

Conceptual Centrality and the Role of Comparison

Jason Jameson

Dedre Gentner

Department of Psychology
Northwestern University

Keywords: Conceptual centrality; similarity; categorization; comparison; structure-mapping.

Introduction

Components of a concept vary in their importance, or “centrality,” for a given cognitive task—the degree to which the component guides or influences cognitive processing. This claim has been empirically established across a variety of tasks, such as categorization (e.g., Ahn, et al., 2000; Rehder & Hastie, 2001) and induction (e.g., Rehder & Hastie, 2001). There is still much dispute, however, over the specific factors related to internal conceptual structure that determine the importance of a conceptual component (e.g., Ahn, et al., 2000; Rehder & Hastie, 2001). Such claims have been investigated at the level of task analysis (or Marr’s computational level), but what is missing is an account that would also include an algorithmic level of analysis—a specification of the representations and processes that would incorporate a role for conceptually central components. Such an account could offer additional insight into the factors that determine conceptual centrality.

We investigated how conceptual centrality might arise from constraints on the comparison process, which has been implicated in several other cognitive processes (e.g., analogy, similarity, categorization, induction). Taking as our guide structure-mapping theory (SMT) (e.g., Gentner, 1983), enables us to make strong predictions about the possible influence of conceptually central changes on tasks that include similarity, categorization, analogy, and induction. SMT is ideally suited for dealing with conceptual structure and coherence (as *systematicity*), and accordingly, conceptual centrality.

Taking SMT as a guide sets up a tension with previous work on conceptual centrality, however. Specifically, one of SMT’s key claims is that similarity is like analogy in that it is sensitive to the structure and systematicity of compared mental representations. Though there are important differences between overall similarity comparisons and other types of tasks (such as analogy and categorization), there are important processing commonalities. How we should interpret dissociations between similarity and categorization (as Ahn and others have found) is thus an open question.

According to SMT, such a dissociation is benign, in that similarity and categorization are supported by the alignment process but that overall similarity may be more sensitive than categorization processes to overlapping surface properties. Further, since structure-mapping principles have found broad applicability across a variety of materials and tasks (e.g., perceptual materials, text materials, etc.) we expect to find the

influence of centrality across a broad range of materials, not just object categories, as has typically been studied.

To investigate these issues, we conducted a two-alternative forced choice similarity task and categorization task, using as stimuli, short single-paragraph stories with a rich relational structure. In the similarity task, participants were instructed to pick the option most similar to the standard; and in the categorization task, a separate group of participants was instructed to pick the option that should be categorized with the standard. For each triad, one alternative contained a change to a central statement (a causal pivot that provides an explanation for key events in the story) and the other contained a change to a less central statement. According to SMT, if similarity processes are sensitive to structure and degree of systematicity, then changing central statements should reduce similarity more than changing less central statements. In addition, the effect should be more pronounced for categorization than for similarity, since overall similarity is more sensitive to surface matches (i.e., less central statements). The results supported our predictions. Participants in both the similarity and categorization conditions reliably picked the alternative with the less central change as most similar to the standard, compared against chance (for similarity: $M = .69$, $SD = .29$; for categorization: $M = .85$, $SD = .36$). Moreover, the difference between the groups was reliable, with the effect more pronounced in the categorization condition.

We are currently extending these results with an analogy task, in which participants are instructed to pick the story that is most analogous to the standard. Since analogical comparisons reflect a strict focus on relational structure, we expect to find a strong effect of centrality. Indeed, preliminary data suggest that this is the case. Overall, these results suggest that our understanding of conceptual centrality may be enriched by considering constraints on the comparison process.

References

- Ahn, W., Kim, N. S., Lassaline, M. E., & Dennis, M. J. (2000). Causal status as a determinant of feature centrality. *Cognitive Psychology*, *41*, 361–416.
- Gentner, D. (1983). Structure-mapping: A theoretical framework for understanding analogy. *Cognitive Science*, *7*, 155–170.
- Rehder, B., & Hastie, R. (2001). Causal knowledge and categories: the effects of causal beliefs on categorization, induction, and similarity. *Journal of Experimental Psychology: General*, *130*, 323–360.