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Skilled Embodiment in Emergency Medicine

The “interactivity turn” and its implication for theory and practice

Abstract: This paper applies a multiscale interactivity perspective in the study of how healthcare professionals enact skilled embodiment in ways that allow them to animate their rich environment during task performance. However, in focusing on interactivity, we are not only interested in the characteristics of embodiment as they are enacted in the here-and-now. While task performance involves not only the whole body (as a multi-sensory organ), but a historical, skilled body that affects the ecology in which a person is embedded, action-perception must be viewed as direct and distributed. That is, habitual performance and skilled embodiment emerge in coordination with lived experience and real-time affordances for action. Specifically, this paper investigates two real-life cases of how patients and medical staff engage in interactivity through rich embodiment including languaging. From an interactivity perspective, the first case indicates a novice doctor’s inability to pick up relevant information in the emergency medicine ecology. The outcome can be crucial and span patient dissatisfaction, erroneous results, and generally insufficient, and unsatisfactory healthcare. The second case provides a counterexample and illustrates how novice doctors can be supported in picking up task-relevant information as they can rely on other team members’ skilled embodiment. The article concludes that an interactivity perspective has implications not just for model-building in linguistics, semiotics and the cognitive sciences but also for practice where educational initiatives adopt the epistemologies behind such linguistic, communicative and cognitive models.

Keywords: embodied interaction; healthcare; interactivity approach; languaging; semiotics

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1 The disembodied view in emergency medicine

This introductory section discusses the communicative background and assumptions behind medical educational initiatives such as training programs, simulation training, and teaching practices. Together, those assumptions function as an underlying mechanism for deciding and judging how medical staff is being educated and evaluated in terms of their professional clinical performances. I will argue below that the mainstream assumptions behind such educational initiatives are fallibilistic and incommensurable with an interactivity perspective.

It is crucial to understand how interactivity develops in medical healthcare, as approximately 70% of all human error in healthcare is related to lack of coordination and communication (Amalberti 2013; Kohn et al. 2000). Adverse events are related to behavioral and non-technical aspects of performance (Yule et al. 2006; Flin and Maran 2004). Within the literature on non-technical skills (e.g. Yule et al. 2006; Flin and Maran 2004), there has been a dawning realization that such skills should be investigated further, since human errors are rarely related to technical skills. As a result of this tendency, many training programs focus on such non-technical skills, but they do so in a rather conventional way that does not correlate with how non-technical skills are developed and used in real life. This claim has consequences on multiple parameters. First, non-technical skills are separated into multiple demarcated activities. This distinction originates in a dualist model that separates cognition from communication, for instance when cognitive skills (e.g. decision-making) are separated from other interpersonal skills (e.g. teamwork). While acknowledging the non-technical turn in emergency medicine, I argue that this field needs to investigate practitioners' behavior as skilled embodiment. That means that cognitive results – as decisions for instance – are shaped by dynamics that go beyond individual local action and perception. Decision-making, in this view, is understood as saturated by nonlocal dynamics (Steffensen 2013), that is decision-makers draw on cultural (and individual) past and absent resources which shape particular behavior in the local context (Steffensen and Cowley 2010).

Thus, understanding of how task performances are completed as practitioners coordinate their actions requires investigations of how they draw on interactivity (see section 2). Conventional cognitive and communicative models are not capable of showing the temporal dynamics involved in non-technical aspects of task performances. In a similar vein, Hutchins argues:

In spite of the fact that we engage in cognitive activities every day, our folk and professional models of cognitive performance do not match what appears when cognition in the wild is examined carefully. [...] The study of cognition in the wild may reveal a different sort of task world that permits a different conception of what people do with their minds. (Hutchins 1995: 371)

Before intervention programs, rating schemes, protocols, and training courses are developed, healthcare institutions would benefit from perceiving non-technical skills as complex activities that do not allow for absolute separation into distinct areas of competence.

Cowley (2019) argues that this disembodied view on language as a means for communication suppresses the dynamics of linguistic embodiment. An interactivity-based understanding of cognitive coordination, however, does not just allow for a more realistic, naturalized model of language; it also allows for a deeper understanding of how particulars and peculiarities shape cognitive events in complex, real-life situations, such as the emergency ward.

2 Theoretical background: The “interactivity turn”

Section 1 argued that there is a need for reorganizing education programs in order to account for how human beings use experience to coordinate around a task in ways that traditional models of communication and cognition alone cannot account for. This section introduces the interactivity approach as an alternative to such models. The section therefore sets out to 1) define the interactivity perspective, and 2) link it to embodied concepts of cognition and languaging before section 4 demonstrates the applicative value of an interactivity-based approach. Based on Steffensen (2013), I will define interactivity as human coordination which is 1) sense-saturated and 2) ecological and multiscalar.

As mentioned above, the fallibilistic assumption that we can separate cognition from communication has resulted in what Steffensen (2016) describes as a dermal metaphysics. In this view, the skin serves as the boundary between an inner mental world and an outer public one. Steffensen (2013) argues that in order to explore how professionals achieve things in their lives (save patients, read books, eat apples), we should take a starting point in interactivity: the coordinative dynamics that constitute events. Interactivity, thus, affords a change in perspective from semiosis to action.

