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# Stepping up to the Blackboard: Distributed Cognition in Doctor-Patient Interactions

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## Abstract

The discourse of laymen and professionals reveals the dependence of cognition on the interaction between participants, and the limitations of studying expertise by examining isolated individual behavior. This paper examines distributed cognition in the management of Multiple Sclerosis (MS). By varying the level of patient experience with the management of MS, we demonstrate the dependence of physician cognition on the patient's contribution in four doctor-patient interactions. Experienced patients actively constructed clinical representations and presented initial evaluations for the doctor to refine and validate. Conversations between newly diagnosed patients and doctors demonstrated the physician work to establish a common understanding of the problem and acceptable interventions. Our analysis focuses on the complementary participant roles, and challenges the notion that medical cognition equals physician cognition.

**Keywords:** distributed cognition; medical cognition; doctor-patient interaction; expertise; problem solving

## Introduction

The study of distributed cognition concerns how thought processes are distributed across individuals and groups, humans and technical artefacts and space and time. Most studies of distributed cognition have been concerned either with technical systems (Patel, Arocha, Kushniruk, 2002) or the interactions among professionals (Hutchins, 1995). But not all complex distributed cognition occurs solely between trained professionals. Many domains (e.g. medicine, financial services, real estate) involve professionals with extensive knowledge and experience who are engaged with laymen in a joint cognitive task.

This study examines professionals and laymen engaged in one such task, namely doctors and patients engaged in managing Multiple Sclerosis (MS). We conceptualize medical cognition in terms of a doctor-patient dyad that jointly identifies the problematic and determines the design and acceptance of an intervention. We illustrate mutual dependence by contrasting the coordination between the physician and "expert" laymen with the extended effort required of both the physician and "novice" laymen in the

identification of problems and solutions. In doing so, we address the mischaracterization of expertise as the composite of individual capability, the origins of problems and the multiple perspectives that shape acceptable interventions.

## Conventional View of Medical Reasoning

Psychology has focused on physician cognition, particularly on how doctors employ isolated psychological processes, like reasoning and decision making (Elstein & Schwarz, 2002). This research has identified the cognitive strategies doctors use in diagnostic reasoning including the use of hypothesis testing, pattern matching and comparisons (Coskerry, 2002).

Experimental studies typical present participants with a standardized problem. This approach omits a potentially important part of medical cognition, identifying the problem to be solved and detecting and redirecting problems outside one's legitimate expertise. Shalin and Bertram (1996) further noted the absence of attention to the cognition of treatment selection, other than the problem of biases in the conceptualization of risk. In our view, neither problem identification nor treatment selection can be done without the patient, who bears primary responsibility for presenting a complaint and provides an idiosyncratic profile of values, context and co-morbidities to influence treatment selection.

Observationally oriented studies of medical expertise identify a normative ontology including culturally endorsed values that define acceptable problems (Shalin & Bertram, 1996). Participants acquire a common technical language that facilitates distributed cognition in a professional setting (Sheehan, Robertson, & Ormond, 2007). Observational study also identifies standard solution methods that render distributed work predictable (Lippa and Feufel, 2009; Shalin, Geddes, et al., 1997). However, patients fall outside of this professional culture and are not accounted for as cognitive agents in this research.

## Conventional View of Patient Role

Research on patients has largely focused on socio-emotional coping (Leventhal & Diefenbach, 1991), use of health

information (Galarce, Ramanadhan, & Viswanath, 2011) or cross-cultural definitions of illness (Good, 1990). At least in chronic illnesses, patients also develop expertise concerning their own illness and how it manifests in their bodies (Lippa, Klein, and Shalin, 2008).

Research on doctor-patient interaction addresses the structure of the clinical encounter (Roter & Hall, 2006) and the social (and especially power) dynamics during a clinical session (Ainsworth-Vaughn, 2003; Mishler, 1984). Many of these studies portray doctor and patient conflict, with the patient attempting to speak through a holistic 'voice of the life world' while the doctor uses a 'voice of medicine' and in so doing exerts power over the patient. However, demonstrating a role for the patient in identifying the problem and evaluating solutions would imply that patients have more power than the conventional view suggests. Because the physician requires patient compliance in the out-patient setting, we show below that physician effort must complement a patient's ability to participate, thereby supporting the claim that *the patient is mutually determining the nature of the exchange*.

