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Integrating cognitive ethnography and phenomenology: rethinking the study of patient safety in healthcare organisations

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Abstract

While the past decade has witnessed a proliferation of work in the intersection between phenomenology and empirical studies of cognition, the multitude of possible methodological connections between the two remains largely uncharted. In line with recent developments in enactivist ethnography, this article contributes to the methodological multitude by proposing an integration between phenomenological interviews and cognitive video ethnography. Starting from Schütz's notion of the *taken-for-granted* (*das Fraglos-gegeben*), the article investigates a complex work environment through phenomenological interviews and Cognitive Event Analysis, drawing on distributed cognition and embodied cognitive science. The methodological integration is illustrated through the study of an adverse event in a highly specialised medical ward. Starting from a nurse's task of administering medicine to a patient, the analysis tracks how a distributed cognitive system in the ward handles an adverse event where a pill becomes contaminated. The analysis demonstrates how complex decision-making processes depend on agents' micro-scale embodied coordination, on their engagement with the material environment, and their anticipation of other agents' intentions. It is concluded that ethnography can accommodate both cognitive and phenomenological research aims, while also contributing to the important mission of understanding successful responses to adverse events in healthcare. The article further contributes to patient safety studies by demonstrating how safe medicine administration itself can lead to increased risk, hereby pointing to a problem of incompatible safety logics as a source of medication errors in healthcare.

Keywords

Cognitive ethnography · Phenomenological interview · Qualitative methods · Distributed cognition · Adverse event · Health research

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1 Introduction

This article argues for an integration of cognitive and phenomenological methods for qualitative investigations of human error in professional contexts, particularly in complex environments with a low tolerance for error. The article presents ethnographic data from such an environment, namely a specialised hospital ward in Denmark, which is a *high-reliability* environment where adverse events can have fatal consequences (Reason, 2000). Hospitals are subject to constant changes, not only in patient-flow and staff composition, but also in technology, guidelines, and knowledge (Plsek & Wilson, 2001), and they are therefore prone to human error (Weingart et al., 2000). We argue that to understand the practices that may lead to human error in complex settings, a research method of participant observation must capture both system functionality of the organisation at hand, as well as the sense-making and experiences of organisational members. The former is a cognitive aspect of complex work, and the latter is a phenomenological aspect. Accordingly, we argue that an exhaustive understanding of work complexity cannot be achieved solely by cognitive methods for studying the functional organisation of work, nor solely by phenomenological methods for understanding practitioners' experience. Rather, it requires an integration of such methods. Although we discuss how such an integration can benefit healthcare, the goal of the article is to demonstrate the research value of an integrated methodology on a particularly clear example of hospital response to an adverse event.

An adverse event is, by definition, a deficiency in the planned and intended functioning of an organisational system (Pham et al., 2012). However, reports on adverse events, in general, tend to highlight what should have been done rather than on what was actually done and attended to by organisational members in situ. How healthcare professionals made sense of the situation is rarely given the attention it deserves (Dekker, 2015). A singular focus on how the system *ought to* function is problematic because little or nothing can be learned from what people *should* have done. Measuring real-life activities against systemic rationality, attributed to the system after the fact, always leaves human agents with the short end of the stick. Rather, adverse events (be it erroneous actions or failure to pick up relevant information) must be understood as how habituated bodies (Roth, 2018) enact in-the-moment intentions and in-order-to motives, in an environment that offers various affordances for action. While errors must be functionally defined, they are also experiential and based on intentions (Reason, 2000). On the other hand, if events in healthcare practices are purely approached from the perspective of in situ experiences, we would have no criteria for assessing whether an error occurred or not. As Roth (2018) observes, when the cockpit crew in the GE235 flight disaster turned off the left engine because the right engine was on fire, it was an error, no matter how the pilots experienced or made sense of the situation. Accordingly, we argue for a method that accommodates a dual perspective on adverse events, that is, a method where errors in organisational systems are identified using cognitive-functional analysis and criteria, but where the focus is on the participants' situated sense-making and embodied cognitive activities.

For this investigation, the dual perspective means adopting a research principle from cognitive science: we take a starting point in the identification of the so-called *functional system*, defined as a constellation of structures, internal and external to humans, conjoined to solve a given task (Hutchins, 1995b, 281). To complement this systemic-cognitive perspective, we explore the embodied, sense-making activities involved in how human agents enact such a functional system. In particular, we focus on behaviour that leads to (or prevents) adverse events and simultaneously goes unquestioned by organisational members. Alfred Schütz (1967, 36-7) called this dimension of experience the *taken-for-granted* – an already constituted meaning-structure that is presupposed and left out of intentional awareness. Schütz argues that the exposure of what is currently taken-for-granted in an organisation requires a pragmatic interest in the organisation at hand:

The taken-for-granted (*das Fraglos-gegeben*) is always that particular level of experience which presents itself as not in need of further analysis. Whether a level of experience is thus taken for granted depends on the pragmatic interest of the reflective glance which is directed upon it and thereby upon the particular Here and Now from which that glance is operating. (...) a change of attention can transform something that is taken for granted into something problematical (Schütz, 1967, 74)

In other words, certain experiential structures only reveal themselves in relation to a specific problem in concrete practice. In our case, we identify the problem as adverse events in hospitals, specifically medication errors. To reveal the taken-for-granted structures concerning medication errors, we take the case of a seemingly simple and easy task. Not only is a simple task more illustrative of our method, but it also highlights how seemingly easy tasks can become complex when the course of action deviates from the norm in complex environments. Another advantage of taking a starting point in a simple task is that it simplifies the identification of such deviations for non-experts.

Our starting point is the very mundane medicine-related task at a hospital ward; a patient ingesting a pill. Administering pills is a task with an easily defined goal: getting the prescribed medicine correctly from the medicine room to, and indeed into, the patient. Based on our ethnographic fieldwork, the task process is equally simple: 1) A doctor makes a prescription based on a diagnosis; 2) a nurse locates the doctor's prescription, dispenses the pills in the ward's medicine room and brings them to the patient; and 3) the patient ingests the pills. This simple process is enacted countless times each day in the ward. Much research into adverse events focuses on the first two steps in the process because they are prone to a large number of medical errors (Pham et al., 2012): wrong medicine is prescribed, wrong dosages are dispensed, known allergies are missed, etc. On the other hand, step 3 of the process, having the patient ingest the pills, is rarely mentioned in the literature, maybe because it seems straightforward in comparison with prescribing

and administering drugs. Based on these reflections, we will analyse a case where a patient has to ingest a full medical dispensing cup of pills and accidentally drops a pill, for which reason a replacement pill has to be found.

In section 2 below, we elaborate on our methodological integration of cognitive ethnography and phenomenology. In section 3, we apply the methods to the case of the dropped pill, analysing task micro-interactions and interpreting the subjective elements involved. Section 4 discusses the application of our integrated methodology including benefits and limitations for hospital practice. Section 5 is a short conclusion.

2 Cognitive and phenomenological methods

To achieve a dual perspective on organisational practices, we juxtapose cognitive and phenomenological considerations with a starting point in cognitive ethnography. This approach parallels previous attempts at doing ethnography from an enactivist perspective. Notably, Legrand and Ravn (2009, 395) show that the researcher can enter a “somatic mode of attention” where ethnographic interviews are “developed into dialogues also characterised as ‘the active interview’”. Further, Kirmayer and Ramstead (2017) use ethnography to study cultural diversity concerning psychopathology; Yateczak (2019) investigates selfhood in people with Alzheimer’s disease as it is mediated through the use of everyday objects; Høffding (2018, 42) investigates musicians’ experiences through an “ethnographic interview”; Jing and Ravn (2018, 390) “use an interweaving of phenomenological explorations and ethnographical methods” for understanding dancer experiences; and Hjortborg and Ravn (2019, 5) use “ethnographic fieldwork” to study experiential structures of tai chi. Our proposal is especially aligned with Hutchins (2010) and Briedis (2019) who both produce descriptions of organisational enaction from ethnographic observations and apply phenomenological concepts to these descriptions, although their specific methods, concepts, and research interests differ from this article.

