embodied skills. It is tempting to think of group interaction, especially in action contexts, on models deriving from the range of wonderful, relatively simple processes of coordination operative in many non-human animal groups. Mechanisms relevantly similar to those at work in animal swarms, flocks, and herds may well operate in many human cases too. This focus, across a number of fields and research traditions, encourages us to think of the kinds of affective and cognitive coordination involved in interdependent groups of the kind I’ve been discussing as based in or requiring convergence. The idea is that – whether in action, navigation, emotion, or memory, for example – what is shared among interdependent group members is something similar: synchronous or entrained actions (Mogan, Fischer, & Bulbulia, 2017; Paxton & Dale 2017), combined estimations of orientation or direction (Fernandez Velasco 2022), or a ‘shared rendering’ of the past (Coman & Hirst 2015).

When philosophers apply these ideas to human interaction, they sometimes describe the groups in question as operating by way of a kind of ‘social parity principle’, understood on the model of Clark and Chalmers’ (1998) parity principle for understanding relationships between brains and artifacts. Deborah Tollefsen (2006), for example, noted that when a relevant ‘external’ cognitive or affective resource is another person rather than an

artifact, there are no deep differences of kind, mechanism, and process between the parts of the distributed system, such that there may be (or develop) relevant forms of functional similarity (or, in the extreme, kinds of merger) between members of an interdependent team or couple.

But the approach I have sketched here, involving shifting balances among many heterogeneous components in cognitive ecologies of skill, suggests that convergence and similarity are not the only or the most interesting forms of interdependence in cognition, affect, and action, even when we are considering human-human relationships rather than the material culture of cognitive artifacts. I have stressed the importance of specialization and of cognitive and affective division of labour among interacting groups, in which individual members bring distinctive capacities into the interaction and perform often very different tasks during interaction. Agreement and convergence are not required for effective group performance. If we think of a group as a certain kind of mechanism, in which distinctive components interact in characteristic operations in producing novel outputs (Theiner 2013), we do not need to assume homogeneity among those components. Unlike many of the relevant processes in non-human animal coordination, the effect of shared history within a human group is often to magnify differences and specialization, rather than reduce to a set of common or similar processes which are then additively combined. More explicit or reflective processes can play significant roles in human groups, in ways that are again unlike many in non-human animals, in allowing shared awareness of the group's history and performance, and in bringing that awareness into the open among group members for adjustment or refinement or critique (Sutton & Tribble 2014; Sutton 2018).

Aiming to complement philosophical analyses of joint know-how and group expertise, in this essay I have built on recent integrative interdisciplinary approaches to collaborative embodied skill in real performance contexts. I have sought to identify, and to offer some initial directions for research into, an expanded array of resources or components that can scaffold or partly constitute the remarkable capacities of some small teams and groups to think effectively on their feet in challenging situations, exhibiting various forms of joint intelligence in action.