Specifically, Steffensen (2013) argues that at the core of human action, one finds sense-saturated coordination, which he defines as interactivity:

Defining interactivity as sense-saturated coordination that contributes to human action characterises three aspects of the relevant phenomena. First, coordination refers to a reciprocal flow of minuscule, pico-scale interbodily movements that link and lock human beings in self-organised systems. [...] Second, this coordination is sense-saturated, that is, it is pervaded by our species-specific capability for sense-making (Linell 2009). We engage in sense-making as our bodies integrate present circumstances with autobiographic memories and sociocultural histories: through sense-making the not-here and the not-now saturate our here-and-now coordination. Third, sense-saturated coordination constrains what we do and how we do it. (Steffensen 2013: 197)

While interactivity has a primordial quality, it is in vain to describe interactivity in all its complexity by single perspectives coming from distinct fields. The framework presented in this article, seeks to provide an ecological account for human interactivity by allowing multiple perspectives to capture different temporal dynamics in interactivity. These perspectives are interdependent descriptions that inform each other in the analytical process, such that the nonlocal is understood in relation to the local and vice versa. Steffensen adds:

Underlying each perspective, one finds interactivity: it is an ontological substrate that each discipline has turned into an 'object.' While all three perspectives [cognitivist, microsociological and biological] may yield descriptively adequate models within an epistemological domain [...] they cannot, in themselves, provide an explanatory model of interactivity, i.e. of what really happens in the flow of human existence. (Steffensen 2013: 196)

The conceptual change (from language and/or cognition to interactivity) entails a different epistemological starting point. As mentioned above, research from an interactivity perspective, asks such questions as how participants coordinate whole-bodied actions to achieve results in their lives. Those kinds of questions are far more tractable – than those which take a starting point in a structural paradigm for instance – and they can be investigated empirically in human interactivity. While the interactivity-based framework does not operate with a clear distinction between language and cognition, it prioritizes what individuals actually do in real-life situations as they draw on experience and previous events (Thibault 2011, 2014; Love 2004). Following Cowley (2011). Thus, attention must be paid to how individuals orchestrate vocal utterances, and other gestures by turning to bodily dynamics *and* symbols (Cowley 2011; Rączaszek-Leonardi 2011).

Interactivity is ecological and multiscalar, which means that it understands an individual in relation to its environment and cultural-historical life trajectory. As such the approach has indeed many strings attached to its neighboring disciplines, such as languaging (Cowley 2019) and embodied cognition (Anderson et al. 2012; Chemero 2003). Embodied cognition emphasizes how human, living beings are evolutionary, behaviorally and developmentally entangled with their environment (Steffensen and Trasmundi, forthcoming). Focus is thus on how the individual flexibly regulates what Jährviletho (2009) defines as the organism-environment-system. Such regulation *can* be investigated as cognitive as it enables the system to act in accordance with particular values (Hodges 2007a, 2007b, 2009; Rączaszek-Leonardi 2011). However, the coordinative action *can* also be investigated as languaging behavior (Cowley 2019, 2009, 2010, 2011; Kravchenko 2011), if we consider languaging as skilled linguistic embodiment we find that to language is to coordinate multiscalar activity with ways of evoking verbal pattern. That is, people may speak, read, imagine, or plan how to engage in specific activities (cf. Cowley 2019). Cowley further stresses the importance of material substance in the study of languaging:

Terms like *language* and *language use* omit both embodiment and materiality and are, for this reason, devoid of explanatory power. As we all know from experience, living persons use coordinating bodies to mesh affect, action, and perception of the actual (i.e. whatever is out-there). Social subjects rely on praxis as bodies act against a domain of pattern, materiality, and institutions. *The idea of languaging* thus challenges appeal to language-systems, use, and usage. In turning to linguistic embodiment, weight falls on how people coordinate with both material and immaterial resources. (Cowley 2019: 484)

Cowley underlines that general applied linguistics indeed could benefit from drawing on embodied cognitive science in order to connect with ecolinguistics and sociolinguistics (Cowley 2019). In that view, extra-linguistic phenomena are being adopted in the study of language but without leaving aside how “Linguistically informed perception can affect human doings, sayings, and feelings (just as these affect the saying and the said)” (Cowley 2019: 488). As Cowley (2019) argues, a languaging perspective is an action-based perspective, which requires a broad view on how people embody feelings, moods, stances, etc. Kravchenko (2008) cites Zvegintsev (1996) to stress how language traditionally has been conceived too narrowly and often as a disembodied pragmatic tool: “To limit the study of language to the study of its use as a means of communication and thought is to deliberately narrow the scope of one’s research and forsake cognizance of the true nature of language in its entirety” (Zvegintsev 1996: 50).

The obvious practical corollary of such a view in emergency medicine is misinformed teaching initiatives, incomplete performance evaluations, and perhaps even a misguided learning focus. An interactivity approach, therefore, requires that we turn to investigations of how people “find their way” (Thompson 2007) in the process of dealing with ideas, tasks, and obstacles in their lives, in this case during patient treatment. In order to understand how people are able to coordinate and align actions to achieve a certain task, Meyer et al. (2017) argue that we need to integrate the fast and microscopic perspective on unfolding events in time with a slower perspective on the sedimentation of habits and culture as well as the emergence of artifacts and methods.

That sociocultural dynamics impact local action (including languaging and cognition) – which again feeds back on cultural development, appears to be commonly accepted among researchers of human interactivity, languaging, and embodied cognition. Section 4 serves as a showcase for how doctors use expertise to animate their environment. However, the recurrent question then becomes, how do we approach human interactivity empirically? One answer is to take a starting point in the method *Cognitive Event Analysis* (CEA). The analytical principles of the model are described below.