Our specific take is also inspired by the two-tier structure of Høffding and Martiny (2016).¹ However, in contrast to Høffding and Martiny, our framework accommodates both interviews and video-ethnographic observation, as well as both cognitive and phenomenological analyses. *The first tier* of our process is the generation of ethnographic data, through cognitive video ethnography and through phenomenological interviews that elicit descriptions of how organisational members experience their work in general and specific work situations in particular. When doing cognitive video ethnography, “the cognitive aspects of the observed practice are revealed in the detailed micro-analysis” (Alač & Hutchins, 2004, 632), and therefore our *second tier* is an analysis of the ethnographic data using the method of Cognitive Event Analysis in combination with a

¹ In Hoffding and Martiny (2016), the first tier of the phenomenological interview is the generation of interviewee descriptions of lived experience. In the second tier, the descriptions are analysed using phenomenological methods (Gallagher and Zahavi 2012, chap. 2) to produce generalized knowledge of subjectivity as such.

phenomenological analysis. Through this integration, the cognitive analysis is illuminated by first-person data from the phenomenological interviews. Section 2.1 details the cognitive aspects of our method, and section 2.2 explains the phenomenological aspects. As we assume that the readership is acquainted with phenomenological methods, we prioritise explaining the cognitive-ethnographic dimension of the methodological integration.

2.1 Cognitive ethnography and cognitive event analysis

Cognitive ethnography is a qualitative participant observation method building on the theory of distributed cognition (Hutchins, 1995a; Hollan et al., 2000; Giere & Moffatt, 2003; Kirsh, 2006; Sutton, 2006). Originating from the work of anthropologist Edwin Hutchins, it aspires to trace the specific distribution of tasks in a given cognitive system such as a medical ward. While many schools of ethnography insist on the independence of the ethnographic method from theory (Ball & Ormerod, 2000), cognitive ethnographers see a firm link between the epistemological paradigm of distributed cognition and methods for tracking how cognitive systems rely on cognitive resources throughout the environment. As a result of this close connection between theory and method, our first step of the analysis is to identify the “invariant task” (Hutchins, 1995b, 281) to be investigated below. The decision on which task to investigate is not solely the analysts. In our case, tracing the emergence of medical error in medication administration was decided in cooperation with hospital practitioners as co-researchers of the research project. We decided to track medicine administering because of its firm association with human error (Pham et al., 2012).

Another characteristic of cognitive ethnography is *verifiability* (Ball & Ormerod, 2000). In our case, verifiability is reached through transparent annotations of video-recorded micro-interactions (as exemplified in Figs. 1 and 2 below). For micro-analysis, we use Cognitive Event Analysis (CEA), which is a qualitative, observation-based method for studying cognitive events in human interactivity (Steffensen, 2013, 2015; Steffensen et al., 2016; Ball & Ormerod, 2017; Trasmundi, 2020; Cowley & Nash, 2013; Steffensen & Vallée-Tourangeau, 2018). Based on ethnographic video data, CEA focuses on the behavioural details of what we call a ‘cognitive *event*’, a concept denoting significant changes in the organism-environment system (Chemero, 2000). Here, CEA draws on radical embodied cognitive science (Chemero, 2009), which sees organism and environment as entangled. Accordingly, no cognitive feature can be ascribed to the organism alone but is always an aspect of the entire organism-environment system. This idea of events corresponds with systemic psychology (Järvilehto, 1998) and is also found in distributed cognition (Hutchins, 1995a, 2014), which takes a functional view on the cognitive system as “a constellation of structures, some of them internal to the human actors, some external, involved in the performance of some invariant task” (Hutchins, 1995b, 281). Distributed cognition maintains that cognitive processes crisscross the boundaries of brains, bodies, artefacts, time, and culture (Hollan et al., 2000) and it is this crisscrossing dynamic that the analysis seeks to understand.

To do so, CEA follows a methodological principle from systemic psychology, according to which “Research should start from the determination of the results of behaviour and lead to the necessary constituents of the living system determining the achievement of these results” (Järvilehto, 2009, 118). To track the results of behaviour to its necessary constituents, CEA proceeds in five steps (Steffensen et al., 2016): 1) Cognitive event identification, 2) Event pivot identification, 3) Data annotation, 4) Cognitive trajectory segmentation, and 5) Cognitive trajectory analysis.

The first step of *Cognitive event identification* follows from the insight of Merleau-Ponty (1963), that all behaviour is a result of both here-and-now perceptions, the situated environment, as well as habituated bodies, an event is not a self-contained category but depends on an observer-dependent identification based on relevant cognitive criteria. Such identification can follow a theoretical classification (e.g., problem-solving, decision-making, planning), or it can build on organisational members’ categorisations of their activities.

The second step in CEA is the *Event pivot identification*. Along the trajectory of the cognitive event, some changes define important phase transitions (occurrences, happenings, or actions), e.g., the pilots turning off the engine in case of the GE235 flight. These central points are termed *event pivots*, and the temporal distribution of event pivots along a trajectory constitute the overall cognitive event. If the event is a case of problem-solving, an event pivot is a transition from having a problem and no solution to having a solution and no problem. If the cognitive event is ‘to diagnose’, the event pivot is the moment when a doctor formulates a disease typology of the patient. Whereas an event is temporally extended (to diagnose takes time), an event pivot is a quasi-momentary transition between a before (still examining the patient) and an after (now starting treatment). Some events may rely on more than one event pivot. For instance, a primary event pivot could be solving a problem, while a secondary event pivot could be the identification of the problem to be solved.

Once the event and the central event pivots are established, CEA practitioners attend to the minuscule details of behaviour. For this third step, which is *data annotation*, most practitioners rely on a rich annotation of behaviour (verbal utterances, gesture, movements, gaze, etc.) and of structural properties of the task environment (e.g. the distribution of artefacts or measurements of important environmental features). The exact design of the annotation procedure depends on the research question and event identification (for details on annotation, see Steffensen et al., 2016).

CEA’s fourth step is a *cognitive trajectory segmentation* based on the identified event pivots and data annotations. If the annotation categories have been carefully selected, a segmentation of the cognitive trajectory should correlate with distinctive behavioural patterns (i.e., with a unique constellation of annotations). With this step, we establish how a given cognitive result (say, a diagnosis) is enacted through preceding embodied behaviour.

From here we can move to the fifth and final step, *cognitive trajectory analysis*, which aims at establishing the salient links between the behavioural and functional properties of the cognitive

event. Having identified the result, the guiding question is: “what were the enabling conditions for the cognitive result, and how was it achieved by the cognitive system animated by one or more living agents?” (Steffensen et al., 2016, 85). Careful analysis of how the cognitive system undergoes event pivots along a cognitive trajectory allows for establishing how intercorporeal engagement with the world and with other agents allows cognitive agents to calibrate their cognitive systems and bring forth results.

In summary, CEA integrates the functional view of distributed cognition and the emphasis on embodied and intercorporeal dynamics, derived from embodied cognitive science (Anderson et al., 2012) and the study of human interaction (Streeck et al., 2011). CEA is a method that allows for a detailed retrospective analysis of the observable dimensions of events, as well as their enabling constraints. But as argued by Pedersen (2015, 250), “CEA *in itself* does not explain what makes an enabling condition an enabling condition” (cf. Trasmundi, 2020). Phenomenology is a candidate for providing such explanations, as it complements the functional analysis with an understanding of how behaviour emerges as moment-to-moment interaction and intentions (Fuchs & De Jaeger, 2009).