In this study, we directly address the interaction between doctors and patients on a cognitive level. We suggest that this dyad constitutes the central portion of a distributed cognitive system. While some researchers have begun to examine distributed cognition in medicine (Pimmer, Pachler, & Genewein, 2013), such studies have examined professional interactions (Cole & Engeström, 1993). Cognition involving professionals and laymen differs from professional team cognition in several ways. Of course, professionals and laymen have different ontological conceptions of the domain and the problematic within it. They have different lexicons, with different words for the same idea, while words in common may correspond to different ideas, e.g., "black-out." Professionals and laymen typically have access to different contextual elements. For example, only professionals can provide biomedical knowledge and test results while only laymen can provide personal, situated information. These differences between physician and laymen result in a lack of common ground (Clark, 1996). Effective distributed cognition depends on interaction that mediates between the disparate positions of the participant much as a blackboard system allows otherwise incompatible computer systems to carryout interdependent tasks.

Clinical reasoning results not solely from the mental processes of doctor or patient but rather emerges from the interaction between the two (Steffensen, 2013). Participants coordinate their cognition through language, using wording to draw on shared cultural constructs and develop a mutual parsing of the environment (Cowley, 2011). We suggest that how this occurs will both vary in accord with the patient's illness expertise. In order to explore this process, we analyze segments of dialogue from clinical encounters concerned with MS management (Cicourel, 2006).

## Methods

Data was collected at a university-based clinic specializing in MS attached to a larger neurology clinic. Twenty-four patients and three medical practitioners participated in the study. To highlight the role of patient expertise in determining the interaction the specific examples in this paper come from four patients interacting with a single physician. The data included were selected to be representative of distributed cognition during several different types of interaction that were common in the larger data set. While in the waiting room, patients were asked to participate in the study. Audio recordings and field notes documented the patient-physician. After observation each participant was interviewed over the telephone.

All the audio recordings of both clinical sessions and interviews were transcribed using a literary transcription method (Kowal & O'Connell, 2004). Transcripts were first analyzed using 'unmotivated looking' (Sacks, 1984) to see what cognitive processes seemed to be functioning in the clinical encounters. Through this process it became clear that there was considerable variability in how diagnostic and treatment decisions were made and especially in the distribution of cognitive processes between doctors and patients during these encounters. However there were commonalities across sessions in the tasks that the participants were working towards. Two of the most common tasks were evaluating symptoms and assessing disease altering medications (in terms of efficacy and side effects). Accordingly, we used cognitive task analysis to identify the component processes involved in carrying out these tasks. Following Bangerter and Clark's (2003) work indicating that discourse between partners engaged in a shared task is divided into tasks and subtasks that can be managed through conversation, several segments were then selected for more detailed analysis focusing on how the process identified in the cognitive task analyses were carried out in the interactions between doctors and patients. Two segments were chosen focusing on understanding symptoms and two were chosen looking at treatment issues. For each pair one segment was taken from an 'expert' patient, who had been actively managing MS for years, and one was taken from a 'novice' patient who was newly diagnosed.

## Results

### Evaluating Symptoms

Analysis focused on portions of the clinical sessions dealing with the evaluation of symptoms identified a common process for this task. The first the symptom was identified. Then, the doctor and patient worked together to create a common representation of the symptom. Typically this involved a qualitative description of the symptom, identification of the relevant context, and definition of the time course of the symptom (i.e. onset & duration), though occasionally only 2 of these 3 elements were included. The

doctor and patient then decided on a diagnosis and came to a conclusion about what relationship, if any, the symptom had to MS. While the process for evaluating symptoms was highly consistent on the surface, closer analysis showed variability in how it was enacted particularly in the distribution of cognitive processes between the doctor and patient. Table 1 illustrates the multi-step task of evaluating symptoms for expert and novice patients.

comprehensible language to ground the exchange. With the expert patient, the doctor uses the term ‘symptom,’ suggesting this patient can distinguish medically relevant symptoms from other forms of discomfort. For the novice patient, the doctor uses the broader term ‘complaints’ to elicit the patient’s symptoms. This allows a wide variety of issues to be raised; the physician can then distinguish which issues constitute problems in this context.

