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Complexity theory and learning: Less radical than it seems?

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ABSTRACT

In a spirit of collegial support, this paper argues that Beckett and Hager's theoretical justification and empirical exemplifications do not do full justice to the complexity of group or team learning. We firstly reaffirm our support for the theoretical argument Beckett and Hager make, though expressing some reservations about Complexity Theory, to explain the taken-for-granted assumptions that learning by an individual is the paradigm case of learning and that context plays a minimal role in this process. Drawing on our joint and separate work, we demonstrate that Beckett and Hager's argument is less radical than it may initially seem because it is predicated on: (i) cognitive-bounded rather than "distributed" or "extended" conception of mind; (ii) material rather than an "immaterial" conception of activity; and (iii) co-present rather than a "fractional" or "connective" conception of ontology. Despite making this critique, we conclude by making the case that we are adding further substance to Beckett and Hager's overarching argument and, in doing so, encouraging them to be more radical about how they conceptualise the complexity of learning.

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Introduction

In their book *The Emergence of Complexity: Rethinking Education as a Social Science* as well as in their contribution to this edition of *Educational Philosophy and Theory*, Paul Hager and David Beckett present a compelling argument about the concept of learning. They state the two premises underpinning their argument in unequivocal terms. They are that: 'learning by groups or teams is typically a distinctive kind of learning that is not reducible to learning by individuals'; therefore 'a degree of holism is essential for achieving a convincing understanding of this distinctive type of group or team learning', because 'groups frequently provide experiences that stimulate distinctive and valuable learning' (Hager & Beckett, 2022, p. 1). We concur wholeheartedly with Hager and Beckett's deliberations and conclusion. We argue however, provocatively, but in a spirit of collegial support, that their theoretical justification and empirical exemplifications do not do full justice to the complexity of group or team learning. We make this argument as multidisciplinary social scientists interested in learning in diverse contexts such as workplaces, project teams, and networks, rather than as philosophers of education with an interest in similar issues (see *inter alia*. Guile, 2010, 2019; Guile and Spinuzzi, forthcoming; Guile and Wilde,

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forthcoming; Leonard & Wilde, 2019; Wilde & Guile, 2021). Moreover, although we assume, like Hager and Beckett (2022, p. 2) that ‘groups frequently provide experiences that stimulate distinctive and valuable learning’, we nevertheless feel that the theories of human interaction and communication we draw on offer a more encompassing basis to conceptualise collective learning and also enable us to take account of the impact of ‘digitisation’ on conceptions of ontology.

To make this case, we firstly outline, briefly, Hager and Beckett’s concept of complexity learning (CL), before affirming and underscoring our support for their argument by drawing on some of our research which has highlighted how contemporary training, when based on neo-liberal conceptions of the individual self can undermine group or team learning. We then point out that, paradoxically, although Hager and Beckett (2022, p. 3) draw on complexity theory to argue that the complexity of ‘systems’ (in their terms group or team learning) arises from a new unit of analysis—the *relations* between entities rather than from the entities themselves—their concept of collective learning is less radical than it may initially seem. We maintain that this occurs for two reasons. Firstly, Hager and Beckett leave un-disturbed the naturalistic legacy in complexity theory and, as such, draw a parallel between human and naturalistic conceptions of interaction and communication. We argue that to understand the dynamics of group learning it is important to identify what differentiates humans from natural activity. We explore this proposition by discussing Vygotsky’s (1987) great insight as a result of his critique of naturalism in psychology (Bakhurst, 1991), which Hutchins (1995) elaborated and extended, that what differentiates human learning, irrespective as to whether it is individual or collective, from animal learning and by extension naturalistic conceptions of interaction, is the way *cultural practices* mediate and distribute cognition between people, artefacts and contexts. We show how this constitutes a radically different conception, but potentially an extension, of Hager and Beckett’s concept of CL. Secondly, we argue conceptually and empirically through reference to an account of jazz group learning that the concepts Hager and Beckett use to establish the theoretical foundations of their argument about complexity—‘general complexity’ and ‘co-presence’—are much more limited than they acknowledge in relation to co-present group learning. Thirdly, we consolidate this argument by drawing on our joint and separate work and using the concepts of ‘fractionality’ (Guile and Spinuzzi, forthcoming) and ‘immaterial’ activity (Wilde & Guile, 2021) to analyse learning among project teams that not only have a minimal history of working with, but also a distributed presence with, one another. We argue that the conjoined working and learning issues we identify as characteristic of project work can be addressed more comprehensively by the Vygotsky-Hutchins lineage we have outlined than by Hager and Beckett’s concept of complexity learning, and we conclude by encouraging them to consider how they could draw on our engagement with their work to develop an even more radical conceptualisation of collective learning.

