Knowledge-based Components of Expertise in Medical Diagnosis

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Studies of clinical reasoning prior to this one had established the general form of clinical reasoning as hypothesis testing; cues in patient data suggest interpretive hypotheses which direct further interrogation of a case. However, parameters of this process reflecting timing and number of hypotheses did not discriminate expert from novice reasoning. As also indicated by other psychological studies emerging at the time (e.g., chess), expertise appeared to reside in the quality of diagnostic outcomes (intermediate and ultimate) and in the knowledge base supporting reasoning. The present study in pediatric cardiology set out to explore the roots of quality in the knowledge base of clinical practitioners.

Hypotheses about the disease knowledge base and its development with experience were proposed, involving: (1) density, the clustering of similar diseases into categories, (2) precision, the tuning of clinical expectations in a disease to their naturally occurring variability, and (3) non-classicality, the elaboration of disease prototypes into many less representative variations.

Medical subjects (students through highly experienced professionals) diagnosed clinical cases while thinking aloud. Each case was designed to test one of the aspects of disease knowledge. This was aided by the use of a "garden path" methodology by which subjects were led initially to an erroneous hypothesis and had to adjust in particular ways if they were to be successful in the case. The focus on quality in the study was addressed through analysis of subjects' use of "logical competitor sets" (LCS), hypotheses sharing a "deep" physiological commonality and defined in advance to be plausible explanations for each case.

Results were generally consistent with the hypotheses concerning knowledge base development. Experts generated and considered LCS diseases in groups, branched to subtle disease variations where appropriate, and evaluated alternatives appropriately to make discriminations. Novices considered subsets of the LCS more in isolation, often focusing on the classic prototype, and made systematic errors of evaluation, reflecting imprecision.

Quality in clinical reasoning was attributed partly to a dense interactive knowledge base for diseases organized by pathophysiological "deep structure," many variations on each disease theme, and well-tuned clinical expectations for diseases.