3 Data and methods

The dataset used in this article derives from a large cognitive, video-ethnographic study conducted at a Danish Hospital (see Pedersen 2015). The data consists of a large set of video recordings of authentic diagnostic situations at an emergency ward and interviews with key practitioners. The cases used in this article are chosen to illustrate how teams coordinate by drawing on skilled embodiment and in ways that exemplify the importance of developing education initiatives in healthcare. The cases are analyzed using analytical procedures common to Cognitive Event Analysis (CEA). CEA is an ecological method that investigates how distributed cognitive systems (Giere 2004; Hollan et al. 2000) achieve results as they rely on real-time dynamics and nonlocal conditions for coordination (Steffensen et al. 2016; Steffensen 2013; Cowley 2014; Trasmundi 2016, 2017; Pedersen 2015; Omerod and Ball, 2017; Trasmundi and Linell 2017; Trasmundi and Steffensen 2016; Linell 2015). A distributed cognitive system includes all components that contribute to cognitive processes and results, including people (self and others), material artifacts, environmental structures, cultural conditions, rules, etc. Results are the achievements of

human actions that enable the individuals to manipulate the ecological setting in accordance with a particular task.

The methodological procedure of CEA consists of defining the event for investigation, then identifying the crucial points in the interaction that lead to phase transitions (identified as changes in the interaction trajectory that impact the task at stake). The work material for CEA is video recordings (Steffensen 2013; Steffensen et al. 2016). Steffensen et al. (2016) elaborate important methodological and procedural steps in CEA. Those steps are: 1) *cognitive event identification*, 2) *event pivot identification*, 3) *data annotation*, 4) *cognitive trajectory segmentation*, and 5) *cognitive trajectory* (for a thorough presentation of those methodological steps, see Steffensen et al., 2016). Event identification involves definition of the kind of event one investigates in the video-data. An event is defined by relying on heuristics or typologies such as decision-making for instance. Second, the identification of event pivots is crucial to understand when and what enables changes in the interactivity trajectory. An event pivot is:

a singular point in time that marks a transition between a before and an after. Depending on the type of cognitive events identified in the first step, different event pivots can be accentuated. In decision-making, central event pivots include the points in time where the decision is proposed and where it is acceded by the relevant parties. Many task management events revolve around event pivots where agents interfere in the process in various ways. In short, an event pivot can be defined as the necessary precondition for seeing the event as a particular kind of event. (Steffensen and Trasmundi, forthcoming)

Event pivots thus mark the condition for phase transitions. A phase transition indicates a system's change from one state to another, for instance from a state of fixation to a state of insight. Step 3 involves data annotation to visualize the emergent behavioral patterns in the overall trajectory, whereas step 4 includes segmentation of the annotation. Together these pre-analytical steps lead to the actual event analysis (step 5) which is carried out by describing the links between the behavioral patterns and the cognitive result (the decision for instance). The guiding analytical focus is thus to describe what enables a specific cognitive output or result.

Using video observation, CEA allows rich analysis of embodiments, taking into account the full array of gestures, head and body movements, gaze, and verbal utterances (Goodwin 2017, 2018; Heath et al. 2010; Meyer et al. 2017; Norris 2004; Streeck 2009; Streeck et al. 2011). In particular, we rely on a Goodwinian approach to interaction analysis, i.e. we focus the analysis toward the cooperative, creative actions that pivots on how participants use, reuse and transform each other's embodied actions to generate new and joint meaningful actions (Goodwin 1994, 2000a, 2000b, 2003, 2007, 2013, 2017, 2018).

4 Analysis: Interactivity and direct perception in emergency medicine

Achieving a diagnosis is the overarching shared task at the emergency ward. How this is done depends on multiple factors such as the practitioners' abilities to relate symptoms to causes, interpret patients' narratives, and connect experience and knowledge to real-time occurrences. How these processes unfold is especially interesting when challenges emerge and creative strategies must replace the usual procedures. There is a striking difference in the way practitioners handle the diagnostic process when faced with challenges. Indeed, their actions do not indicate that their perceptions rely on objective representations. Rather, they tend to imply situated initiatives based on direct perception (Gibson 1986; Noë 2004). Direct perception is, according to Gibson (1986), antirepresentationalistic. It is:

[...] what one gets from seeing Niagara Falls, say, as distinguished from seeing a picture of it. The latter kind of perception is *mediated*. So when I assert that perception of the environment is direct, I mean that it is not mediated by the *retinal* pictures, *neural* pictures, or *mental* pictures. *Direct perception* is the activity of getting information from the ambient array of light. I call this a process of *information pickup* that involves the exploratory activity of looking around, getting around, and looking at things. (Gibson 1986:147 [italics in original])

He further elaborates that “our reasons for supposing that seeing something is quite unlike knowing something come from the old doctrine that seeing is having temporary sensations one after another at the passing moment of present time, whereas knowing is having permanent concepts stored in memory” (Gibson 1986: 258). Gibson's alternative theory of information pickup thus closes the gap between perception and knowledge, as individuals become aware of the world by living in it: by feeling, tasting, seeing, smelling it, etc. (Trasmundi 2017).

Furthermore, if perception is sense-saturated and depends on local and nonlocal coordination, different people use different strategies in order to achieve the same output. If this hypothesis is supported, it has educational consequences for how practitioners are trained because the complexity that follows such a view leads to a deeper investigation of a practitioner's level of expertise in relation to environmental affordances for proper action. In the light of this, designing medical materials or focusing on an individual's perceptual skills only deals with part of the cognitive ecology of medical task performance. This analysis thus investigates how medical practitioners make use of a visual

system that goes beyond local and individual interaction. It shows how medical decision-making is determined by local dynamics, sociocultural patterns, and lived experience. It argues that explanations of human interactivity cannot be confined to only the microsocal timescale. I exemplify this by investigating two cases from emergency medicine where problem-finding and problem-solving are related specifically to ecological vision. I further argue that the function of a visual system is directly related to the conditions of error cycles as well as learning. The operation of visual systems will be demonstrated in the CEA analyses.

