A Study of Narrative as the Cognitive Process Underlying Diagnostic Reasoning

PI:	Curtis Scott Smith, MD
Team:	Chris Francovich, EdD Magdalena Morris, RN, MSN Andrew Turner, PhD Bruce Robbins, PhD Lynne Robins, PhD William Hill, PhD Francine Winkle, BS
Organization:	St. Luke's Regional Medical Center

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STRUCTURED ABSTRACT

Purpose: We aimed to study the narrative competence of a continuum of learners and its relationship to their diagnostic reasoning.

Scope/objectives:

1) Confirm that narrative is being used in diagnostic reasoning.
2) Catalogue the linguistic elements used when discussing three common causes of dyspnea.
3) Compare the use of the linguistic elements by subjects at various levels of training.

Methods: We performed semi-structured interviews of premedical students, first-year medical students, third-year medical students, second-year internal medicine residents, and experienced faculty (10 each) as they diagnosed three common causes of dyspnea. A second observer recorded emotional tone. All interviews were digitally recorded, and blinded transcripts were created. Grounded theory was used to identify salient categories, and propositional analysis was performed. Transcripts were then unblinded. Systematic differences in grounded categories were identified, and summary concept maps were created for each learning level.

Results: We discovered two key findings:

1) *The Apprentice Effect*: First-year medical students exhibit less reliance on symptoms and experience, fewer episodic memories, greater "struggling with disease definition," fewer propositional assertions, more blunted concept maps, and more negative affect compared to all other learners.

2) *Faculty Expertise*: Experts more commonly seek diagnostic cues in the environment, use 'nearest neighbor' groupings to facilitate retrieval, and focus on critical cues that efficiently separate diagnostic narratives. This may have evolved or been learned by experience, and this question has important pedagogical implications and should be studied further.

Key Words: Undergraduate Medical Education; Emotional Stress; Narrative Medicine; Diagnostic Reasoning

PURPOSE

We aimed to study the narrative competence of a continuum of learners and its relationship to their diagnostic reasoning. Narrative competence was assessed using analytical (propositions and semantic categories) and non-analytical (memories and emotions) linguistic elements. We compared their narrative competence with their diagnostic strategy for three common causes of shortness of breath. Our objectives were:

1) Confirm that narrative is being used in diagnostic reasoning.
2) Catalogue the linguistic elements used when discussing three common causes of dyspnea.
3) Compare the use of the linguistic elements by subjects at various levels of training.

SCOPE

Background: A striking feature of human and other primate cognition is our propensity to categorize.[1] This is thought to be the result of limited working memory capacity and resultant need to offload details from conscious processing.[2] Classic research demonstrates that working memory can process approximately seven 'chunks' of information at a time.[3] A chunk is handled as a unified, coherent piece of information and is regulated in various ways depending on experience and development. For instance, how one conceptualizes heart failure changes dramatically with experience. Notions such as ischemia, wall motion, chamber pressure, and arterial resistance become more complex and integrated. Much of what initially required conscious attention becomes automatic and implicit with experience.

Understanding how medical information is chunked and then categorized as illness is critical to understanding and ameliorating diagnostic error. In this study, we explored the role of narrative structures in learning and organizing information throughout the continuum of medical education.

Participants/Settings: We chose to use semi-structured interviews with trigger questions that would be expected to elicit participants' intuitions, analyses, and stories. These interviews were performed on 10 each of premedical students (PM) from Boise State University; first-year medical students (MS1) from the University of Washington site in Moscow; and ID and third-year medical students (MS3), second-year medicine residents (R), and experienced medicine faculty (F) from the medicine department at the Boise VA Medical Center.

METHODS

Study Design: A cross sectional observational study with semi-structured interviews.

Data Sources: For each of three diseases the following four trigger questions were asked, and the answers were audiotaped.

- If someone complained of shortness of breath, how would you figure out that the cause was (congestive heart failure, emphysema, and pneumonia)?
- What do you believe are the critical elements for making that diagnosis?
- What helped or hindered you in learning this?
- Can you remember anyone (an acquaintance, family member, or patient) with this disease?