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References

- Aagaard, J. (2021). '4E cognition and the dogma of harmony', *Philosophical Psychology* 34 (2): 165-181.
- Becker, H. (2008). *Art Worlds (updated and expanded)* (University of California Press).
- Bicknell, K. (2021), 'Embodied intelligence and self-regulation in skilled performance: or, two anxious moments on the static trapeze', *Review of Philosophy and Psychology* 12 (3): 595-614.
- Bicknell, K., & Sutton, J. (eds.) (2022), *Collaborative Embodied Performance: ecologies of skill* (Bloomsbury).
- Bicknell, K., Sutton, J., & Harris, C.B. (in progress), 'The Wisconsin moment: embodied interaction in collaborative recall experiments'.
- Bietti, L., & Sutton, J. (2015), 'Interacting to remember at multiple timescales: coordination, collaboration, cooperation and culture in joint remembering', *Interaction Studies* 16 (3): 419-450.
- Birch, J. (2019), 'Joint know-how', *Philosophical Studies* 176: 3329-3352.
- Bourbousson, J., & Fortes-Bourbousson, M. (2016). 'How do co-agents actively regulate their collective behavior states?', *Frontiers in Psychology* 7: 1732.
- Bratman, M.E. (2014). *Shared Agency: a planning theory of acting together* (Oxford University Press).
- Christensen, W., Sutton, J., & Mcllwain, D.J.F. (2016). 'Cognition in skilled action: meshed control and the varieties of skill experience. *Mind & Language* 31 (1), 37-66.
- Christensen, W., & Sutton, J. (2019). 'Mesh: cognition, body, and environment in skilled action'. In M.L. Cappuccio (ed.), *Handbook of Embodied Cognition and Sport Psychology* (MIT Press), 157-164.
- Christensen, W., Sutton, J., & Bicknell, K. (2019). 'Memory systems and the control of skilled action'. *Philosophical Psychology* 32 (5), 693-719.
- Clark, A., & Chalmers, D. (1998). 'The extended mind'. *Analysis* 58 (1), 7-19.
- Colombetti, G., & Krueger, J. (2015). 'Scaffoldings of the affective mind'. *Philosophical Psychology* 28 (8): 1157-1176.
- Coman, A., & Hirst, W. (2015). 'Social identity and socially shared retrieval-induced forgetting: the effects of group membership'. *Journal of Experimental Psychology: General* 144 (4): 717-722.
- Eccles, D.W., & Tenenbaum, G. (2004). 'Why an expert team is more than a team of experts: a socio-cognitive conceptualization of team coordination and communication in sport', *Journal of Sport and Exercise Psychology*, 26: 542-560.
- Ericsson, K.A. (2006). 'The influence of experience and deliberate practice on the development of superior expert performance'. In K.A. Ericsson, R.R. Hoffmann, & A. Kozbelt (eds.), *The Cambridge Handbook of Expertise and Expert Performance* (Cambridge University Press), 685-705.
- Fernández Velasco, P. (2022). 'Group navigation and procedural metacognition'. *Philosophical Psychology*.
- Gaffney, P. (2015). 'The nature and meaning of teamwork'. *Journal of the Philosophy of Sport* 42 (1), 1-22.
- Geeves, A., Mcllwain, D.J.F., & Sutton, J. (2014), 'The performative pleasure of imprecision: a diachronic study of entrainment in music performance', *Frontiers in Human Neuroscience* 8: 863.
- Gesbert, V., Durny, A., & Hauw, D. (2017). 'How do soccer players adjust their activity in team coordination? An enactive phenomenological analysis'. *Frontiers in Psychology* 8: 854.
- Goodwin, C. (1994). 'Professional vision'. *American Anthropologist* 96 (3), 606-633.
- Grasseni, C. (2004). 'Skilled vision: an apprenticeship in breeding aesthetics'. *Social Anthropology* 12 (1), 41-55.
- Habgood-Coote, J. (2022), 'Collective practical knowledge is a fragmented interrogative capacity', *Philosophical Issues* 32: 180-199.
- Harris, C.B., Paterson, H.M., & Kemp, R. I. (2008). 'Collaborative recall and collective memory: what happens when we remember together?' *Memory* 16 (3): 213-230.
- Harris, C.B., Keil, P.G., Sutton, J., Barnier, A.J., & Mcllwain, D.J.F. (2011). "'We remember, we forget": collaborative remembering in older couples'. *Discourse Processes* 48 (4), 267-303.
- Harris, C.B., Barnier, A.J., Sutton, J., & Keil, P.G. (2014). 'Couples as socially distributed cognitive systems: remembering in everyday social and material contexts'. *Memory Studies* 7 (3): 285-297.
- Harris, C.B., Barnier, A.J., Sutton, J., Keil, P.G., & Dixon, R.A. (2017). "'Going episodic": collaborative inhibition and