4.1 Dysfunctional action-perception: Difficulties in picking up relevant cues in the environment

A medical problem never emerges in a vacuum, and the complexity of finding and solving problems increases as multiple expressive features penetrate the environment. In the medical books, a problem is often presented in itself, whereas in real life, multiple problems arise simultaneously and the order in which they should be dealt with, or how they should be dealt with, is a situational issue.

The following interactivity trajectory unveils an inadequate approach to such a situational challenge. With CEA terminology we observe a problem-solving event in which a novice doctor enacts an action pattern that constrains both cognitive problem-solving and interpersonal relations with the patient. The doctor is about to complete a simple task: she needs to listen to the patient's lungs to clarify if there is a murmur, but that requires that the patient sits and leans forward. However, the length of the tube attached to the oxygen mask that the patient is wearing prevents this simple standard task. As the patient cannot sit and keep on the oxygen mask at the same time, a dilemma emerges. What is easily completed in theory becomes impossible due to practical issues and it fixates the doctor who needs to come up with alternative solutions. But how to do this turns out to be impossible to get around for the novice doctor. First, the emergence of the dilemma is illustrated in the gallery below. This dilemma leads to continuous cycles of probing and fixation, which are analyzed in relation to the doctor's level of perceptual richness.

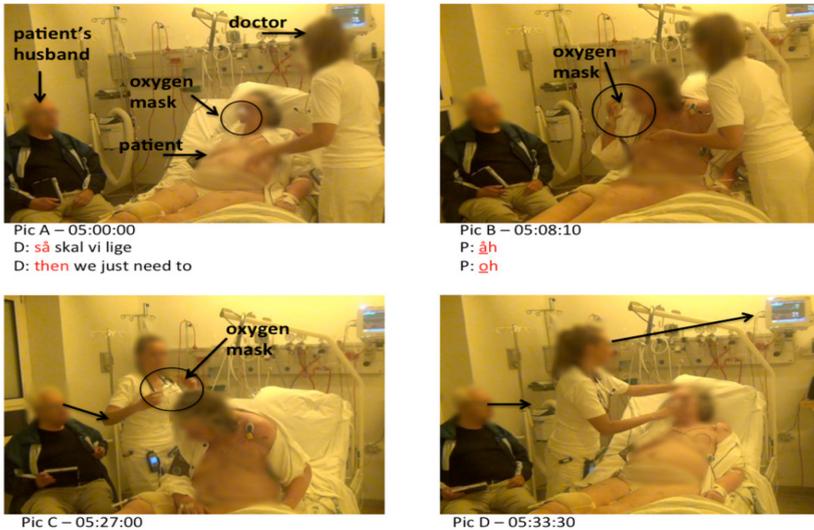


Figure 1: In the gallery we observe how the doctor fails to get the patient in a position where she can listen to her lungs, as the oxygen mask falls off.

Pic A: Doctor wants the patient to lean forward

Pic B: Patient leans forward, and the mask falls off

Pic C: Doctor gets the mask

Pic D: Doctor puts on the mask again

Red markings in the text indicate the verbal utterance articulated as the picture is taken.

As the doctor gets the patient up in the bed in order to listen to her lungs, the patient's oxygen mask falls off (Picture A + B). The doctor then walks around the bed to get the oxygen mask, which is indeed needed, as the patient's oxygen saturation is low and causes the patient great trouble in breathing. The doctor puts on the mask and the patient forcefully falls back in the bed again in exhaustion. The doctor then observes the medical measurements on the screen above the patient's head (Picture D). The dilemma is now explicit for all involved parties: (a) the doctor freezes, (b) the patient appears exhausted, and (c) the patient's husband is attending to the doctor's behavior. The patient is in a critical and unstable condition, and the dilemma causes a series of activities that are unpleasant for the patient and which trouble the doctor.

From a rational point of view, one relevant thing to do is to call for assistance to be able to listen to the patient's lungs. To get assistance to complete a very simple task is not usual in the ward, and the problem seems to be deferred by the doctor for a moment. Instead of calling for assistance

immediately after the challenge is explicit, the doctor waits and walks around, doing what appears to be “nothing,” when the context is taken into consideration. Her actions are abrupt, and she appears fixated, a cognitive state that Steffensen et al. (2016) describe as *suspended nexts*, or what Dewey (1910) characterizes as a *forked-road situation*. Such situations are characterized as situations where the individual is unable to pick up information directly and link action-perceptions to the task at hand in functional ways. Often, this situation leads to moments of fixation, that is, the individual freezes and/or fixates on the same thing over and over again.

Wittgenstein argues how people draw on groundless rationalizations (here in terms of explaining language rules) when explanations are depleted: “If I have exhausted the justifications, I have reached bedrock and my spade is turned. Then I am inclined to say: ‘This is simply what I do’” (Wittgenstein 1963: 85e, §217). This point applies to the following analysis, which pivots on the complexities that follow a situation where a suspended next inhibits the doctor in solving the problem (listen to the patient’s lungs). Thus, working from the hypothesis that perception is dynamic and altered by an individual’s interaction with the environment, a rational approach in order to expand the visual system seems to be related to action, or rather to moving around within the environment. Theoretically, the situated environment in which the problem appears can be described as a *spatial problem zone* in which one moves around to perceive the problem from as many new angles as possible and to contain embodied frustration in order to overcome the suspended next (“doing something”). This is what we observe the doctor is doing.