Simultaneously, a process observer recorded emotional tone with a validated tool based on facial expression and body language.[4]

Analysis: Transcripts were analyzed in two ways. One team used grounded theory[5] to identify and negotiate salient categories in the data and code passages in the transcripts with these categories. Each individual's response to each question was the unit of analysis. These researchers independently read and reread the transcripts identifying categories that explained the generation of ideas for diagnostic analysis. Each category was defined with necessary and sufficient conditions and illustrated with text examples. This team met several times to negotiate categories and definitions until agreement was reached. Discrepancies were adjudicated by the principal investigator. The transcripts were then coded with the consensual set of categories.

Another researcher performed a propositional analysis and used this to create concept maps. Any 'IF →THEN' assertion such as "CHF causes lower-extremity edema" was identified as a single proposition. These were arranged into concept maps, a branching hierarchical structure in which the logical relationship between concepts could be articulated in linking phrases such as "gives rise to," "results in," "is required by," or "contributes to."[6] In addition, the answers to the "can you remember anyone with this disease" trigger were divided into episodic (personal perspective) and semantic (factual) memories.

The learning level of each transcript was then unblinded. The grounded theory categories were explored directly and by using Boolean operators between groups (such as "symptoms" NOT "technical"). Summary concept maps were created for each learning level.

RESULTS

Grounded theory analysts identified 17 salient categories in the transcript data. Inter-rater scoring agreement was 92% in the final analyses.

1) The "Apprentice" Effect: Coding to "cue generation" (a list of cues generated to explain or define a diagnosis), "logic" (in which some effort is made to formalize an argument for a diagnosis), and "rule-based response" (relying on a general rule or algorithm to respond completely to a question) were all increased for MS1s compared with PM, but coding to "experience" (referral to personal experience) and "symptoms" (participants refer to the symptoms associated with an ailment) was decreased and did not return to the premed baseline until residency.

When asked "can you remember anyone with this disease," the numbers of answers scored as episodic (personal perspective) were PM 20, MS1 4, MS3 20, R 21, and F 18, demonstrating a distinct decrease in MS1's.

One key category is "struggling with disease definition" (see figure 2), defined as "the participant appears to struggle with the definition or lists of diseases or diagnoses," and scored as follows: PM 117 text units, MS1 174 text units, MS3 17 text units, R2 24 text units, and F 1 text unit. These results demonstrated maximal 'struggling' at the MS1 level.

In the propositional analysis, the average number of propositions per disease per group was as follows: PM 4.2 (+/- 2), MS1 2.3 (+/- 1.8), MS3 8.4 (+/- 3.1), R 12.4 (+/- 5.4), and F 9.6 (+/- 4.2). The word count per transcript steadily increased with experience level. However, concept maps for MS1's were blunted and showed less organizing conceptual structure compared with all other groups, including PMs.