2.2 Phenomenological interview and analysis

Phenomenology plays a role in both our data gathering and data analysis. During the former, cognitive ethnography is scaffolded by in situ phenomenological interviews. Preferably, organisational members will be interviewed about their experiences during or right after events. This means that phenomenology cannot be an after-thought, but must be “front-loaded” (Gallagher, 2003) into the research design. We did experience that cognitive video ethnography and phenomenological interviews could become mutually exclusive, as the first primarily involves shadowing the work with a video camera and the second having an active dialogue. Our recommendation is to communicate to subjects that questions will be asked both during their work and after significant work events. As Urban and Quinlan (2014) suggest, it does require spending time in the ward and becoming sufficiently acquainted with routines before questions can be asked naturally. Without such preparations and a researcher attitude of patience, the phenomenological method can become disruptive to working subjects.

We treat the method of phenomenological interviewing rather superficially here, as it has been well covered before (see also Zahavi, 2019). The aspiration of doing phenomenological interviews is reaching the pre-reflective experiences of the interviewee. The interviewer aspires to establish a first-person understanding of how the interviewee makes sense of their work. We approach interviewees with an open-ended questioning style that prompt pondering of work interactions that relate to our research interest. Thus, with a starting point in principles from Høffding and Martiny (2016), we interview nurses and doctors about interactions concerning medicine administration with attention to details of their bodily experiences and engagement. One way of achieving that attention

is through reiterated ‘how do you...’ questions that prompt the interviewee to re-live the interaction in dialogue with the interviewer.

In the second phase of our investigation, phenomenological interviews and cognitive analyses are subject to a phenomenological interpretation. Thus, we do not only analyse the phenomenological interview transcriptions; we also contrast interview data with our annotated video data. As tools for analysing, we use several phenomenological theoretical concepts for understanding medical practice (as proposed by Zahavi, 2019) along with *eidetic variation* and *intersubjective corroboration* (Gallagher & Zahavi 2012, 29–31) for validating our analysis. The two concepts refer to using our imagination to vary and subtract our analysis until we find essential aspects and also to check and validate these essential aspects with medical staff and fellow researchers. We are also inspired by Hutchins’s way of interpreting cognitive ethnography data using phenomenological concepts, leading to descriptions of what he calls “enactment of phenomenal objects” (Hutchins, 2010, 438).

3 The case of the dropped pill: An analysis

The following analysis explores the response to an adverse event in a hospital ward. The analysed task, as presented in Section 1, is that of having the patient ingest his medication. However, in this case, the task changes, as the patient accidentally drops the pill on the floor, so it becomes contaminated. From this adverse event, an embedded task emerges, namely that of replacing the pill with an uncontaminated one. Only when this task has been solved, can the original task be solved. Given the overall CEA methodology, two patterns are important in our analysis of the adverse event: how the cognitive system reacts when an adverse event occurs, and how it executes the relevant countermeasures in response to the adverse event. These two patterns will be analysed and discussed in Section 3.1 and 3.2, respectively.

3.1 Task emergence

The case begins early morning in a highly specialised medical ward in Denmark. The first author is shadowing the work of a male nurse (anonymised as ‘Ryan’). Ryan is taking care of an elderly male patient (anonymised as ‘Hal’) with a stomach infection, respiratory problems, and diabetes. Hal is delirious and speaks of dolphins swimming around in his visibly distended abdomen since he adversely received a double dosage of sleeping drugs during shifts. In his delirious state, he has taken several bad falls and bumped his head badly trying to get out of bed this morning. These preceding adverse events happened before the researcher entered the ward and were therefore captured anecdotally. During the morning medication rounds, Ryan hands out a small medical dispensing cup full of pills to Hal and observes while Hal ingests the pills. However, one pill slips Hal’s mouth and falls to the floor. This is an adverse event because the pill is now considered contaminated by hospital regulations, and Hal does not receive the full amount of the prescribed

medicine. While the dropping of the pill was not caught on camera, because the camera focused on Ryan's work, Fig. 1 illustrates Ryan's immediate reaction after Hal drops the pill: He notices that Hal has dropped the pill on the floor, and he moves the tray table away to find the pill (1a). He then ducks in front of Hal (who follows him with his gaze) and seizes the dropped pill (1b). He places it on the tray table in front of Hal, and he inspects it visually for 15 s (1c). Hal asks, "was it the one I dropped there" and reaches his hand towards the pill as if to grab it (1d). As Hal physically reaches out for the pill, Ryan quickly shields the pill (1e) with his right hand and pushes it a few centimetres away from Hal (1f).

Hal's pill dropping prompts the cognitive system to reconsider the course of action. The system enters a state of a "suspended next" (Steffensen & Vallée-Tourangeau, 2018), that is a situation where "the lack of experience-based solutions forces the agent(s) to (...) search the problem space to come up with possible solutions" (Steffensen & Vallée-Tourangeau, 2018, 175). The suspended next last for 41 s until Ryan formulates the solution: "Shouldn't I find you a new one. One that hasn't been on the floor" – the formulation of this solution is the primary event pivot. Accordingly, the 41 s between the two event pivots function as a decision-making event that prompts us to ask: what conditions this specific decision to be reached? Why does it become taken-for-granted that Ryan should find a replacement?

As Fig. 1 show, the cognitive system proceeds through five phases that cascade into the final decision, which Ryan utters in phase VI, immediately following the event pivot). At first glance, Ryan's decision seems to follow from a conversational focus on the identity of the pill in phase IV and V:

Hal: Was it one I dropped there?

Ryan: It was one you dropped, but shouldn't I find you a new one. One that hasn't been on the floor.

However, a closer look at the embodied dynamics throughout the five phases reveals that Ryan's decision is constrained by a change of focus in the cognitive trajectory. This change becomes clear when we inspect the cognitive trajectory because it shows a striking asymmetry between the two participants. Ryan's actions through-out phase I-III are quite straightforward: in phase I, he changes the layout of the room by moving the tray table, allowing him to have an overview of the floor so he can see the pill. In phase II he ducks to pick up the pill, and in phase III he spends 15 s visually inspecting the pill on the tray table, presumably to determine if he can immediately identify the dropped pill. However, the pill is generic and not identifiable.

While this course of action pertains to Ryan's professional vision (Goodwin, 1994), each of these steps affects Hal's perception of the situation. First, Ryan's unusual bodily movement as he ducks to the floor, makes the pill a point of attention, that is, whereas it slipped into the periphery of Hal's

attention, Ryan's movement redirects his attention to the pill. Second, when Ryan places the pill on the tray table, the changed position of the table means that the pill is right in Hal's line of vision. Third, Ryan's intent inspection of the pill makes it a distinctive dialogical affordance for Hal. Accordingly, as we reach phase IV in Fig. 1, Hal is prompted by Ryan to *act* on the presence of the pill. On a verbal level, Hal's utterance ("was it one I dropped there?") seems to focus on the *identity* of the pill. However, as he asks this question, he moves his right hand forward towards the pill. Thus, he seemingly attempts to finish the task of ingesting the pills that was suspended at the secondary event pivot. From the perspective of Hal's habituated body, that of a layperson and delirious patient, this action is meaningful, as he is not encultured into the hospital staff's categorisation of sources of contamination. But Ryan is. While the first half of his response