Table 1: Evaluating Symptoms<sup>1</sup>

Process	Expert Patient	Novice Patient
Symptom introduction	D: Any new <i>symptoms</i> since I’ve seen you? P: Yeah, yeah, yeah. Monday,	D: Any other <i>complaints</i> ? P: My <i>headaches</i> . That’s the only thing. I get headaches <i>all the time</i> .
Symptom representation	I was up here on Monday. Well when I had my cardiac. Well, uh uh I was walking a little bit in down town Cincinnati to a lunch meeting and uh ... my left leg started to <i>tingle</i> really bad and that that usually is... is a uh they it’s been called... they call it I want to say <i>false flare up</i> but that, that’s not correct but...	D: Are you on any medications for the headache? P: Just ibuprofen that’s the only thing I take. D: How often do you get them? P: Not every day, every other day. A lot of times its mild and it’s not too bad. Like, I have D:[uh, huh] P: [one right now. But it’s... D: How does it hurt? The top of your head? P:It hurts like right here right through my {temples}, but I get these weird, weird pains like in the back of my head. D:[huh] P: [And then I have to just literally just stop for a second because it’s a pressure like something’s squeezing the back of my head at times and it just makes my whole head throb. I don’t know what is.
Diagnosis	D: <i>Pseudo relapse</i> is what we call that. P: Or it could be a <i>relapse</i> . This is usually a sign. But as I relaxed you know I stopped what I was doing I went and I lay down didn’t do anything it has seemingly dissipated. I believe it was just the amount of walking I was doing. D: Ok how long did it last in total? P: Probably about 4 hours, 5 hours D: So we wouldn’t classify it as an attack, because it lasted such a short time. It would P: [right] D:[last more than that. It’s good enough?	D: Yeah it sounds like <i>migraines</i> . Do you feel that you’re sensitive to light and loud noises? P: <i>Not too much</i> . Maybe like... D: [when they get worse P: Yeah whenever I if I have the headache and I go outside in bright light yeah it makes it <i>a little worse</i> but <i>it doesn’t cause</i> my headaches. D: Yeah, right, right but they do get worse. P: Yeah.
Evaluation of significance for MS	P: Yeah, it <i>it feels normal for me</i> since I’ve had MS.	P: Are the headaches related? To the MS? D: I don’t think so. There are indications that there’s migraines in patients, in people with MS. But in general there is, migraines are so common.

**Symptom Introduction** Both discussions begin with a move to identify a problem and establish it as a focus of attention. This process entails the establishment of mutually

**Symptom Representation** The expert patient’s detailed initial representation includes both a qualitative description and relevant context. He also suggests a partial solution to the diagnostic problem, reaching for a medical term to use as coordinating language. His introduction of this term with ‘they call it,’ implies that he does not think of his symptoms

<sup>1</sup> Italics indicate words that are significant for the analysis.

using these terms. In so doing, he conforms to one of the social control components operating in the clinical setting, that medical personnel have privileged access to technical terms. "That's not correct" prompts the doctor's turn, to validate or refute his symptom representation.

By contrast, the contribution of the novice patient is piecemeal. At the beginning, it is still not clear if her 'complaint' is even a medically relevant 'symptom.' But she asserts that the frequency of her headaches makes them medically relevant. The physician follows up on this implication by checking if they are already being treated, i.e., the responsibility of another medical professional. The doctor asks the patient questions, prompting her elaboration. The patient here has the essential subjective experience (episodic knowledge) but lacks the abstract (semantic) knowledge to understand what aspects of her experiences are clinically relevant, while the doctor has the necessary semantic knowledge but is dependent on the patient to provide specifics for her episode. The interplay between them comprises an effort to create a shared understanding of the symptom to support diagnosis. The patient concludes by saying she doesn't 'know what it is' with the implicit question "do you?" prompting the doctor's turn.