As a consequence of reaching cognitive bedrock, she literally moves around and manipulates the visual array of the cognitive system. This is illustrated in the following event trajectory:

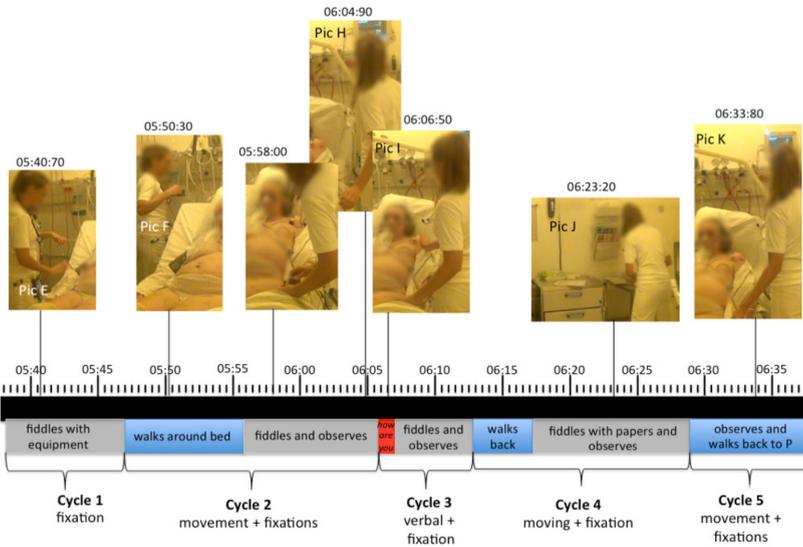


Figure 2: Within this problem-solving event, the doctor needs to figure out how she can deal with the emerged challenge (the short tube that inhibits her from achieving the task of listening to the patient's lungs).

Within this emerging challenge, we observe how the doctor undergoes multiple phases of fixation (those are explained below). She literally moves in-and-out of a problem zone, identified as cognitive manipulation. The doctor initiates multiple actions that allow manipulation of the visual array.

Gray boxes: indicate that the doctor observes/freezes
 Blue boxes: indicate that the doctor moves/walks around
 Red box: indicates that the doctor utters something

After the doctor understands that she is unable to listen to the patient's lungs (she stops working on her plan as it does not work), she initiates various behavioral contortions and procrastinations when time is a limited resource. In Figure 2 it is visualized how the doctor employs five action cycles in order to manage the increasing frustration within the cognitive system.

The first cycle involves the doctor's fiddling with the tubes and attempting to arrange them nicely (see Picture E). While the tubes are the problem (they are too short, and the oxygen mask falls off when the patient sits), this aesthetic organizing does not contribute directly to the problem-solving. In another study, Steffensen et al. (2016) identify:

a general tendency to impose an aesthetic order onto the physical layout of her surroundings [...] To account for this dimension of [the participant's] cognitive trajectory, we define an aesthetic action as an action that (a) transforms the physical layout of the environment in order to make it more ordered, and (b) has no task-related, cognitive function. (Steffensen et al. 2016: 32)

In this context the neat reordering does not provide the doctor with a useful overview and she is prompted to do something to contain the frustration. She walks away and initiates a second cycle that involves a new combination of moving and fixed-procedure following: she checks the workings of the equipment and gains information about the patient's medical condition. Specifically, the doctor walks behind the bed. Based on the video observations and considering the functional task she needs to solve (listen to the patient's lungs), her actions are described as irrational, and she immediately walks back to the other side of the bed. As she moves, the visual system changes its perceptual array, but as the emerging properties of the system have not yet provided her with any functional affordances for proper action, she fixates on procedures: She fiddles with the medical equipment attached to the patient's finger (see Picture G) and observes the values on the screen (see Picture H). Nothing in the data indicates that the doctor has decisive information, and she fixates on the measurements for 5.5 seconds (see Figure 2).

The third cycle differs from the previous attempts to gain information. The doctor asks a verbal question: *How are you feeling?* as she touches the patient's shoulder (see Picture I). The patient utters: *oh* and the odd answer further indicates her critical condition. The response, thus, does not contribute to the process of figuring out what to do next. The doctor then resumes fiddling with the equipment. The husband and the patient gaze momentarily at the doctor (see Pictures F + G) observing what the doctor is doing.

The doctor has not yet been successful in getting out of the negative loop, and a fourth cycle of moving and fixation in order to manage the problem space is initiated. The doctor continues to seek a solution on her own. She turns away and walks to another corner of the room, where she fiddles with a paper record without looking further into its content (see Picture J). Once again, she stops, removes some papers, puts them back on the table and observes medical measurements on the electronic display. Time goes by and the doctor does not come up with solutions although she walks around in the room. So far, her actions have not led to new insight and she moves away from the corner again. As she returns to the bedside, she hesitates before she once again observes the medical values on the screen (see Picture K).

Every time the doctor gets back to the patient, the challenge remains the same. Paradoxically, the doctor knows exactly what the local task is (listen to the patient's lungs), but she is unable to attain it. After the oxygen mask falls off, the doctor spends a minute on walking around and repeating nested tasks: checking oxygen saturation etc. (see Figure 2). Basically, there are only three solutions to the problem: (a) to call for assistance, (b) to get a longer tube, or (c) to reorganize the position of the bed so that the tube is long enough. The doctor does not initiate any of these solutions within this timeframe, and moving in-and-out of the problem space seems to be an escape strategy. Her moving around is identified as loops of fixation patterns that can be interpreted as a strategy of getting out of a literal problem zone.

