Combining knowledge and interaction perspectives to decipher learning during a clinical interview

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Abstract: The mystery of how instruction leads to learning of disciplinary-based knowledge is examined through a fine grained analysis of a learning episode taken from a clinical interview in physics. The analysis employs two distinct theoretical perspectives, the Knowledge in Pieces perspective on conceptual change (diSessa, 1993), and a distributed perspective of learning (Stevens & Hall, 1998), linking the student’s knowledge in-use and in-development to the interaction with the interviewer/tutor and the learning artifacts.

Introduction
How exactly does instruction lead to learning of disciplinary-based knowledge? Based on interactions between participants in disciplinary practices and related visual inscriptions, Stevens and Hall (1998) suggested that practicing a discipline involves the development of a disciplined perception. For instance, the development of visual practices unique to the discipline of architecture includes a set of specific forms of embodied actions, such as looking at the world in terms of layout, terrain, etc. Thus, instruction in its very essence is an asymmetric action which involves disciplining students’ perception. Stevens and Hall argued that the relevant unit of analysis should be the “materially mediated, distributed character of real world perception” rather than “internal cognitive processes” (p. 110). A focus on internal cognitive process led diSessa and colleagues (diSessa & Sherin, 1998; diSessa & Wagner, 2005) to hypothesize the construct of expert-like concepts termed coordination classes. A coordination class includes schemes of perceiving the concept in the environment, and thus seems intimately related to the notion of disciplinary perception, though the focus of analysis is very different. The fault lines between these two approaches are whether the relevant unit of analysis is the practice or the concept, and whether the interesting story is in the interaction level or in the knowledge level. In my view these two approaches complement rather than contradict one another, particularly if the aim of analysis is to understand the subtle relations between instruction and learning. After all, expert knowledge is developed during interactions with more capable others while using artifacts and objects unique to the discipline, and expert interaction is shaped by experts’ knowledge. In fact, there was a call for more theoretical work associating the more functional conceptualizations of interaction analysis and the more structural constructs of knowledge analysis in a recent AERA funded conference entitled "Integrative Approaches to the Analysis of Cognition and Learning". This poster presents an analysis of a short learning event in an episode drawn from a clinical interview with a high school student about the existence of the normal force in physics. The analysis is aimed at linking the student’s knowledge in-use and in-development to the interaction with the interviewer/tutor and the learning artifacts.

Context of inquiry
The episode discussed here is drawn from a data corpus that was collected as part of a project that examined the role of prior knowledge in analogical reasoning (Kapon & diSessa, 2010, in press). As part of this project I conducted six clinical interviews with high school students around a tutoring session that used a sequence of bridging analogies on the existence of the normal force from classical Newtonian mechanics. During the interviews the interviewees could handle all the objects used in the analogies (books, springs, boards, etc.). A fine-grained comparative knowledge analysis (diSessa, 1993; diSessa & Sherin, 1998) was employed in these interviews, and showed that differences in individual responses to an instructional sequence can be explained by differences in the particular knowledge (termed explanatory primitives) that is activated, and differences in the relative reliability (“confidence”) the individual assigns to a particular explanatory primitive. However, the fine-grained knowledge analysis raised additional detailed questions about the reasoning prompted by instructional analogies, such as which aspects of the interaction with the interviewer/tutor and objects in the learning environment activated a particular explanatory primitive, convinced the learner to shift preferences from one primitive to another, and later use the primitive in the construction of new understanding. This poster does not attempt to answer these questions but rather present insights from a preliminary analysis that tries to integrate the knowledge and interaction perspectives.

The poster discusses an episode that illustrates the nature of this inquiry exemplifying an instance of a development of a disciplined perception in the context of Newtonian mechanics, namely perceiving motion in terms of the forces involved. The analysis specifically attends to the interviewer’s instructional moves and the interviewee’s responses. Activation of prior knowledge constructs and their relative considerations were based on the interviewee’s choice of words, focus of attention, gestures, and tone, and triangulated with other episodes from the interview (triangulation of expression) and the literature on intuitive knowledge in early Newtonian
mechanics (triangulation of form). The knowledge analysis was guided by the Knowledge in Pieces perspective on conceptual change (diSessa, 1993). The interaction analysis was guided by distributed perspectives of learning (Stevens, 2010; Stevens & Hall, 1998) and conversation analysis (Sacks, Schegloff, & Jefferson, 1974).

Preliminary analysis
The episode starts when the interviewer reacts to a student’s account for the fact that the book she placed on the table did not fall to the floor. The student's explanation was that: “the particles in the table […] are compacted too tightly for the book to get through”. He claimed that it does not make sense that the table exerts a force while “preventing the book from moving through it”. At this point the interviewer asked the student to hold out his hand, and she placed a book on it. She asked him whether his hand exerted a force on the book. He was not sure, and he played with the book for a while, as if weighing the book with his hand, thinking silently. The interviewer started piling more books on his hand. At this point the student said “I’d say it’s the amount of force for [stops an think] my hand to compensate for the attraction of gravity.”

The knowledge analysis suggests that the student activated the supporting p-prim when initially making sense of the book on the table scenario. The supporting p-prim (diSessa, 1993) stipulates that a “strong” or stable underlying object merely keeps overlaying and touching objects from falling. The interaction with the book on the hand activated a competing p-prim, dynamic balance. Dynamic balance (diSessa, 1993) explains situations of balance when forces are recognized, namely when a pair of forces or directed influences are in conflict and happen to balance each other. Note particularly the student’s “compensating” language, and his explicit mention of gravity as a force (“attraction”). The activation of dynamic balance is mediated here by the activation of two other primitives: The first is that effort entails force. Effort is a common co-occurring element of situations where force applies (diSessa, 1993); the second is that gravity pulls things downwards.

Now let us attend to the interaction with the interviewer during this exchange. The interviewer piling increasingly more books on top of the hand of a student who was not certain whether his hand exerted a force on a book that is placed on it could be interpreted as a form of recipient design (Sacks et al., 1974) aimed at disciplining the student's perception by directing his attention to the effort made by his muscles. The next turns reveal that though the student activated dynamic balance he was not certain that it was more appropriate than supporting in the case of the book on the hand. This preference was gradually solidified during the interaction with the interviewer who constantly disciplined the student's perception towards the forces involved. For instance she reiterated his description of the force of gravity while explicitly adding the direction of this force (“downwards”) to the sentence; she asked him if he “felt” the force, which he immediately answered by: “Yeah. To maintain it at this level, it requires a certain amount of force to keep it level”. Note again how effort entails force mediated dynamic balance. This example illustrates how the student's specific activation of p-prims and his consideration of their relative appropriateness as explanatory means were influenced by the particular conversational moves of the interviewer.

References

Acknowledgments
This research was supported by a Marie Curie International Outgoing Fellowship within the 7th European Community Framework Program.