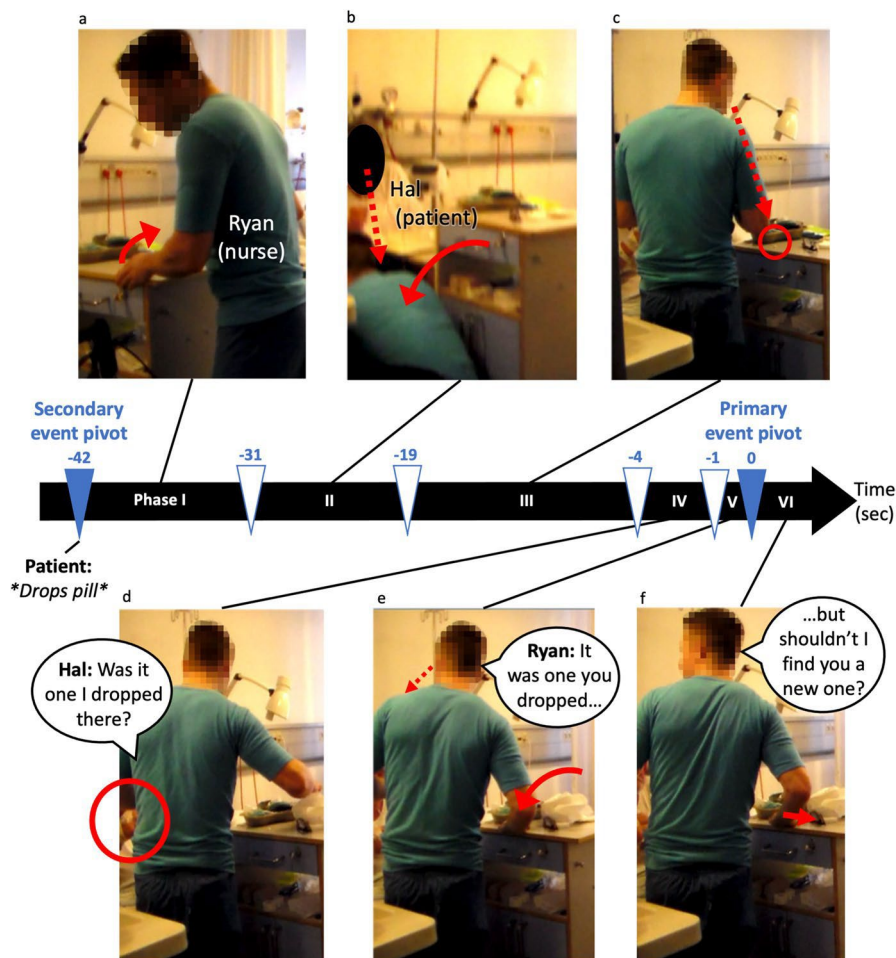


Fig. 1 The dropped pill. The timeline shows the key moments when the patient drops the pill and Ryan picks it up. Solid arrows indicate bodily movements; truncated arrows indicate gaze direction; circles indicate points of interest from an analytical perspective. The triangles on the cognitive trajectory indicate event pivots (blue triangles) and phase transitions (white triangles), as discussed in section 2.1

(“it was one you dropped”) pertains to the verbal aspect of Hal’s question (i.e., it focuses on the identity of the pill), his embodied behaviour responds to Hal’s attempt at resuming the ingestion of the pill. Thus, Ryan covers the pill with his hand to shield Hal from it, and he further moves it slightly away from Hal.

In conclusion, Hal’s reaching out for the pill significantly changes the cognitive trajectory, and Ryan’s decision to find a replacement is not merely a reaction to the fact that Hal dropped the pill. Rather than following an (unwritten) norm at the ward, according to which a dropped pill is thrown away, Ryan honours Hal’s unarticulated wish to finish the intake of the medication. In line with CEA’s focus on distributed cognitive systems, we can thus conclude that the decision to seek a replacement pill is not made by Ryan in isolation; it is shaped by the material and actional dimensions of the entire cognitive system consisting of patient, nurse, tray table, and pill – as well as cultural norms and situated behaviour.

In a phenomenological analysis of the interaction in Fig. 1, it might first appear taken-for-granted that the dropped pill should be replaced with a clean one. However, as we have shown with CEA, this decision is constrained by several environmental factors – the location of the tray table, the generic-looking pill, etc. – as well as intersubjective factors, including the curiosity of Ryan and Hal into the identity of the generic-looking pill. These constraints go beyond the immediate interaction in Fig. 1, as both Hal’s and Ryan’s actions are constrained by previous events, most notably the double dosage error that happened to Hal during the night. Hal’s experience is visibly still under the influence of sleeping medication, which appears to have lowered his situational awareness. For example, he fell twice while trying to get out of bed in the morning, and in Fig. 1 he attempts to grab the pill, not being mindful of how the floor might have contaminated it. Ryan’s attention is also influenced by the adverse event: Ryan explains later that Hal “is somewhat confused today and he has also received double up of Zonoct (a sleeping drug) last night”, and then adds “we have to see (...) if we can shield him today.” Using the idiom of ‘shielding’, Ryan indicates that special attention should be on protecting Hal. This protective framing of Hal’s situation saturates the interaction, as Ryan literally shields Hal from the pill (Fig. 1e), and thus from further adverse events.

In an intersubjective corroboration (Gallagher & Zahavi, 2012, 31) of our analysis, several other nurses were asked what they do if and when pills are dropped to the floor. A common answer was akin to “sometimes I just throw out the pill if I can’t recognise it and I consider it non-vital”. Although it is a rule that dropped pills should be replaced, these answers suggest that it is unusual to replace dropped pills – simply because it happens too often and can take away valuable time from other tasks. Consequently, local circumstances must make our case special: the intersubjective mood (that of shielding the delirious Hal from further adverse events), and the specific affordance layout as shown in Fig. 1, bring forth the plan to replace the pill. The decision to find an uncontaminated pill cannot be attributed to Ryan but happens as a result of the interaction within an

intersubjective relation of patient-nurse, as both agents are part of the situation when the pill possibly becomes contaminated. Although Hal is under the influence of sleeping medication, he is still making some sense of the situation in which the pill is dropped and the nurse ducks in front of him. Hal strives to make sense of the pill, partly in terms of its identity, partly as it becomes an affordance for finishing the intake of medication. The fact that Hal is included in the situation as sense-maker changes the meaning attributed to the situation: it becomes important to find a replacement pill.

A final factor of this phenomenological analysis is the role of the researcher. As the researcher is present with a video camera, he is a candidate for becoming a part of the distributed cognitive system (Steffensen, 2013). The researcher presents a gaze from the outside, and Ryan knows that the researcher is studying human errors, just like he knows that the researcher is aware of the adverse double dosage that Hal received during the night. Ryan's awareness of the researcher's attention and interests may potentially transform the researcher from merely an observer into a factor that influences the decision to replace the pill. The presence of the video camera might not be conducive for chucking the pill, and the awareness of the researcher's interests might have prompted Ryan to demonstrate how adverse events are handled. We have, however, not been able to interview Ryan post hoc on his perception of the researcher's presence in the situation.

3.2 Task execution

In this section, we investigate how the problem of finding an uncontaminated replacement pill is solved in the medicine room. The interaction takes place as Ryan steps into the medicine room 20 min after Hal dropped the pill. The medicine room is locked and can only be opened with a staff ID card. When Ryan enters the room, a female nurse (anonymised as 'Alba') is already in the room, dispensing drugs for another patient. The medicine room is equipped with cupboards and storage for medication, a long table at which the nurses can dose the medication, and two computers where information on medication, as well as each patient's medication list, can be retrieved. A sign on the door says "disturbance-free zone", as it is a managerial policy that staff should keep conversation to a minimum in the room, in order to prevent medication errors.

As established in the previous section, the task at hand is to find a replacement for the dropped pill. Forestalling the event segmentation, this task falls into three sub-processes: *configuration*, *selection*, and *validation*. 'Configuration' refers to how the distributed cognitive system is set up to identify the pill; 'selection' is the process of narrowing down the potential replacement pills to the correct one; 'validation' is the process of ascertaining that the selected pill is in fact and beyond doubt identical to the one Hal dropped. In this section, we demonstrate how each sub-process conditions the following ones.

It is a foundational assumption in distributed cognition that cognition comprises both human agents, material artefacts, and sociocultural resources (Hollan et al., 2000). Manipulating these

elements is a crucial way of administering cognitive processes, for instance, to bring in needed people or to rearrange artefacts. This is what we refer to as a *configuration* of the system.