**Diagnosis** After the doctor provides the expert patient with the relevant term, the patient chooses a related term to provide an alternative hypothesis. He then revisits his initial diagnosis, by saying it matches a pattern that is typical for him (it's 'usually a sign'), and that it ended quickly. He completes his turn asserting his belief in his last explanation (walking a lot). This assertion provides an opportunity for the doctor to either validate or object to the patient's self-assessment. The doctor questions the time course of the incident; this is critical for the definition of an MS attack, and validates the patient's self-assessment. The patient presents the symptom and provides the initial analysis, but together they decide on an account that renders the symptom non-problematic. Had the patient not considered the symptom potentially problematic, he would have provided a diagnosis by omission. Once the symptom is raised, judgment cannot have the status of a diagnosis without the doctor's contribution.

The diagnostic phase with the novice patient illustrates a disparity between doctor and patient. In diagnosing the patient as having 'migraines,' the doctor is introducing a medical term. But the patient lacks the knowledge to associate this term with her subjective symptoms. The doctor and patient must work together to test the migraine theory. During this testing process the patient has to infer the clinical characteristics of a migraine from the doctor's questions and try to match them with her experiences. As the doctor's questions become more leading, the patient's answers flag caution, using limiting language like 'not too much' and a 'little worse,' and making sure the doctor doesn't over interpret her responses by asserting that light 'doesn't cause' the headaches. While the patient lacks the

semantic knowledge to provide a diagnosis, she is keenly aware of her influence on the process.

**Evaluation of Significance** The evaluation of significance is not a question of simple medical significance, but significance as a problem for this specialist to address. The evaluation process follows the same general pattern seen throughout the interactions. The expert patient provides his own assessment. But the novice lacks the knowledge to understand the significance of her symptoms and poses the question to the doctor. The doctor already has dismissed the headaches as unrelated. But the patient has not agreed and must ask a question to reach a final resolution. Far from being inert, the novice patient raises concerns and influences turn taking while the doctor provides a medical overlay.

In both dialogues, the doctor's reasoning was constrained by elements the patient chose to represent in the conversation while the patients' reasoning was chiefly constrained by their understanding of MS. The variance between expert and novice interactions was seen in the sophistication of the language used and patterns of turn taking. The expert dialogue used sophisticated language and a pattern of patient presentation of symptoms and proposed diagnosis followed by a doctor response. Whereas the novice dialogue had basic vocabulary and required many more question-answer sequences to insure availability of relevant information and accuracy of the diagnosis.

### **Evaluating Treatments**

Many clinical sessions included discussions focused on evaluating the efficacy and/or side effects of particular treatments, either currently being used or being considered. These assessments involve multiple criteria including: side effects, clinical outcomes, MRI outcomes, and pragmatic considerations. Though all of these criteria were used multiple times most assessments only evaluated two or three criteria. Each party was responsible for a subset of the evaluation criteria. The patient was the only one to have subjective knowledge about the acceptability of symptoms and side effects, while the physician was the only one who could assess efficacy with respect to MRI outcomes. The clinical outcomes can be evaluated by both participants. A multi-attribute evaluation required input from both perspectives and interaction concerning multiple issues.

Table 2 includes dialogue from two patients who have recently begun new treatments. In both discussions, the doctor initiates the evaluation by asking a question. The expert patient, who has had MS for several years and been treated unsuccessfully with a number of medications, immediately responds in a medically relevant fashion. She begins with her own assessment of the medication's side effects using language that is medically oriented (e.g. 'muscle tightness,' 'joint pain'), but not explicitly technical. She includes information about her subjective experiences and the opinion of the nurse to support her conclusions. The doctor responds directly to the patient's contributions and

