

# Attainment and Potential: Procedures, Cognitive Kit-Bags and Cognitive Units

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Why do two students, both of whom did well in one course, have vastly different experiences in the subsequent course? Does the successful student merely have more available procedures, or is there a fundamental difference in his or her cognitive activities?

Nancy and Kathy both earned a “B” in college algebra, and both enrolled in pre-calculus the following semester. Nancy had little difficulty in pre-calculus, but Kathy had a great deal. The course is a degree requirement, so she needed to pass it; she dropped once, re-enrolled and eventually passed, but with much work and anguish. Why do “so many of the population fail to understand what a small minority regard as being almost trivially simple?” (Gray & Tall, 1994). Why do two students with apparently similar attainment go on to perform so differently?

To seek insight into these questions, we explored the cognitive structure demonstrated by the two students working problems involving graphs of lines from the first algebra course, and compared their problem solving approaches. We have previously studied the diffuse cognitive structure of a less successful algebra student (Crowley & Tall, 1999). This study compares and contrasts the work of a similar student—who struggled with very straightforward algebra concepts—with that of a student who proved to be more successful in the succeeding course.

Barnard and Tall (1997) introduced the idea of “cognitive unit” as “a piece of cognitive structure that can be held in the focus of attention all at one time.” We see cognitive units as forming the nodes of a cognitive structure linked to other units using the web metaphor of Hiebert and Carpenter, incorporating the varifocal element of Skemp. If various elements are not connected securely, the individual may not be able to consider the totality as a cognitive unit. Links are not made to a flexible conceptual entity, but to one procedure from a collection, the student’s “cognitive kit bag”. Interviews revealed quite different cognitive structures. The successful student had a variety of approaches to problems, checking mechanisms, and an overall grasp of linear equations as if it were a **cognitive unit**. The other student had a **cognitive kit-bag of procedural techniques** with no flexibility or checking mechanisms. She had the same attainment but very different potential to cope with the ensuing course.