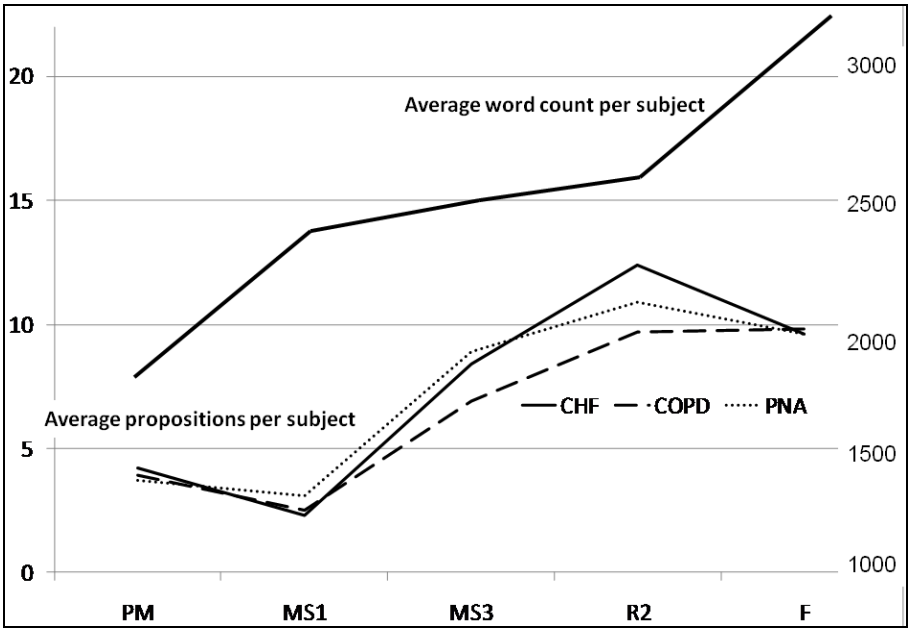

Fig 1. Average word count and number of propositional assertions per subject transcript for the five levels of learners and the three diagnoses studied.

The emotional tone averaged 0.23 (aroused) for PM, -0.067 (tense) for MS1, 0.42 (alert) for MS3, 0.51 (alert) for R, and 0.78 (excited) for F. One resident scored 'sad' (recounting a patient who had recently died), and three faculty members were the only interviewees to score 'calm.'

In summary, first-year medical students exhibited less reliance on symptoms and experience, fewer episodic memories, greater "struggling with disease definition," fewer propositional assertions, more blunted concept maps, and more negative affect during their interviews compared to all other learners.

2) Faculty Expertise: The intersection of coding to "Cue Generation" with other categories demonstrates that experts generate diagnostic cues far more often than other levels from the patient's symptoms and physical examination and from personal experience (Figure 3). Their overall reliance on "tests" is lower than R2s and MS3s, whereas their reliance on history is the highest of any group (Figure 2).

When asked "can you remember anyone with this disease," the faculty answers tallied as semantic (factual) memories were the highest for any group and were greatest for facts related to a prototypical presentation. Faculty episodic (personal perspective) memories were generally detailed specific examples of 'boundary' cases—cases that represented the limit of the prototype or diagnostic group.

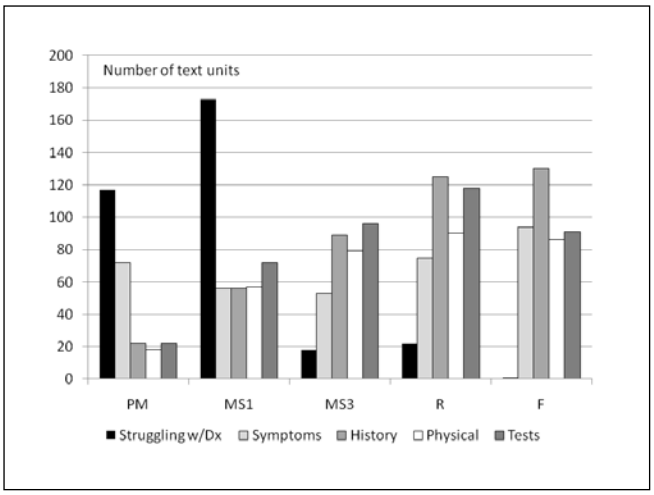

Figure 2. Text unit counts for key diagnostic categories by learner level.

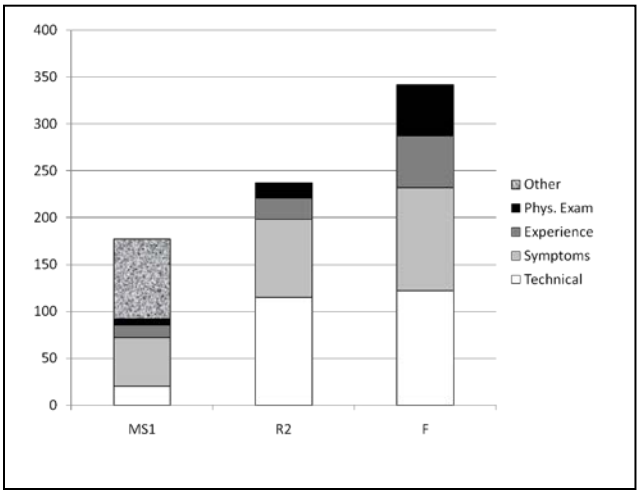

Figure 3. Coding to "Cue Generation" intersected with other important categories related to diagnosis by learner level.