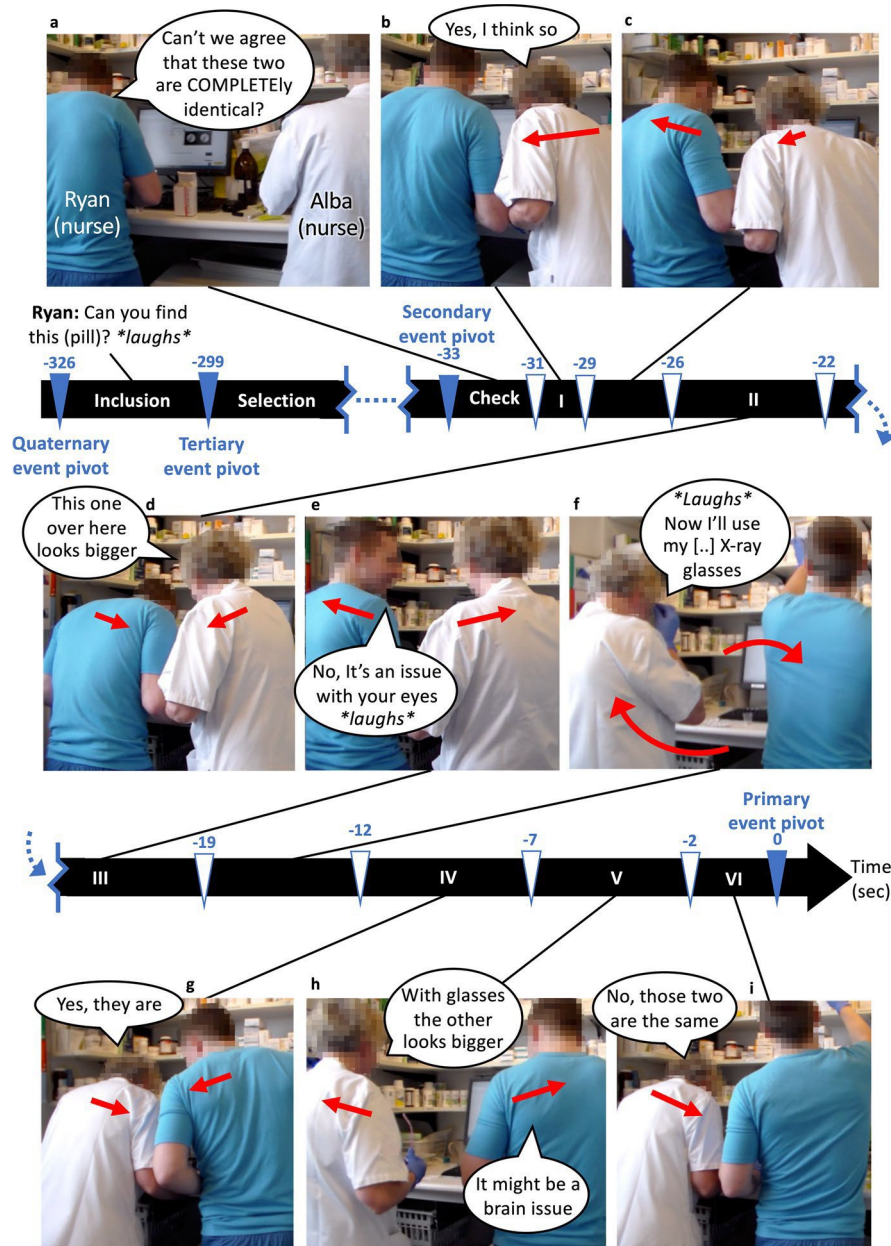


Fig. 2 Replacing the dropped pill. The figure shows the interaction of Ryan and Alba when they compare the size and shape of the contaminated pill and its replacement. Solid arrows indicate movement. Speech bubbles indicate the nurse's talk during the event.

Immediately after Ryan has entered the room, we notice that he reconfigures the cognitive system to include Alba. He picks up the dropped pill, shows it to Alba, and asks with a grin: "Can you find this one?" Looking at the generic white pill, Alba laughs and retorts: "No, I can't!" It is quite obviously a joke, though the exchange between the two has the crucial function of turning Alba into

a *potential* member of the cognitive system, as the joke has made her aware of Ryan's task. As we shall see, she will become increasingly involved during the next two phases. Other resources are also included. Ryan places the dropped pill on a piece of paper towel, and while that prevents the pill from contaminating the table, it further has the epistemic function (Kirsh & Maglio, 1994) of background texture for visual comparison of pills (cf. our recount of the validation phase below). Other resources included in the cognitive system are the patient's digital medicine list and the medicine database with images of pills. As he embarks on his task, Ryan places these two resources side-by-side on the computer monitor.

In the configuration phase, Ryan functions as the "main cognizer" (Galosia et al., 2010), and he sticks to this role in the *selection* phase. First, he begins to compare the dropped pill with screen images of pills from the medicine database. Hal's medicine list is long, so Ryan compares the pill with pictures of numerous candidate pills.² By comparing the dropped pill on the paper towel with images of pills from the medicine database and the medicine list, Ryan eliminates most of the drugs on the medicine list, until he has narrowed down the list to only two possible candidates that both look similar to the dropped pill – both white and round. Ryan cannot decide which one of the pills is the correct one, but because he has made Alba a *potential* member of the cognitive system, he can now activate her by uttering his doubt: "I'm not a hundred per cent sure if it's this one." In response, Alba suggests opening the pillboxes of the two candidate pills, allowing for a physical comparison: "You know what you could. Sometimes I simply just unpack one and sacrifice it (i.e., throw it away if it is not identical)." Ryan follows this advice, and after opening two pillboxes, he decides on a pill that looks identical to the dropped pill. He places the candidate pill on the paper towel, side-by-side with the dropped pill and asks Alba for validation.

Figure 2 is our annotation of the *validation* phase, showing how the cognitive event passes through five validation checks. The first check starts when Ryan asks Alba to confirm that he has found the right pill: "Can't we agree that these two are COMPLETELY identical?" (2a). Alba moves closer to inspect the two pills, and she immediately agrees that "Yes, I think so" (2b). Alba takes an even closer look at the two pills (2c), moves back again, and concludes: "when standing here I think this one over here looks bigger" (2d), thus suggesting that the two pills are *not* the same drug. The nurses check the pills again and Ryan concludes with a smile that "No, that's an issue with your eyes" (2e). As Ryan puts back the medicine packages, Alba laughs and says, "You know what, now I'll put on my glasses, my x-ray glasses, then I'll finally be able to see something" (2f). They then move in close and compare the two pills again, and Alba concludes: "Yes they are (identical)" (2g). Ryan answers "they are entirely the same." Alba still hesitates to trust her vision though: "Yes they

² In the selection process, Ryan consults Alba multiple times, thereby creating a closed-loop between the selection and the validation because Alba falsifies candidate pills during the selection. For reasons of length, we do not analyse this specific dynamic in detail.

are, but you know what, when I put on my glasses, I think this other one looks a little bigger. No, I think they are (identical)” (2 h). Ryan jokingly comments on her indecisiveness: “it might be a brain issue.” Finally, Alba inspects the pills a last time, before she ends the event by concluding: “No, those two are the same” (2i). This confirmation shows that a solution has been reached. The nurses have passed through five visual checks before reaching consensus, which is the primary event pivot.

Interpreting the sequence, we notice that the exchange is characterised by the dialogical collaboration between the two nurses despite the “disturbance-free zone” sign on the door to the medicine room. At the follow-up phenomenological interview, Ryan explains his experience in the medicine room:

Researcher: Why does it say out there in the medicine room that it has to be free of disturbances? Who decided that?

Ryan: It is actually because we don’t want relatives and others to disturb in there. It’s to avoid mistakes from happening. Precisely because you can see that the more disturbances that happen during medicine dispensing, the bigger the risk of mistakes.

Although Ryan experiences the disturbance-free zone as a preventive measure against interruptions from patients and relatives, he is still aware of the danger of disturbing Alba and other colleagues. For him, though, the medicine room is also a collegial space:

Ryan: I mean **lowers voice**, sometimes you stand out there (in the medicine room) and talk purely private out there **raises voice again**. Sometimes it’s like a haven, where you can be sure you will not be disturbed by patients or relatives.