Table 2: Evaluating Treatment

Expert Patient	Criteria Assessed	Novice Patient
D: So, tell me how it is. P: It's good, it's very good. I had the first. Um, the first two were no <i>side effects</i> . The third one I had some <i>muscle like tightness</i> like sore in my wrists, kind of like <i>joint pain</i> . And D: [uh, uh] P: [then after that dose the one time and I had read that that was a side effect and I talked D: [um, hum] P: [to the person that infuses it and they had said also you know that it was. And I didn't D:[oh, ok] P: [have any side effects then this last time. D: So just one time. P: Just the joint pain but that was it. D: So a little bit of muscle tightness in the area but that was it. P: Yeah, yeah but I mean <i>physically I feel so much better</i> . D: Do you?... P: Yeah, I'm like back to normal. I mean even the numbness is not what it was. I mean I have a little in my toes but like what you can live with you know. D: Oh, hahaha. Me too. How was walking? <i>I see much better</i> . P: Great. I mean it's, we adopted our little girl and we were in Guatemala. D: No way, no way, no way. P: I mean that's what I mean I was down there we were in the airports and holding the baby. It was fine, I just made it. I wasn't tired. ... Husband: Have you heard anything, like from other patients, that Tysabri a good alternative. D: The majority of patients they have very good results. They do get better. That's what I always heard. That's what I always heard. And usually good candidates are people who don't respond well to the other treatments. Who get enhancing lesions on the MRI who still have active disease, who still have inflammatory disease.	Side effects Pragmatics  Side effects  Pragmatics  Symptom Reduction    MRI results MRI results	D: How are you doing on Copaxone? P: First I didn't want to do the shot cause {I} wasn't too fond of needles. I was <i>afraid</i> of them, because I had a bad experience with needles. Dr: Oh. P: I got used to it. Dr: You're not getting any <i>injection site reactions</i> ? P: It turns red and there's <i>a little lump sometimes</i> . Dr: And they're <i>frequent</i> to like every day you have to do that {injection}. ...  Dr: There is a lesion that is here. So we repeat the MRI if there is still anything new after enhancement then what we will have to do is switch the medication.

show acceptance of her evaluation. The patient then focuses on the benefits from the treatment, providing both abstract assessments and specific instances where the improvement was especially evident. The doctor supports her in this process including her own assessment of the patient's improved gait. Much of the active assessment is done by the patient, although she relies on the doctor to add validity to her judgments. The husband prompts further validation by asking how the patient's experiences compare to others. The doctor provides final validation by relating her professional experience and providing a physiological explanation.

By contrast, the dialogue with the novice patient illustrates an initial struggle to establish common ground. While the doctor intends to elicit an assessment of the treatment in medical terms, the patient interprets the question more broadly describing her emotional response. The doctor restates her question more specifically. The patient responds and then the doctor revisits the pragmatic issue the patient raised. Thus we have a physician led discussion of side effects and a patient led discussion of the emotional impact and pragmatics of the medication.

Eventually the doctor returns to an assessment by reviewing MR images. The patient does not participate at all in discussion of this factor. The patient is absorbed with her subjective experience, which is not a category of concern to the doctor. And, the doctor shifts to MRI interpretation, for which the patient has neither language nor knowledge.

The contrast between expert and novice discussions is striking. The expert patient both defines the problem space and provides the basic evaluation. But, the doctor provides the validation and extension that transforms the patient's personal assessment into a verified medical outcome. By contrast, the novice patient and physician evaluate the medication on three dimensions. Each dimension is assessed by one participant with minimal contributions from the other. There are no co-constructed conclusions.

## Conclusions

In this study, we have examined the interactions between doctors and patients with Multiple Sclerosis. We revealed

the role of language, available to the expert patient and constructed for the novice patient. While expert patients had a sense of relevance, novice patients did not, placing a demand on the physician to elicit a relevant contribution. With expert patients, the doctor's role was to understand the patients' reasoning, check and validate the patients' conclusions, and extend the conclusions by relating them to broader medical constructs. With novices, the doctor's reasoning was constrained by what the patient contributed to the dialogue and the patient's acceptance of hypotheses. This suggests that over the course of multiple clinical interactions patients become attune to the cognitive processes involved in MS management and oriented associated language and values increasing the efficiency of distributed clinical cognition.

Our point is not that all expert patients behave in one way, while all novice patients behave in another. But that the patient's level of expertise shapes the physician's behavior, because she cannot independently identify and solve problems. The patient's power lies in directing a portion of the interaction concerning experience that only she can provide and determining the structure of the physician's work. Medical cognition, especially in chronic illness, cannot be fully understood without considering the patients' contributions and the role of patient-physician interactions. More generally, distributed cognition among participants with different perspectives cannot be fully understood without an account of the processes for identifying the problematic and creating a shared space for the mutual design and acceptance of solutions. Future research is needed to address the interplay of participants' access to knowledge and environmental elements, language, interaction, and distributed cognition.

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