Moving around within the room allows for different perceptual possibilities. One way of developing a visual system is by trying to manipulate the situation in order to connect things in new ways, to perceive things from different angles, to understand alternative perspectives, etc. In this case, frustration emerges (the doctor's behavioral trajectory is characterized by abrupt actions where it previously was characterized by smooth actions and flow), and it most likely constrains her cognitive task performance. Thus, the functional result remains absent, and she wastes important time in a critical situation.

The doctor's actions indicate an undeveloped medical visual system that is biased by local constraints (the length of the tube and the patient's unresolved medical condition) and nonlocal expectations of individual problem-solving. Within these constraints, identification of functional solutions is inhibited even though the doctor clearly perceives the problem. Only very late does the doctor give up and finally call for assistance; however, the patient has been suffering from the doctor's hesitation, and she is exhausted and scared (this information was obtained by me as a participatory observer).

On the one hand there is no good reason for the doctor to move around in the room (behind the bed, around the bed, and to the corner of the room), and yet on the other hand it makes sense to do something when bedrock is reached. When challenges emerge, frustration and stress often co-emerge. Logical and abstract reasoning (trying to think of a solution) requires stillness and a hierarchy with one isolated problem after the other: if/then sequences. In this situation, the doctor needs to balance the heterarchy of multiple nested activities: take care of the patient's emotional and medical condition, complete certain procedures (physical examination), and figure out how to deal with a sudden dilemma (complete a task that cannot be completed within the actual setting).

The working hypothesis emphasized that moving around leads to an alteration of the visual system. Moreover, her moving around can be an

indication of reducing complexity. When stress and frustration emerge as a result of imperfect initiatives, a natural bodily response to such emotional chaos is movement, an escape pattern that gives the doctor time to contain the unbearable: not managing what should be done. Hence, the doctor's retrying-moving strategy is interpreted as a strategy for dealing with complexity (emotional, medical, interpersonal) and a strategy for manipulating the visual system to become able to perceive new affordances in a way that yields solutions, as she needs to compensate for the lack of skilled embodiment. However, in this case the moving around and doing things do not expand her visual perception in a functional way. Fixation wins. Finally, as the doctor does not call for assistance at an earlier stage, she enacts an activity pattern that allows the emergence of error cycles. Her actions serve as positive feedback mechanisms, and as she gets no closer to any solution, time runs and the patient suffers from pain and anxiety.

4.2 Learning as becoming through immersed emulation

In the second example, I focus on a decision-making event, which also functions as a learning situation. Specifically, a medical team needs to decide a patient's course of treatment based on their diagnostic understanding. The interactivity trajectory is therefore characterized by shifts between hypothesis generation and decision-making (see Figure 4 below¹). However, due to the focus of this special issue, the examples emphasized in this analysis pivot on how a medical student comes to understand the actions of a medical team who recalibrates its boundaries as the patient interferes. From the team's recalibration, the medical student is provided with optimum conditions for learning, as she becomes able to engage through immersed emulation.

In this setup the experts make decisions about diagnostic procedures, whereas the student not only observes the flow of medical interaction, but also functions as a part of it and hence feels the consequences of the system's decisions directly. The medical team consists of five team members from various departments: an experienced doctor from the emergency ward who carries the overall responsibility, a gastrointestinal surgeon who has been called in for

¹ The case example presented here is a partial analysis of an overall diagnostic event (see Trasmundi (forthcoming) for the analyses of all six phases within this event). Thus, in this analysis, I only present the first phase to emphasize the point of learning as becoming through immersed emulation.

assistance, a medical student (a trainee expected to learn from observation), an experienced nurse from the emergency ward, and a paramedic who is in some sort of ongoing training (he is not visible in this excerpt). The patient is a middle-age male who arrived with stomach cramps and his condition is still acute. Below is an overview of the setting and the medical team.



Figure 3: The setting in which the medical team evaluates the patient's symptoms.

As we enter this situation, the doctors engage in medical hypothesis generation and the main doctor lists the medical circumstances in a low voice to the surgeon. However, the patient tries to engage in that dialogue too, and I will therefore zoom in on how the patient's interruption is managed by the team, including the medical student. The paper applies the transcription system developed by Gail Jefferson for the analysis of conversation (see Jefferson 1983, 1985, 2005). Below follows the transcription where the medical team discusses the patient's symptoms as the patient interrupts.

ENGLISH TRANSLATION

1. 05:37:20, D: °and then there has been this diarrhoea for about a day
which I cannot explain either°
2. 05:40:50, S: °°yes°° (.)°no°
3. 05:41:50, ps. (0.7)
4. 05:42:20, P: I [just I
5. 05:42:40, D: [and at that time he had a real pain in the stomach when
he arrived right
(0.4)
6. 00:44:20, ps. (0.4)
7. 05:44:60, P: [I just thought it was s a kind of a ehm=
8. 05:46:80, S: [as long as it i::s not an chronic pain syndrome or
something that is about to develop (xxx) usually not
presenting itself like this (.) it usually progresses
slowly right
9. 05:53:60, D: yes
10. 05:54:00, ps. (1.0)
11. 05:55:00, S: the question is whether we should have some imaging on this

Transcript: S = Surgeon, D = Doctor, ps. = pause

As the medical team discusses the patient's situation, it orients toward the patient's stomach, which is the location of the medical problem. The discussion is articulated in medical language, in low voices, and at the end of the patient's bed, and it is clear that the main interactants are the medical staff, which means that the patient is not involved at this particular moment in the interaction. The medical student follows the medical discussion (see Pic A) and the nurse completes individual clinical procedures. A pause of 0.7 seconds emerges in l. 3, and the patient uses this possible completion point as an opportunity to engage in the interaction by uttering his own concerns with regards to his symptoms (l. 4). However, the main doctor immediately interrupts the patient and continues the medical discussion (l. 5) and maintains the system's boundaries unaffected, as he does not orient toward the patient at all. From the doctors' behavior we can argue that the patient's utterance is treated as irrelevant at this point in the interaction. However, both the nurse and the medical student respond to the patient's request through gaze (see Figure 4, Pic B below).