Researcher: **Laughs** Yes, because it’s unlocked everywhere else.

Ryan: Yes, exactly. That and the toilet are probably the only spaces, where you- **laughs** where you can ventilate. Also, if you would like to be a bit collegial. So, it’s pretty much out there (in the medicine room) that is the only space.

In Ryan’s experience, the medicine room is a “haven” and can, therefore, be a space for dialogue and jokes. We have shown in the analysis that it is precisely the dialogical inclusion of Alba that enables the solution to the problem of validating the replacement pill. If the ‘no-interruption’-rule were strictly enforced, it would rule out the specific reconfiguration of the cognitive system (Ryan could not casually include Alba), potentially obstructing the task at hand. Thus, the solution is brought forth by the nurses’ intersubjective experience of the medicine room as a space for cooperation. Furthermore, the dialogue in the medicine room is not only task-related but also ‘collegial’, as Ryan calls it. Thus, it seems to be a central function of informal team interaction to secure the team members’ availability, which allows for reconfigurations of cognitive systems.

From an ecological-enactive perspective (van den Herik, 2018, 2020), the nurses' utterances function as *attentional actions* that guide the agents in finding an uncontaminated replacement. Their utterances become a way of modifying and constraining the perception of the environment, as they highlight certain aspects of reality that should be paid special attention to. For instance, in the selection phase, Ryan specifies relevant tactile-visual dimensions when he utters that some pills are too “flat” or too “thick.” Likewise, Alba expresses doubt by describing one pill as “bigger” than the other in the validation phase. These expressions index the parameters for the perceptual work that can be performed (Goodwin, 1994). Linguists use the term *linguaging* to describe such constraints on what is a possible solution to the task (Cowley & Kuhle, 2020); in this case, a solution that focuses on the pills' sameness in size and shape, rather than, say, their texture or weight.

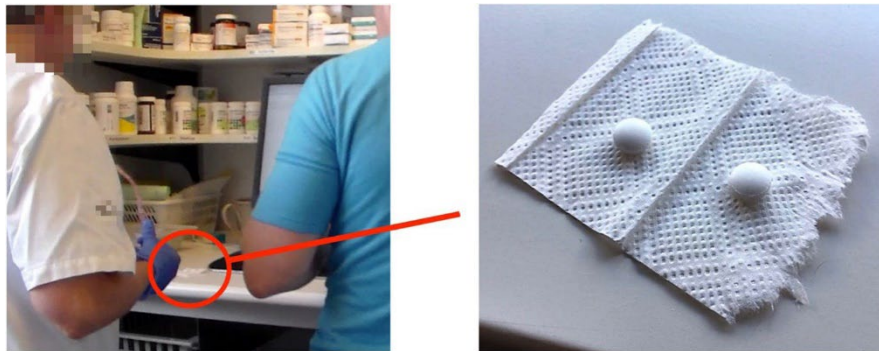


Fig. 3 The paper towel texture pattern provides an intrinsic scale for comparing the size of the pills. If the pills cover the same amount of ground texture, they appear to be the same width. The image on the right is a reconstruction using a paper towel from the actual ward, obtained 17 months after the event.

As languaging “is a mode of organization that links people with each other, external resources and cultural traditions” (Cowley, 2011), it only makes sense when integrated with how agents perceive their environment. This link comes to the fore in how the nurses establish that the two pills are “the same” by indexing relevant visual constraints. However, the function of such constraints depends on their visual perception. In his classical work on ecological perception, Gibson (1979) scrutinises such issues in great detail (cf. Gallagher & Zahavi, 2012, 230). Gibson (1979, 164) points out that visual perception happens through a “reciprocity between observer and environment.” Perception relies on horizon and background, and this is especially important when trying to determine the size of two objects since the texture of the background surface provides an intrinsic scale for comparing object size.³ If the surface texture is equidistant, equal amounts of texture correspond to equal stretches of distance along the ground. This is where the paper towel, on which Ryan has placed the pills, becomes important. The texture of the paper towel provides a scale for determining if the two pills are the same size. As illustrated in Fig. 3, the pattern of the paper

³ This is well-known from optical illusions that use distortions in the background to trick the perceiver into seeing something as bigger or smaller than it is.

towel varies, and hence the comparison of the pills depends on where the pills are placed on the paper towel: if one is placed within the diamonds, and the other on the diagonal lines, a comparison is more difficult than if both are placed within diamonds. The nurses' visual comparison is thus a qualified estimate that depends on ambient factors such as ground texture.

Phenomenologically, the solution to the task in the medicine room depends on how the nurses perceive their work: we have shown that the nurses perceive the medicine room as a "haven" where they can talk freely. They use utterances to constrain the possible solutions to their problem, specifically by narrowing the solution to the size and shape of the pills rather than other factors. Thus, the nurses provide a validation of the pill that is based on a visual estimate dependent on ambient factors such as the texture of the paper cloth on which the pills lie. In this way, intersubjective and environmental factors alike constrain how the cognitive system brings forth a solution in the medicine room.



Fig. 4 Ryan hands Hal the pill and hereby executes the task of administering medicine

As an epilogue to this analysis, we take a look at what Ryan does after he has found the replacement pill. In Fig. 4, we see Ryan handing the pill to Hal followed by Hal successfully ingesting the pill. The task of administering medicine is now finalised and the adverse event has been successfully countered. Again, we notice how Hal shows interest in the identity of the pill:

Ryan: Here's that last pill. Yes, it was the one you dropped. I was down and got it.

Patient: So, which one was it I dropped?

Ryan: It was the one called (medication name)

Concluding our analysis, the pill has become what Merleau-Ponty (1963, 162) calls a *use-object*, that is an object endowed with meaning based on the *perceived situation* and intentions of the actions of other subjects (see also Thompson, 2007, 76–77). From the moment Hal stretches his hand forward and Ryan perceives his action as an attempt to grab the dropped pill (Fig. 2e), the perceived situation for Ryan's work is founded in his perception of Hal's interest in the pill. If it was not the case that Ryan perceived Hal's intention as grabbing the pill, the adverse event might have been resolved with the pill being quickly discarded and Hal not receiving his remaining pill. In this way, the functional dimensions of cognitive systems at work cannot be separated from how agents perceive and make sense of the work in question. A nurse's perception of a patient's intentions can make the difference between an adverse event being successfully captured and not being captured.

4 Discussion and applicability

Our analysis showed that Ryan, as part of a cognitive system, weighs several environmental and intersubjective factors in order to solve the replacement task successfully. Should the pill be replaced even though it would take time and increase the risk of giving a wrong replacement? Should Alba be included in the task although it would disturb her medicine administration? And should the replacement pill be administered to Hal although Ryan could not be entirely certain that the pill was identical to the dropped pill? All these decisions required an implicit weighing of cost against benefit (Kirsh, 2006).⁴ Although we cannot calculate if it was worth it to find a replacement pill, we do know that Ryan had to make decisions on these trade-offs. His decisions were based on environmental and intersubjective factors such as Hal's interest and his collegial attitude towards Alba. Within these constraints, Ryan made numerous attempts to provide a safe replacement process, especially by including an experienced colleague for support and validation. On the other hand, Ryan's insistence on safety did also lead to increased risk for other agents, i.e., the increased risk for medication errors in Alba's work and the increased risk of adversely giving Hal another double medicine dosage (if the replacement pill turned out to be the wrong one). The clearest example of the increased risk following Ryan's decisions was perhaps the bending of the 'no-disturbance'-rule to increase the safety of the visual validation of the replacement pill.