Complexity theory and learning: Building blocks, naturalistic legacy and problem

Noting that although it originated in the natural sciences last century, CL has come to be recognised as beneficial for the social sciences because it shares with them a concern for the workings of complex systems, Hager and Beckett (2022, p. 5) distinguish between two kinds of complexity: ‘restricted’ (rule-based) and: ‘general’ (emergent). Arguing that common human experiences and learnings arise from agentic and therefore emergent individual and collective activity, Hager and Beckett (ibid) conclude that in the ‘social sciences such as education, it is through the agency of the humans that comprise parts of these complex systems, together with the causal powers of the social interactions occurring within these systems, that enable novel, even *unpredictable*, outcomes that emerge from the processes—indeed, the activities—of these complex systems’. Hence Hager and Beckett (ibid) conclude that ‘restricted complexity’ is

too limited for theorising human learning and interaction since it does not acknowledge how human intentionality shapes our world whereas *'general complexity'* does enable researchers to explore how a 'group as a whole typically learns'.

The foundation for the above conclusion about general complexity is Hager and Beckett's (2022) parsing of Chalmers and Bedau's respective interpretation of the concept of emergence in relation to their interpretation of complexity theory. This leads Hager and Beckett (2022, p. 4) to conclude that 'weak emergence is a very common phenomenon' in natural as much as in social systems and, therefore, an acceptance of 'unexpected emergents', such as, new forms of behaviour or even systems constitute one important building block for any account of learning in groups. Defining the other building block as 'co-presence', that is, work groupings (of between 2 and 12 members) who they present as the 'fundamental meaning-making phenomena of both our working lives and of our social interactions more generally' (Hager & Beckett, 2022, p. 6), they give this claim a Deweyan–Bentlean twist (1949/1989). Drawing on their concept of 'trans-action', Hager and Beckett (ibid) explain how co-present parties are created or influenced by their participation in interactive processes in ways that not only change them, but also the relations between them.

We concur with Hager and Beckett that it is necessary to escape from the near hegemony of individualist conceptions of learning for the reasons they state, and to also avoid the pernicious way that socio-economic and political dimensions influence and shape individualistic approaches to learning (Leonard & Wilde, 2019). Using a Foucaudian lens, one of us has highlighted how 'the individual' has become further entrenched in approaches to learning, and in conceptions of learners, as neoliberal conceptions of the self have become prevalent in policy discourse. In previous research (Leonard & Wilde, 2019), it was demonstrated how employability training schemes aimed at young people were underpinned by neoliberal conceptions of the individual self and utilised techniques geared towards supporting young people to conceptualise themselves in this manner as well. For example, four case study schemes were all predicated on one of the main tenets of neoliberalism—individual responsabilization (Beck & Beck-Gernsheim, 2002). They therefore all, even the programme that had been designed by young people themselves, included this element as the main structuring principle, requiring young people to think of and evaluate themselves in relation to a set of pre-determined skills. This focus neglects the range of socio-economic and political factors that influence entry into employment, such as the availability of jobs as well as forms of disadvantage, such as access to public transport or childcare and discrimination. By masking social inequalities, not only is the responsibility for gaining employment pushed onto the individual and their abilities to acquire skills, but also it either conceals group learning, or even discourages learning strategies that might utilise relationships and peer collaboration to support collective learning. Hence, we echoed Hager and Beckett's conclusion that by focussing on cognitive processes rather than other elements of learning that occur through interaction, the significance of relationships in shaping the self is denied (Leonard & Wilde, 2019).