- facilitation when long-married couples remember together'. *Memory* 25 (8): 1148-1159.
- Harris, C.B., Barnier, A.J., Sutton, J., & Savage, G. (2019). 'Features of successful and unsuccessful collaborative memory conversations in long-married couples'. *Topics in Cognitive Science* 11 (4), 668-686.
- Hutchins, E. (1995), *Cognition in the Wild* (MIT Press).
- Iskander, N. (2021), *Does Skill Make Us Human? Migrant workers in 21st-century Qatar and beyond* (Princeton University Press).
- Kimmel, M. 2016. 'Embodied (micro-)skills in tango improvisation'. In F. Engel (ed.), *Das Entgegenkommende Denken* (De Gruyter), 57-74.
- King, A., & de Rond, M. (2011). 'Boat race: rhythm and the possibility of collective performance'. *British Journal of Sociology* 62 (4), 565-585.
- Kiverstein, J., & Rietveld, E. (2021). Skilled we-intentionality: situating joint action in the living environment. *Open Research Europe* 1: 54.
- Larson, J.R. (2010), *In Search of Synergy in Small Group Performance* (Taylor & Francis).
- Laughlin, P.R. (2011). *Group Problem Solving* (Princeton University Press).
- Malone, T.W., & Woolley, A.W. (2020). 'Collective intelligence'. In R.J. Sternberg (ed.), *The Cambridge Handbook of Intelligence* (Cambridge University Press), 780-801.
- Marion, S.B., & Thorley, C. (2016). 'A meta-analytic review of collaborative inhibition and post-collaborative memory: testing the predictions of the retrieval strategy disruption hypothesis'. *Psychological Bulletin* 142 (11): 1141-1164.
- Martens, J.H. (2021). 'Habit and skill in the domain of joint action'. *Topoi* 40 (3): 663-675.
- McIlwain, D.J.F., & Sutton, J. (2015). 'Methods for measuring breadth and depth of knowledge'. In D. Farrow & J. Baker (eds.), *The Routledge Handbook of Sport Expertise* (Routledge), 221-231.
- Meade, M.L., Nokes, T.J., & Morrow, D.G. (2009). 'Expertise promotes facilitation on a collaborative memory task'. *Memory* 17 (1): 39-48.
- Meade, M.L, Harris, C.B., van Bergen, P., Sutton, J., & Barnier, A.J. (2018). *Collaborative Recall: theories, research, and applications* (Oxford University Press).
- Millar, S.K., Oldham, A., & Renshaw, I. (2013). 'Interpersonal, intrapersonal, extrapersonal? Qualitatively investigating coordinative couplings between rowers in Olympic sculling'. *Nonlinear Dynamics, Psychology, and Life Sciences* 17 (3) : 425-443.
- Mogan, R., Fischer, R., & Bulbulia, J.A. (2017). 'To be in synchrony or not? A metaanalysis of synchrony's effects on behavior, perception, cognition and affect'. *Journal of Experimental Social Psychology* 72: 13-20.
- Nokes-Malach, T.J., Meade, M.L., & Morrow, D.G. (2012). 'The effect of expertise on collaborative problem solving'. *Thinking & Reasoning* 18 (1): 32-58.
- Palermos, S.O., & Tollefsen, D.P. (2018). 'Group know-how'. In J.A. Carter, A. Clark, J. Kallestrup, S.O. Palermos, & D. Pritchard (Eds.), *Socially Extended Epistemology* (Oxford University Press), 112-131.
- Paxton, A., & Dale, R. (2017). 'Interpersonal movement synchrony responds to high- and low-level conversational constraints'. *Frontiers in Psychology* 8: 1135.
- Pino, D. (2021). 'Group (epistemic) competence'. *Synthese* 199: 11377-11396.
- Preston, B. (2012). *A Philosophy of Material Culture: action, function, and mind*. Routledge.
- Protevi, J. (2023). '*Esprit de Corps* and thinking on (and with) your feet: standard, enactive, and poststructuralist aspects of relational autonomy and collective intentionality in team sports'. *Southern Journal of Philosophy*.
- Rimé, B., & Páez, D. (2023). 'Why we gather: a new look, empirically documented, at Émile Durkheim's theory of collective assemblies and collective effervescence'. *Perspectives on Psychological Science*.
- Rosenberg, M., Gordon, G., Noy, L., & Tylen, K. (2022). 'Social interaction dynamics modulates collective creativity'. In *Proceedings of the Annual Meeting of the Cognitive Science Society* 44.
- Salmela, M., & Nagatsu, M. (2017). 'How does it really feel to act together? Shared emotions and the phenomenology of we-agency'. *Phenomenology and the Cognitive Sciences* 16 (3): 449-470.