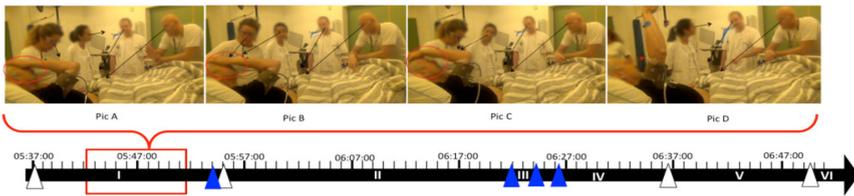


Figure 4: The overall decision-making trajectory consists of five phases (see Trasmundi, forthcoming). However, as the focus of this analysis is to show the learning potential of relying on a team's interactivity, I emphasize phase I, where the medical student's behavior deviates from the team's behavior in crucial ways.

The red box in the model corresponds to the timeframe from lines 4–8 in the transcription.

Only 100ms after the patient initiates his verbal articulation both the nurse and the medical student gaze at the patient's head (see Pic B). The patient's utterance prompts them to investigate the patient's perspective further. Pedersen (2012) describes how a request for dialogue often serves as sociocultural affordances for attention and engagement, even though it might disturb and be dysfunctional to do so with regard to a given task. While the nurse briefly suspends her task and expresses her concern for the patient through gaze, she soon (after 2.3 seconds) resumes the procedures (see Pic C).

The medical student, however, disengages from the medical interaction and remains focused on the patient for 8.3 seconds before she re-orientes toward the medical discussion (see Pic D).

This interaction pattern is repeated: The patient revises his utterance and seeks to contribute with his personal perspective on his symptoms during a brief pause (l. 6). He utters: *I just thought that thought it was s a kind of a ehm=* (l. 7), and only this time it is the surgeon that cuts off the patient. Again, the medical student orients toward the patient, whereas the rest of the team ignore his utterance and continue their task performances. Since the student's behavior is different from her previous behavior (she gazes at the patient for a significantly shorter amount of time), it is fair to assume that she emulates the medical team's action-perceptions. For instance, as she can observe that the team is not disturbed by the patient's utterance, she resumes the observation of the doctors' performances.

In this excerpt the medical team acts independently of the patient's attempt to become a part of the interaction. The team is characterized by stability, professionalism, and coordinated action, and the doctors are able to remain focused on the medical task performance. Consequently, the affordances emerging for the nurse and the medical student are hardly noticed by the doctors (they do not respond). For the medical student, in turn, they become relevant changes that can facilitate insight. That is, the overall situation provides her with optimum conditions for understanding how professional behavior during hypothesis generation is managed.

In this example, the learning environment is not based on instructions and procedures only, but also on immersed emulation. Therefore, this practice is best explained as embodied perception of interbodily dynamics enacted as variations in the environment emerge. In the example, the doctors' inattentive attitude toward the patient's utterances is not a sign of reduced sensitivity or stress (the team is calm and efficient), but it indicates its level of experience. The doctors' behavior illustrates an immediate understanding of how certain interactive patterns can constrain medical tasks (for instance hypothesis generation).

The team's performance thus serves as an expression of clear priorities, overview, and expectations of what the different team members are expected to do in such known situations as they draw on interactivity. For instance, we observe the organizing power of gaze: The nurse immediately acts on the change in the environment, which can serve as a cue for further investigation, hence she gazes at the patient. Her skilled embodiment is identified in her immediate evaluation and ability to pause, and then resume as she learns that the patient's utterance concerns his personal comments at a point in the

interaction where it is not the time for subjective evaluations. The doctors are under time pressure to come up with a plan for further treatment. The team members thus, adapt smoothly to the changes in the environment through clear and efficient distribution of responsibilities. The team engages in a reciprocal relationship where they co-act in ways that unveil their distinctive experiential backgrounds. The medical student is easily picked out as the novice – not due to her role as an observer but due to her inability to immediately pick up task-relevant information (e.g. she withdraws from the hypothesis generation). However, as she will learn to identify patterns of functional behavior through immersive emulation, her ability to pick up relevant information becomes richer, more automatized and immediate (cf. Gibson 1986). In this case, social rules of dialogical involvement do not apply, as decision-making in terms of further treatment is more crucial than engaging with the patient. Thus, the right thing to do emerges *pari passu* with the act of picking up information in the environment that enables functional task performance. This ability, thus, requires experience that goes beyond pure rule-following.

To some degree emergency medicine is about routine practice, and there are numerous procedures and protocols that enhance work practice and contribute to safe and standardized outcomes. However, unexpected and sudden changes unpacked in milliseconds give the practitioners narrow possibilities for reflection. Generally, while novices allocate a lot of cognitive effort into rule-following processes, experienced practitioners rely on expertise defined as an embodied intuition equipped with experience over time (Merleau-Ponty 2012). In this case the experienced team relies on an embodied historicity, which releases cognitive power to important tasks (Trasmundi, forthcoming).