Despite our above supportive observations, what troubles us about Hager and Beckett's account of group learning is that it has left un-disturbed the naturalistic legacy in complexity theory and underscored this with a naturalistic philosophical justification and, as such, leads them to draw a parallel between natural and human interaction. In their discussion of the parallel they claim exists between complexity theory and collective learning, Hager and Beckett (2022, p. 10) use the concepts of weak emergence and high- and low-level phenomena in different human systems to underpin their claim collective learning is an emergent phenomenon. While we follow Hager and Beckett and agree that the crucial feature of complex human systems is that their complexity arises from the relations between different forms of human activity and that interactions between non-linear human relations can give rise to novel structures or qualities, we are not convinced that their concept of emergence captures what is distinctive about human learning and interaction. Moreover, while we accept that humans develop

complexity-reducing sensory and cognitive capacities, we see this as a culturally constituted process rather than a biological inheritance.

Collective learning: The constitutive role of cultural mediation and cultural practices

Our alternative culturally constituted conception of human learning comes from Cultural-Historical Activity Theory (CHAT). The root of this alternative conception, which informs our understanding of these issues, is Vygotsky's (1987) 'general genetic law of cultural development'. In a determined attempt to eradicate the influence of naturalistic assumptions about cognition in psychology, especially but not limited to behaviourism (see *inter alia*. Bakhurst, 1991; Derry, 2013; Wertsch, 1985), Vygotsky (1987, p. 57) developed a general formulation of the way in which we internalise extant forms of social practice, for example, language, due to our participation in collective activities in society and how the reverse transition from internal to external forms of thought (i.e. externalisation) results in the creation of cultural artefacts, for example, new books. Vygotsky defined this process of human development from children to adulthood, as follows: 'Every function in the child's cultural development appears twice: first on the social level, and later, on the individual level; first between people (interpsychological), and then inside the child (intrapyschological)'. Vygotsky concluded that this process applied equally to the way in which children develop their capability to voluntarily pay attention to their own activity, for example, playing with others, a teacher's explanation of a task prior to undertaking that task, the development of memory, and the formation of initially everyday and eventually theoretical concepts. Hence, Vygotsky concluded that 'All the higher mental functions originate as actual relations between human individuals' rather than through biological inheritance. Over the intervening years, Vygotsky's cultural-historical theory of learning has been developed by Engeström (1987, 2008) in particular to engage with a particular expression of group learning namely 'expansive learning', that is, the creation of new modes of activity, in work contexts facilitated by a researcher-led 'interventionist' methodology, and used in the fields of education and philosophy to explain the cultural development of mind, identity and agency (see *inter alia*. (Derry, 2013; Ellis et al., 2010; Postholm & Vennebo, 2019).

Influenced by Vygotsky, though concerned with adult cognition and learning, Hutchins (1995) was concerned to combat a subsequent form of naturalism found in cognitive science namely the concept of 'information processing'. To do so and show how cognition had always had a cultural root, Hutchins elaborated and extended the above law in his work on 'distributed cognition'. To make this move, Hutchins (1995, p. 283) posed the following question: 'What happens if we consider adults learning more complicated thinking strategies in more complicated settings where the primary goal of activity is successful task performance?' This led him to demonstrate conceptually and empirically (Latour, 1996, pp. 55–57) that many of the external interpsychological functions, in other words, cultural practices, associated complex distributed systems, such as navigation, are too complex to be internalised by single individuals and therefore are distributed between individuals and cultural tools. This process therefore not only constrains human perception and action, but also shapes the types of necessary embodied skills adults need to develop to successfully perform in a distributed cognitive system. Adults in this world are, according to Hutchins (1995, p. 316, xvii), firstly, 'a very *special medium* that can provide *coordination* among many structured media—some internal, some external, some embodied in artifacts, some in ideas and some in social relationships' and secondly, they learn 'as local adaptations in a dynamic system of co-ordinations of representational media'.