We have thus identified a conflict of aims between ensuring safety on a local, task-solving scale for Ryan on the one hand, and maintaining safety on an institutional scale on the other. In this case, the goals of a local safety logic of dialogical validation and intersubjective intent, versus the formal safety logic of having a no-interruption zone, are incompatible. Safety researchers have found such conflicts of goals to be a prevalent source of errors of everyday work, and argue that identifying and monitoring such conflicting goals are therefore of utmost importance for safety (Bergström &

⁴ We are grateful to two anonymous reviewers for pointing out these issues of cost-benefit.

Dekker, 2014). Our investigation confirms that the risk of everyday adverse events stems from conflicting goals in an organisation trying to cope effectively with the complexities of its structure and operational environment:

The processes that normally help assure safety and generate organisational success (risk assessments, operational trade-offs) can also be responsible for organisational demise: failure incubates non-randomly, opportunistically alongside or on the back of the very structures and processes that are supposed to prevent it (Dekker & Pruchnicki, 2014, 541).

This is Ryan's dilemma. By doing his work responsibly and safely, Ryan simultaneously had to expose the system to increased risk. He did himself become exposed to the *sharp end* of the healthcare system (Hughes, 2008). Such conflicts have been described as a "tension between health agendas and staff routines" (Brown & Reavey, 2017, 9) and "a tension between the linear logic of forecasted action and the fuzzy logic of practice" (Ernst, 2016, 111). In these situations, healthcare staff has to reconcile conflicting demands. They must find a 'third way' out (Ravenhill et al., 2020, 1395; Brown & Reavey, 2017), or what can be described as building an "inner logic" (Ernst, 2016, 111) that can account for the disattending to formal rules, etc. For instance, Ryan explained that he disturbed Alba in the no-disturbance zone because "we don't want relatives and others to disturb". Ryan constructed an emergent third way of reasoning between the institutional security logic of no-disturbance and the local safety logic of inter-collegial validation. This construction is not presented as a problem for Ryan, but rather as a taken-for-granted way of doing things:

Incompatible goals emerge from the organisation and its interaction with its environment. The managing of these conflicts is typically transferred to local operating units (the sharp-end), such as control rooms, patient wards, airline cockpits. The conflicts are negotiated and resolved in the form of countless daily decisions and trade-offs. These are decisions and trade-offs made by individual operators or crews vis-a-vis operational demands: external pressure becomes internalised: the macro becomes micro where global tension between efficiency and safety seeps into local decisions and trade-offs by individual people or groups (...). Some might consider these trade-offs between production and protection to be amoral calculations by managers, (...) but cost and efficiency are taken-for-granted goals in most professions committed to problem-solving under constraints. (Dekker & Pruchnicki, 2014, 537–38)

Our integration of cognitive ethnography and phenomenology reveals exactly the cognitive conflict events where "the macro becomes micro" and taken-for-granted issues of cost-benefit trade-offs that nurses take on themselves in such situations. Our proposed method offers a unique

opportunity for revealing both the interactional dimension of safety as well as the experiential, that together form risk behaviour and adverse events. Because our method includes concrete experiences, results can easily be communicated back to and understood by nurses, doctors and managers at the ward. Such feedback to the ward is a scheduled part of the concrete research project, and it will involve sharing Ryan's story in Figs. 1 and 2, sharing our interpretation with the ward, and engaging in a dialogue with the staff about how they interpret the event, as well as our analysis of it. While our analysis is limited to a specific hospital institution, it can provide an opportunity for practitioners to reassess their taken-for-granted practices of how time, rules, resources, and intentions should be structured.

5 Conclusion

Cognitive ethnography combined with phenomenological interviews is a method that captures both interactions and experiences in local organisational practices. This is relevant in relation to human errors in healthcare since adverse events are functionally defined as breakdowns in the broader system. Nonetheless, adverse events also remain the product of how organisational members make sense of the institutional setting as well as of their own and each other's behaviour. With cognitive ethnography, we track the cognitive networks that work together towards specific outcomes, and with phenomenological interviews, we elicit subjective descriptions of how organisational members make sense of the same work. The combination of these data-gathering processes allows for an integration of Cognitive Event Analysis and phenomenological interpretation of work sequences, focusing on key moments where agents respond to errors.

We have illustrated the integration of methods in the empirical analysis of a nurse's mundane pill administering, which turns into a complex adverse event as the patient drops a pill to the floor. Our analysis shows that the nurse captures the adverse event successfully without it causing harm to the patient. The successful capture is shaped by a specific layout of environmental affordances that constrain the task, and an intersubjective community at the medical ward that collaboratively makes sense of the task and the environment. However, solving the task in a safe manner requires the nurse and extended cognitive system to break formal safety rules, e.g., by disturbing colleagues in the no-disturbance medicine room. The cognitive system of nurses and patient had to make trade-offs between institutional safety rules and a locally emergent safety and became exposed to increased risk in the process, which points to incompatible goals of formal and local logics in the everyday management of medicine in hospitals. The combination of cognitive and phenomenological methods makes it possible to understand the micro-dynamics of medicine management as well as the intersubjective and experiential dynamics through which the cognitive system negotiates formal and local logics. In conclusion, safe medication administration can itself lead to an increased risk of adverse events, because incompatible safety logics is a source of medical errors in healthcare.

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Author contributions

All authors contributed to the study conception and design. Data collection was prepared by all authors and performed by Malte Lebahn and Lotte Abildgren. The first draft of the manuscript was written by Malte Lebahn and all authors has commented on and edited versions of the manuscript. All authors read and approved the final manuscript.

Data availability

Not applicable.

Declarations

All participants have provided their informed consent. The research study has been reviewed by the relevant ethics committee.

References

- Alač, M., & Hutchins, E. (2004). I see what you are saying: Action as cognition in fMRI brain mapping practice. *Journal of Cognition and Culture*, 4, 629–661.
- Anderson, M. L., Richardson, M. J., & Chemero, A. (2012). Eroding the boundaries of cognition: Implications of embodiment. *Topics in Cognitive Science*, 4(4), 717–730.
- Ball, L. J., & Ormerod, T. C. (2000). Putting ethnography to work: The case for a cognitive ethnography of design. *Int. J. Human-Computer Studies*, 53, 147–168.
- Ball, L. J., & Ormerod, T. C. (2017). Cognitive psychology. In C. Willig & W. S. Rogers (Eds.), *The SAGE handbook of qualitative research in psychology* (pp. 572–589). SAGE Publications Ltd..
- Bergström, J., & Dekker, S. W. A. (2014). Bridging the macro and the Micro by considering the Meso: Reflections on the fractal nature of resilience. *Ecology and Society*, 19(4). <https://doi.org/10.5751/ES-06956-190422>
- Briedis, M. (2019). Phenomenological ethnography of radiology: Expert performance in enacting diagnostic cognition. *Phenomenology and the Cognitive Sciences*.