One key category for faculty was "Disconfirming Cue," defined as "the absence of an expected cue or the presence of a cue that negates the diagnosis." Eighty-seven percent of all text units coded to this category were uttered by faculty, and 16% of all faculty diagnostic narratives included a disconfirming cue example. These were used very heavily by faculty to sort out the boundaries of diagnostic categories.

The propositional analysis and concept maps of faculty were qualitatively different than all other groups. First, they had a drop in propositional assertions from residents (see Figure 1) and tended to use very high-order grouped conceptual propositions. Second, though all other learner levels focused their activity to the right of diagnosis on the concept maps (attending to the tests and treatments appropriate for that diagnosis), the faculty focused their activity to the left (nuances of sorting out the diagnosis).

Here is an example from faculty subject 011. Note the detail of the episodic memory, the use of a disconfirming cue, and its focus on defining the boundaries of a condition—pneumonia.

> "I was working in a small town, around 6000 [people], in the mountains. It was July, black fly season, and a woman came in with all the classic signs of pneumonia: cough, shortness of breath and fever and the classic physical findings, but it was the wrong season…She had Faget's sign (pulse-temperature disparity) and she had Legionella."

As noted above, faculty had the most positive emotional tone (excited) during the interviews.

3) Discussion and Conclusions: First-year student responses demonstrated the "apprentice effect," manifested by a drop in medical narrative competence, a distorted salience landscape with overreliance on 'objective' tests, and emotional distress compared with premeds, MS3s, or residents. In conversations with the interview team, they appeared to be self-conscious and uncomfortably aware that they couldn't answer questions unequivocally.

They wanted to please, but knew they had to be evidence based and avoid premature closure, so they rejected their prior experience as a basis for providing answers. Instead, they expressed insecurity and a desire for concrete evidence in the form of tests.

Faculty rely on their prior experience as an organizing framework, grouping things in 'nearest neighbor' categories, with general central prototypes and specific instances defining the boundaries. Much more than any other group, they attend very closely to the history and physical cues from the patient and the contextual cues from the environment, focusing especially on high-value disconfirming cues, or "rule-ins/rule-outs."

Taken together, these data suggest that first-year students learn (or are taught) to distrust personal experience with sick people and lay understandings of disease. Although this may safeguard against premature closure, it also leads to downplaying the more experiential, intuitive aspects of diagnosis. Faculty eventually learn to reconnect to the patient and the environmental context for critical diagnostic cues, but it takes quite some time (at least after the R2 year in our study). This suggests two further studies.

1) This study was done entirely within one training continuum (medical school and affiliated residency), and the medical school is configured as a fairly traditional 2 years of basic science + 2 years of clinical curriculum. It is not known whether these findings represent an artifact of our research methods, a developmental stage in medical training, or a curriculum effect. It may well be that other types of curriculum delivery, such as problem-based learning (PBL) or team-based Learning (TBL), would ameliorate much of this apprentice effect. This should be studied further.

2) Faculty employ a very organic process for diagnosis that is much more connected to the patient and environment. This could be the result of human evolution,[7] in which case learners need to hone specific traits. Or it could be the result of learned rational cognition,[8] in which case pedagogy could be improved by directed experiences and reflection. Determining which requires a detailed experiment examining data such as saccadic eye movements, galvanic skin conductance, pulse, salivary cortisol, resistance to change blindness, etc, during the diagnostic process. This should also be studied further.

PUBLICATIONS AND PRODUCTS

Smith CS, Hill W, Morris M, Francovich C, Langlois-Winkle F, Robbins B, Robins L, Turner A. The "Apprentice Effect" in first year medical students: They're overwhelmed and cautious (abstract-poster). Feb 4, 2011. NW Regional SGIM. Portland, OR. SELECTED BEST POSTER IN MEETING

Smith CS, Hill W, Morris M, Francovich C, Langlois-Winkle F, Robbins B, Robins L, Turner A. The "Apprentice Effect" in first year medical students: They're overwhelmed and cautious (abstract-poster). May 4, 2011. SGIM National Meeting. Phoenix, AZ.

Manuscripts are being prepared for both of our major findings.

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