From Hutchins (2014, p. 36) perspective, 'all instances of cognition *can be seen* as emerging from distributed processes (italicization in original)' and therefore individuals and groups have always learnt through a mediated, that is, emergent internalisation-externalisation process where

the outcome could range from anticipated, to un-anticipated or novel depending on the purpose of the activity in which they were engaged. This constitutes a radically different conception of distribution and collective learning in complex systems compared with Hager and Beckett's use of the same terms when they discuss co-presence and emergent learning in groups, as well as with Engeström's (1987, 2008) well-known work on researcher-facilitated collective expansive learning. The root of the difference in both cases lies in the way in which Hutchins elaborates and extends Vygotsky's general genetic law of cultural development to adults. The processes of occupational coordination occur as members of a distributed system, such as a navigation team, who have different roles, skills and inclinations to be agentic, internalise and externalise their engagement with the collective task-in-hand. Internalisation here does not mean simply adults copying external cultural practices, rather internalisation refers to the transformation of those external practices and changes in their structure and function in ways that are individual and collective: hence the creative and improvisational character of navigation (Hutchins, 1995, p. 283). Hutchins therefore allows us to appreciate the way in which distributed processes and their cultural practices facilitate emergent collective learning, without losing sight of individual learning within that process, in a deeper way than can be captured by the concept of trans-action (Guile, 2010, p. 81) and without the forms of researcher-facilitation associated with Engeström's concept of expansive learning.

At first sight, this may appear to be a very similar, even identical, argument to the one Hager and Beckett make. They note that humans reduce complexity in order 'to facilitate ease of thought or action' (Hager & Beckett, 2019, p. 190), and they nominate, among other examples, a jazz group as an example of a co-present group centred on a 'shared process towards a common goal' and whose members produce their own distinctive outputs so that they simultaneously blend seamlessly into the whole that is the musical performance. Where the concept of CL differs, significantly, from the Vygotsky-Hutchins lineage that we have outlined above is with respect to the role of cultural mediation and cultural practices. Reducing complexity to facilitate ease of thought or action and the creation of co-present sub-groups is presented as a situated but nonetheless naturalistic way of doing things. In doing so, Hager and Beckett pass over the reason this array of possibilities exists. The first reason is that humans develop, as our account of Vygotsky and Hutchins has demonstrated, our higher mental functions continually throughout the life-course as we engage in increasingly more complex forms of cultural mediation from pre-set tasks to self-generated tasks in education and pre-set tasks to self-generated tasks in workplaces. The former internalisation-externalisation process is therefore a constitutive, albeit continually transformed, feature of the latter: hence there is more of a relationship between individual and education-based learning and collective in-the-wild learning than Hager and Beckett acknowledge. The second reason is that our cultural practices, as Hutchins (2011, p. 441) points out, 'shape active sensing and ways of seeing the world by highlighting what to attend to and what to see when attending'. In making this case, Hutchins (2011, p. 443) is allowing us to appreciate how different forms of 'professional vision' (Goodwin, 1994), in the case of a jazz group, the expertise each member has initially developed via internalisation-externalisation processes through their training and professional experience is further developed (i.e. emerges) in an orchestra's dynamically distributed system of cognition, and how such systems also contribute to the way members of an orchestra organise its thinking, acting and feeling in situated activity. Hence, it follows for Hutchins (2014, p. 38) that it is cultural practices that 'tend to reduce entropy (increase predictability) at all scales in a cultural cognitive ecosystem', rather than biologically inherited complexity-reducing sensory and cognitive capacities.

One way to illustrate this conceptual account of distributed cognition in relation to Hager and Beckett's argument is to return to the example of a jazz group. To do so, we draw on the account in Ian Carr's book *Miles Davis* (1982/1999) of Miles Davis's ground-breaking album *In a Silent Way*. Curious about the genesis of the album, Carr interviewed the musicians who

contributed to the session. His account starts with John McLaughlin's (guitarist) recollections about how the version of the title tune came about to explain the situated interplay and group learning between the musicians as a result of Miles Davis saying to him:

'Play it like you don't know how to play guitar.' 'I didn't know what he was talking about....Anyway, so I started playing the melody and he was yeah right ...so I carried onthen Wayne [Shorter – saxophonist: authors] played it and then Miles and Wayne togetherI couldn't believe Miles's versionWe played it on one chord....and the tune is in E.... one simple, really simple chord....and he transformed it into something that was really special.' [Dave Holland, bass player further explained: authors]. "What he [Miles: authors] is ...he's saying "Don't play what's there, play what's *not* there (italicisation in original)." He's saying "Don't play what your fingers fall into"....."Play something else." Holland continues by saying, Miles was 'always trying to put you in a new space all the time where you weren't approaching the music from the same point of view ... from a preconceived point of view.'

The above account of the making of *In a Silent Way* represents instances of cognition having emerged from distributed processes. All the musicians have, through an internalisation-externalisation process over the course of their respective careers in schools of music, membership of different groups, and self-directed learning, not only developed a unique way of playing their instruments, in other words, their style, but also their own conjoined way of working and learning from one another, in other words, propagating musical knowledge between them. The problem with this accumulated knowledge and certainty about style and improvisation for Miles Davis was that the tune his group is recording was lacking an element of surprise or novelty. He therefore created a context to facilitate a more creative approach to the recording of the tune by through calling on his well-known cultural practice of issuing a cryptic instruction to musicians—in this case John McLaughlin—and letting him lead in an unknown direction the development of the tune once he had internalised the meaning of the statement 'Play it like you don't know how to play guitar.' (Carr, 1982/1999, pp. 175–176). McLaughlin's tentative externalisation of that request was then responded to in a similar vein by the other musicians contributing to the session—Wayne Shorter, Dave Holland, Tony Williams (the drummer) and Miles Davis himself, without any further instruction because, as Dave Holland acknowledged, they had all inferred Miles Davis wanted then to play what was not there.

What the Vygotsky-Hutchins lineage allows us to appreciate is that firstly, general complexity and co-presence, even with Hager and Beckett's enhancement via the concept of trans-action, are an insufficient explanation of the type of group learning described above. They struggle to explain the way in which cognition and expertise is historically and culturally constituted and distributed between group members as well as the way in which group members draw on both to infer how to respond to the cue the group leader offered about how to think afresh about how to respond to one another's musical contributions. Secondly, the way in which contexts with distributed cultural practices to facilitate working and learning are created, and how members coordinate among different resources—some internal (i.e. expertise and experience), some external (relationship with others), some embodied in artefacts (i.e. where fingers would usually fall), some in ideas (i.e. play what you don't know) and in the process group members engage in dynamic local adaptations, to achieve an established (i.e. recognisable jazz tune) but novel (sound, tempo and structure) outcome.

Collective learning: Immaterial activity and fractional ontology

The Vygotsky-Hutchins lineage, when supplemented by our interpretation of Moulier Boutang (2012) post-Operaismo influenced writing on the 'cognitive' dimension of work as well as our work on 'fractional ontology' (Guile and Wilde, forthcoming), also allows us to analyse the way in which cognition and expertise are historically and culturally constituted and distributed between group members who in contrast to the above example lack a history of working with one another but nevertheless engage in forms of collective learning.

Operaismo is an eclectic strand of Marxist economic, philosophical and political scholarship (see *inter alia*. Pasquinelli, 2015; Peters & Bulut, 2011; Virno & Hardt, 1996). In contrast to classic Marxism, Operaismo presents a different way of understanding capital because, instead of assuming the purpose of capital is to produce goods and services, it argues that knowledge production in workplaces is the ‘very thing that accumulation aims at’ Moulrier Boutang (2012, p. 71). In his book *Cognitive Capitalism*, Moulrier Boutang (2012, pp. 71–72) argues that a decisive shift has occurred from a ‘Smithsonian’ to a ‘Cognitive’ division of labour i.e. the functional differentiation of teams to the creation of interprofessional teams. The outcome has been, according to Moulrier Boutang (2012, p. 22) that the ‘essential point of capitalism is no longer the expenditure of human labour power, but that of invention power’. This occurs as interprofessional teams engage in ‘immaterial’ activity by capturing ‘externalities’, in other words, ideas, suggestions and so forth which they use to facilitate innovations in the work process (*ibid*).