The crucial point is that an interactivity perspective gives a richer understanding of which interbodily dynamics that are enacted in situated learning practices. We can describe team members' enactment of expertise as different dynamical patterns of behavior that correlate with their abilities to pick up task-relevant information directly. By comparing the two examples, I underline the importance of organizing caring work environments for both patients and healthcare practitioners in ways that allow for creative and professional perception-action.

5 Conclusion: Why interactivity matters

How does the expert immediately understand what the right thing to do is? And why does a novice become overwhelmed and confused when complexity

reaches a certain point? First, by emphasizing learning as becoming, the analysis tuned in on the ability to identify *information as either prompting action or fixation* (Gibson 1986). As people become skilled, they learn to differentiate between various kinds of situations. That is, throughout a professional's educational lifespan, which consists of repetitive actions in a well-known environment, the professional becomes experientially attentive to specific patterns that stabilize over time. As interactive behavior forms patterns over time, the novice becomes skilled in picking up those patterns as meaningful affordances for action. In the first case, the novice needs to learn this the "hard way," that is, by herself, by enacting different scenarios. In the second case, the novice's action-perception is guided and constrained by what the experienced medical team does. That is, this team selects the relevant cues of attention as it orients to specific variations in the layout of affordances and, in turn, ignores others. The novice is provided with optimum conditions for emulating the team's performance and is supported in the recognition of behavior as an enactment of functional patterns in the situation. The student is provided with great opportunities for perceiving the consequences and emotional changes within the system without being the main person responsible for the action of the team (cf. Lave and Wenger 1991). As learners (in this case the medical student) start to notice those patterns, their expectation of what other people will do can become more systematic and immediate, and their anticipation of the flow of events can become even more direct and subconscious.

Within the emergency medicine setting, particular movements are experienced as repeatable actions as they carry out task-specific functions, as identified in the analysis. The doctor is only able to affect the novice doctor because the novice already has enough rich sensorimotor skills that enable her to pick up certain parameters of the doctor's action-perception in the situation (she knows about medical diagnostics for instance). The novice should therefore be able to match the timing of the team's movement to the task. In this latter example, the novice's sensorimotor skill is needed to understand the team's action *as* a certain kind of functional action that manipulates and modifies specific parts of the habits related to the task performance. Thus, control – achieved by coordinated actions – depends on expertise for picking up patterns of action (sound and movement) as patterns of movement timings in relation to the task (Trasmundi and Harvey 2018).

Professional task performance is saturated with routines and habits in many different ways. Those habits structure the actions of the practitioners, so that they do not have to say, explicate, or pick up more information than needed for good enough performances. Therefore, learning through immersed emulation (as in contrast to the first example of individual problem-solving) can

have experientially rich effects on how we anticipate what others will do, which routines will be useful, and how one adapts most functionally to a dynamic environment (Trasmundi and Harvey 2018). Thus, interactive behavior forms patterns over time. People pick up on such patterns, as they become increasingly skilled in demarcating valuable information from the world in which they are embedded (cf. section 2). That is, over time, professionalism is identified as an ability to expect and anticipate what other people will do, based on knowledge about professions/roles as well as facts about the setting – in this case the emergency ward, clinical and medical procedures, etc. The analysis shows that to coordinate around an organizational task (e.g. to save a patient) is a complex embodied activity. This coordination is a skilled behavior that concerns a dynamic and habitual, shared understanding of what is possible and expected. Cowley (2019) describes this coordination as languaging behavior and Steffensen (2013) turns to interactivity. In both cases, the consequence is that we orient to how the practitioners do much more than decode meanings in the local.

The analysis provided here, thus, is paradigmatic of interactivity as it pivots on how coordination is achieved and enabled through lived experience. While the paper is an attempt to contribute to the interactivity turn in the language sciences and the cognitive sciences, it has direct practical and ethical implications as well. At a very concrete level, the analysis gives insight into the domain of real-life coordination at a hospital where some action-perception loops are more conducive for dialogical healthcare practices than others. While showing *how* this coordination emerges and is enabled, the paper invokes important practical-ethical and methodological consequences of how we support “learning as becoming” in complex and risky environments. By combining practitioners with different levels of expertise, learning is based on meaningful interactivity. That is, it is based on immersed emulation of skilled embodiments rather than individual probing strategies. Even though the less skilled practitioner might not know why the more experienced practitioner acts as he does in a given situation, the (dys)functional output of an action is perceived. Therefore, learning should not be understood in terms of interpreting signs, but rather as an activity of perceiving patterns that stabilize over time.

Important methodological and conceptual work is needed for an interactivity-based perspective to explain what enables people to fix attention to specific environmental factors. Obviously, this is not just a conceptual challenge, but a methodological one too, as we need to point to this fixation of attention as a result of skilled expertise, memory, and know-how. The upshot of all this is that we need to understand linguistic phenomena as continuous with, and inseparable from, non-linguistic action, perception, and interpersonal

coordination (Trasmundi and Harvey 2018). Finally, *Cognitive Event Analysis* is a promising method that takes its starting point in interactivity and it defines crucial aspects of the interactivity trajectory that impact the outcome of an event. Steffensen and Trasmundi (forthcoming) argue that this method is apt for approaching human coordination in ways that are in accordance with the foundational views of human interactivity.

The article concludes that an interactivity perspective has implications not just for model-building in linguistics, semiotics, and the cognitive sciences but also for practice where educational initiatives adopt the epistemologies behind such linguistic, communicative, and cognitive models.

Acknowledgements: Many thanks are due to each of the two reviewers for working through many different aspects of this paper. Their efforts were both helpful and instructive. I would like to thank Stephen Cowley, as well, for his own extremely helpful feedback on an earlier draft of this paper.

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