- Shea, N., Boldt, A., Bang, D., Yeung, N., Heyes, C., & Frith, C.D. (2014). 'Supra-personal cognitive control and metacognition'. *Trends in Cognitive Sciences* 18 (4), 186-193.
- Slaby, J. (2016), 'Mind invasion: situated affectivity and the corporate life hack', *Frontiers in Psychology* 7, 266.
- Sutton, J. (2018). 'Shared remembering and distributed affect: varieties of psychological Interdependence'. In K. Michaelian, D. Debus, & D. Perrin (eds.), *New Directions in the Philosophy of Memory* (Routledge), 181-199.
- Sutton, J., & Bicknell, K. (2020), 'Embodied experience in the cognitive ecologies of skilled performance'. In E. Fridland & C. Pavese (eds.), *The Routledge Handbook of the Philosophy of Skill and Expertise* (Routledge), 194-205.
- Sutton, J., & McIlwain, D.J.F. (2015). 'Breadth and depth of knowledge in expert versus novice athletes'. In D. Farrow & J. Baker (eds.), *The Routledge Handbook of Sport Expertise* (Routledge), 95-105.
- Sutton, J., McIlwain, D.J.F., Christensen, W., & Geeves, A. (2011). 'Applying intelligence to the reflexes: embodied skills and habits between Dreyfus and Descartes'. *JBSP: Journal of the British Society for Phenomenology* 42 (1): 78-103.
- Sutton, J. & Tribble, E. (2014), 'The creation of space: narrative strategies, group agency, and skill in Lloyd Jones's *The Book of Fame*'. In C. Danta & H. Groth (eds.), *Mindful Aesthetics: literature and the sciences of mind* (Bloomsbury), 141-160.
- Sutton, J., & Williamson, K. (2014). 'Embodied remembering'. In L. Shapiro (ed.), *The Routledge Handbook of Embodied Cognition* (Routledge), 315-325.
- Sweet, K. (2023), 'How to collaborate well'. *Pacific Philosophical Quarterly*.
- Theiner, G. (2013). 'Transactive memory systems: a mechanistic analysis of emergent group memory'. *Review of Philosophy and Psychology* 4 (1), 65-89.
- Thonhauser, G. (2022). 'Towards a taxonomy of collective emotions'. *Emotion Review* 14 (1), 31-42.
- Tollefsen, D.P. (2006). 'From extended mind to collective mind'. *Cognitive Systems Research* 7 (2), 140-150.
- Tollefsen, D.P., Dale, R., & Paxton, A. (2013), 'Alignment, transactive memory, and collective cognitive systems'. *Review of Philosophy and Psychology* 4 (1), 49-64.
- Vesper, C., Butterfill, S., Knoblich, G., & Sebanz, N. (2010), 'A minimal architecture for joint action'. *Neural Networks* 23 (8-9), 998-1003.
- Weldon, M.S. (2000), 'Remembering as a social process'. *Psychology of Learning and Motivation* 40, 67-120.
- Williamson, K., & Cox, R. (2014), 'Distributed cognition in sports teams'. *Educational Philosophy and Theory* 46 (6), 640-654.
- Williamson, K., & Sutton, J. (2014), 'Embodied collaboration in small groups'. In C.T. Wolfe (ed.), *Brain Theory: essays in critical neurophilosophy* (Palgrave), 107-133.