Interpreted from a Vygotskian-Hutchian perspective, Moulrier Boutang is arguing that this shift in the division of labour has created a new cultural context in workplaces which requires team members to internalise and externalise new cultural practices. Using this combined CHAT-post-Operaismo conceptual framework, we have explored a particular manifestation of interprofessional project team immaterial activity—‘client-focused interprofessional project teams’ (C-fIPPT). This term refers to a common pattern of work in the global economy where an organisation tenders for contracts and then assembles a project team from within their own and other organisations to deliver that contract’s stipulated outcomes (Guile & Wilde, 2018; Wilde & Guile, 2021). Members of C-fIPPTs only have therefore a ‘fractional’ (Guile and Wilde, forthcoming) relationship or mode of co-presence with one another since many of them will be, simultaneously, working on other projects. They constitute therefore a paradigmatic example of collective fractional and immaterial working and learning.

To illustrate this claim, we present below a summary of a vignette from a forthcoming publication about a C-fIPPT comprised of architects, fabrication and service engineers. The vignette starts mid-meeting when the lead architect has just posed the following question ‘Could we group the flues’ (to avoid them protruding over the top of the building)? Team members then looked at 3D images produced by members of the team who are not present in the meeting, before one of the service engineers suggested he ‘could seek clarification about options for positioning the chiller from the manufacturer’. One of his colleagues then reminded the team that the acoustic engineers (not present) had ‘measured the acoustics last week’ and they’d have to ‘check whether they are Ok with any new proposal’, before thinking aloud about whether ‘a “decorative” solution’ might be the way to resolve the protruding problem. To explore this suggestion, the project team had to firstly, agree among themselves how to share ideas and discuss their implications since they lacked a history of working with one another. Secondly, oscillate between externalising their ideas by thinking aloud to generate possible solutions before selecting a suggestion to focus on and internalising other team members aesthetic, technical or financially-informed suggestions about how to implement that solution. Thirdly, conjoin their face-to-face and ‘digital’ connectivity (Schwartz, 2021) so they could use the 3D drawings, which had been created by members of the team who were not present, as a resource to ‘see’ the building they were re-designing from their specialist perspective, from the perspectives of other team members’ specialist perspective, to anticipate how absent team members’ might respond and then agree a solution to the problem-in-hand. The cumulative effect of the project team’s deployment of these cultural practices was that they were able to commingle aesthetic (look of the building), technical (repositioning flues) and financial (cost of repositioning flues) considerations to resolve the above protruding problem.

The form of complexity and co-presence described in the vignette emerged as a result of the way in which cognition has been distributed via cultural practices—in and beyond the situation—between professionals, artefacts and environment in the forms of fractional and immaterial working and learning described above. Team members, unlike the Miles Davis

example, were a contingent, unstable set of actors with divergent concerns and forms of knowing, their challenge was to learn enough about one another's concerns and modes of justification to make their joint effort relatively coherent and stable. To do so, they engaged in an 'ontological performance' where the discursively immaterial and socio-material conditions of possibility they generated enabled them to frame and enact their collective learning as decisions (ibid).

Complexity theory and learning: Conclusion

We have affirmed the strategic importance of the case Hager and Beckett have advanced that learning by groups or teams is typically a distinctive kind of learning that is not reducible to learning by individuals or the aggregation of individual learning. We have nevertheless argued that the naturalistic legacy which runs through complexity theory, even when supplemented by insights from notably Dewey and Bentley (1989), imposes significant limitations of their conceptualisation of collective learning, including the role of cognition in that process. We have argued that, because Hager and Beckett share with us a common interest in conceptualising and investigating collective learning, our interpretation of the Vygotsky-Hutchins lineage offers them a way to firstly, make the cultural dimension of collective learning visible when conceptualising and investigating the complexity of that form of learning. Secondly, take account of the immaterial and fractional ontological dimensions of collective learning that, currently, fall outside of the sphere of their argument about complexity and collective learning.

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