Expertise Effects on Sorting Strategies of Causal Phenomena

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Introduction

Recent work has emphasized both the importance of relational categories in cognition, (Gentner & Kurtz, 2005) and role of causal structure in categorization of causal phenomena (Rehder, 2003; Sloman, Love, & Ahn, 1998). Whereas some categories may be defined primarily by features, relational information may be the sole determiner of other categories. Particularly, mechanism or the underlying structure which explains *how* a causal process functions (Forbus, 1984) seems to be a likely candidate for relational causal categories: the same type of mechanism can explain causal phenomena across many domains.

Experiments

The current study examines how participants categorize textual descriptions of real-world phenomena that vary along two dimensions: domain (e.g. economics) and causal structure (e.g. negative feedback). We compared novices (introductory psychology students) to experts (students in physics and an integrated science program)—students likely to have experience analyzing causal mechanisms. We predicted more causal sorting for experts than for novices.

We created descriptions in a 5 (causal type) x 5 (domain) design. In writing the descriptions, we used Latent Semantic Analysis (LSA) (Landauer, Folts, & Laham, 1998) to ensure that the causal descriptions were relatively low in contextually relatedness. LSA relatedness ratings were significantly lower for descriptions within the same causal system (M=0.10, SD=0.04) than for those within the same domain (M=0.21, SD= 0.08), $t(24)$=5.36, p<.001.

Participants were given 5 example cards, each distinct in causal type as well as in domain. They were asked to sort the remaining 20 descriptions into the five categories that were instantiated by the exemplar cards, plus one "Other" category. This task was designed to allow participants to sort either by domain or by causal system.

Results and Discussion

As predicted, experts sorted more cards into relational categories (matching the exemplar by causal system) than domain categories $t(19)$=2.10, p=.02 (1-tailed, paired). The novices sorted more cards by domain than by causal system $t(19)$=2.08, p=.03 (1-tailed, paired) (Table 1).

Table 1: Means and Standard Deviations for Expert and Novice Sortings

	Novices		Experts	
	mean	stdev	mean	stdev
Domain Match	5.25	2.31	3.5	1.85
Causal Match	3.15	2.82	5.25	1.87

Hierarchical cluster analysis (HCA) was conducted on the summed sorting data and revealed four groups based on domain for novices: novices conflated the domains of mechanical and electrical engineering. Five groups based on causal system were revealed for the experts.

The sortings that deviated from the dominant sorting strategy could often be explained by exceptionally high LSA scores. The conflated mechanical/electrical engineering cluster received LSA ratings (M=.179, SD= .084) that were almost as high as the average *within-domain* pair (M=.209, SD=.084), $t(26)$=-.08, p=.22. Two out of three anomalies appearing in the HCA of the experts could be explained by exceptionally high LSA ratings. Apparently, extreme contextual relatedness drew experts to sort by domain despite a dominant causal system strategy.

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