- Brown, S. D., & Reavey, P. (2017). Dark organizational theory. *Journal of Cultural Economy*, 10(3), 280–295. <https://doi.org/10.1080/17530350.2017.1298533>
- Chemero, A. (2000). What events are. *Ecological Psychology*, 12(1), 37–42.
- Chemero, A. (2009). *Radical embodied cognitive science*. The MIT Press.
- Cowley, S. J. (2011). *Distributed language*. In *distributed language*. John Benjamins.
- Cowley, S. J., & Kuhle, A. (2020). The rise of languaging. *Biosystems*, 198, 104264. <https://doi.org/10.1016/j.biosystems.2020.104264>
- Cowley, S. J., & Nash, L. (2013). Language, interactivity and solution probing: Repetition without repetition. *Adaptive Behavior*, 21(3).
- Dekker, S. (2015). *Safety differently: Human factors for a new era* (2nd ed.). CRC Press.
- Dekker, S., & Pruchnicki, S. (2014). Drifting into failure: Theorising the dynamics of disaster incubation. *Theoretical Issues in Ergonomics Science*, 15(6), 534–544. <https://doi.org/10.1080/1463922X.2013.856495>
- Ernst, J. (2016). The logic of nursing work: An organizational ethnography of practice. In A. Reff Pedersen & D. Humle (Eds.), *Doing organizational ethnography* (pp. 100–116). Routledge.
- Fuchs, T., & De Jaeger, H. (2009). Enactive intersubjectivity: Participatory sense-making and mutual incorporation. *Phenomenology and the Cognitive Sciences*, 8(4), 465–486. <https://doi.org/10.1007/s11097-009-9136-4>
- Gallagher, S. (2003). Phenomenology and experimental design. *Journal of Consciousness Studies*, 10/9(10), 85–99.
- Gallagher, S., & Zahavi, D. (2012). *The phenomenological mind* (2nd ed.). Routledge Taylor & Francis Group.
- Galosia, M., Steffensen, S. V., Cowley, S. J., & Alinier, G. (2010). When life hangs on biosemiosis: Tracking expertise in a medical simulation Centre. In S. J. Cowley, J. C. Major, S. V. Steffensen, & A. Dinis (Eds.), *Signifying bodies: Biosemiosis, interaction and health*. Catholic University of Portugal.
- Gibson, J. J. (1979). *The ecological approach to visual perception*. Houghton Mifflin.
- Giere, R. N., & Moffatt, B. (2003). Distributed cognition: Where the cognitive and the social merge. *Social Studies of Science*, 33(2), 301–310.
- Goodwin, C. (1994). Professional vision. *American Anthropologist*, 96(3), 603–633.
- Hjortborg, S. K., & Ravn, S. (2019). Practising bodily attention, cultivating bodily awareness – a phenomenological exploration of tai chi practices. *Qualitative Research in Sport, Exercise and Health*
- Hollan, J., Hutchins, E., & Kirsh, D. (2000). Distributed cognition: Toward a new foundation for human-computer interaction research. *ACM Transactions on Computer-Human Interaction*, 7(2), 174–196.

- Hughes, R. G. (2008). Nurses at the “Sharp End” of Patient Care. In R. G. Hughes (Ed.), *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Agency for Healthcare Research and Quality (US).
- Hutchins, E. (1995a). *Cognition in the wild*. The MIT Press.
- Hutchins, E. (1995b). How a cockpit remembers its speeds. *Cognitive Science*, *19*, 265–288.
- Hutchins, E. (2010). Enaction, imagination, and insight. In J. Stewart, O. Gapenne, & E. A. Di Paolo (Eds.), *Enaction - toward a new paradigm for cognitive science* (pp. 425–450). The MIT Press.
- Hutchins, E. (2014). The cultural ecosystem of human cognition. *Philosophical Psychology*, *27*(1), 34–49.
- Høffding, S. (2018). *A phenomenology of musical absorption*. Palgrave Macmillan.
- Høffding, S., & Martiny, K. (2016). Framing a phenomenological interview: What, why and how. *Phenomenology and the Cognitive Sciences*, *15*, 539–564.
- Jing, H., & Ravn, S. (2018). Sharing the dance - on the reciprocity of movement in the case of elite sports dancers. *Phenomenology and the Cognitive Sciences*, *17*(1), 99–116.
- Järvillehto, T. (1998). The theory of the organism-environment system: I. description of the theory. *Integrative Physiological and Behavioral Science*, *33*, 321–334.
- Järvillehto, T. (2009). The theory of the organism–environment system as a basis for experimental work in psychology. *Ecological Psychology*, *21*, 112–120.
- Kirmayer, L. J., & Ramstead, M. J. D. (2017). Embodiment and enactment in cultural psychiatry. In C. Durt, T. Fuchs, & C. Tewes (Eds.), *Embodiment, Enaction, and culture* (pp. 397–422). The MIT Press.
- Kirsh, D. (2006). Distributed cognition: A methodological note. *Pragmatics & Cognition*, *14*(2), 249–262.
- Kirsh, D., & Maglio, P. (1994). On distinguishing epistemic from pragmatic action. *Cognitive Science*, *18*, 513–549.
- Legrand, D., & Ravn, S. (2009). Perceiving subjectivity in bodily movement: The case of dancers. *Phenomenology and the Cognitive Sciences*, *8*, 389–408.
- Merleau-Ponty, M. (1963). *The structure of behavior* (A. Fischer, Trans.). Duquesne University Press.
- Pedersen, S. B. (2015). *The cognitive ecology of human errors in emergency medicine: An interactivity-based approach*. University of Southern Denmark.
- Pham, J. C., Aswani, M. S., Rosen, M., Lee, H., Huddle, M., Weeks, K., et al. (2012). Reducing medical errors and adverse events. *Annual Review of Medicine*, *63*, 447–463.
- Plsek, P. E., & Wilson, T. (2001). Complexity, leadership, and management in healthcare organisations. *BMJ*, *323*, 746–749.

- Ravenhill, J. P., Poole, J., Brown, S. D., & Reavey, P. (2020). Sexuality, risk, and organisational misbehaviour in a secure mental healthcare facility in England. *Culture, Health & Sexuality*, 22(12), 1382–1397. <https://doi.org/10.1080/13691058.2019.1683900>
- Reason, J. (2000). Human error: models and management. *BMJ*, 320, 768–770.
- Roth, W. (2018). Autopsy of an airplane crash: A transactional approach to forensic cognitive science. *Cognition, Technology & Work*, 20, 267–287.
- Schütz, A. (1967). *The phenomenology of the social world*. Northwestern University Press.
- Steffensen, S. V. (2013). Human interactivity: Problem-solving, solution-probing and verbal patterns in the wild. In S. J. Cowley & F. Vallée-Tourangeau (Eds.), *Cognition beyond the brain: Computation, interactivity and human artifice* (pp. 195–221). Springer Science+Business Media.
- Steffensen, S. V. (2015). Cognitive probatonics: Towards an ecological psychology of cognitive particulars. *New Ideas in Psychology*, 42, 29–38.
- Steffensen, S. V., & Vallée-Tourangeau, F. (2018). An ecological perspective on insight problem solving. In F. Vallée-Tourangeau (Ed.), *Insight: On the Origins of New Ideas* (pp. 169–190): Routledge.
- Steffensen, S. V., Vallée-Tourangeau, F., & Vallée-Tourangeau, G. (2016). Cognitive events in a problem-solving task: A qualitative method for investigating interactivity in the 17 animals problem. *Journal of Cognitive Psychology*, 28, 79–105.
- Streeck, J., Goodwin, C., & LeBaron, C. D. (2011). *Embodied interaction: Language and body in the material world*. Cambridge University Press.
- Sutton, J. (2006). Distributed cognition: Domains and dimensions. *Pragmatics & Cognition*, 14(2), 235–247.
- Thompson, E. (2007). *Mind in life: Biology, phenomenology and the sciences of the mind*. Belknap Press.
- Trasmundi, S. B. (2020). *Errors and interaction: A cognitive ethnography of emergency medicine*. John Benjamins Publishing Company.
- Urban, A.-M., & Quinlan, E. (2014). Not for the faint of heart: Insider and outsider shadowing experiences within Canadian health care organizations. *Qualitative Research in Organizations and Management: An International Journal*, 9(1), 47–65. <https://doi.org/10.1108/QROM-10-2012-1107>
- van den Herik, J. C. (2018). Attentional actions - an ecological-enactive account of utterances of concrete words. *Psychology of Language and Communication*, 22(1), 90–123.
- van den Herik, J. C. (2020). Rules as resources: An ecological-enactive perspective on linguistic normativity. *Phenomenology and the Cognitive Sciences*, 1–24.
- Weingart, S. N., Wilson, R. M., Gibberd, R. W., & Harrison, B. (2000). Epidemiology of medical error. *BMJ*, 320, 774–777.

- Yatzak, J. (2019). Everyday material engagement: Supporting self and personhood in people with Alzheimer's disease. *Phenomenology and the Cognitive Sciences*, 18, 223–240.
- Zahavi, D. (2019). The practice of phenomenology: The case of max van Manen. *Nursing Philosophy*, 00, e12276.