IUSB Seed Grant Final Report

Project Working Title: Role of Expert Knowledge in Semantic Categorization

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Description of Grant Activity:

This research project investigated the role of expert knowledge on categorization and knowledge representation. Expert knowledge in a given domain (i.e., birds, marine creatures, and fish), influences category-based decisions and reasoning (Bailenson, Shum, Atran, Medin, & Coley, 2002; Boster & Johnson, 1989; Shafto & Coley, 2003). That is, experts are more likely to rely on causal or ecological relations (i.e., habitat) in categorization, and are more confident in their category decisions (Verges & Simmons, 2004). Novices, on the other hand, are more likely to rely on taxonomic relations (i.e., similarity) as a basis for their category decisions, and are less confident in their category decisions (Verges & Simmons, 2004). Therefore, expert knowledge may affect the representations of semantic categories (Murphy & Medin, 1985).

Preliminary data confirm the relation between expertise and category structure. In two experiments, novices (i.e., undergraduate ecology students), and experts (i.e., ecology) graduate students judged the category membership of artifactual and natural items, and rated their confidence in that membership judgment. Across both experiments, findings suggest that experts in the natural sciences were overall, more confident and less graded in their category decisions for artifacts and natural kinds. In contrast, novices were less confident and less graded in their category judgments for natural kinds. For artifacts, however, novices were more confident and more graded in their category judgments. These findings suggest important differences in how the role of expertise influences the representation of semantic categories.

Ability to Complete Project Agenda:

Preliminary data are suggestive of the overall relation between expertise and category structure. These findings substantially aid in the development of a research manuscript to be submitted to the journal Cognition. Although a greater sample size is needed for added generalizability, partial funding from the Office of Research at Indiana University South Bend was used to pay participants in order to achieve this goal.

In sum, my research program investigates the role of expert knowledge in categorization. In order to promote the overall research agenda, this project aimed to (1) examine the influence of expert knowledge on the category structure of artifacts and natural kinds, and (2) foster a stronger relation between my research and educational goals.

To meet these challenges, several hypotheses and proposed activities have been met and planned for future implementation:
**Research Question 1:** How does expert knowledge influence the category structure of artifacts and natural kinds?

*Hypothesis 1a:* Expert knowledge of natural kinds (e.g., biology, ecology) may influence semantic categorization. Experts are predicted to be more confident and less graded in their category decisions of natural kinds in comparison to novices.

This hypothesis has been confirmed in two experiments, which tested the role of expert knowledge on biological categorization. In these experiments, novices (i.e., undergraduate students) and experts (i.e., graduate students) demonstrated significant differences in their confidence ratings and gradedness judgments.

*Hypothesis 1b:* Expert knowledge of artifacts (e.g., buildings, machine parts) may influence semantic categorization. Experts are predicted to be more confident and less graded in their category decisions of artifacts in comparison to novices.

This experiment has also been confirmed, though in a separate research project. Please refer to the Faculty Research Grant for my project entitled, “The Role of Expert Knowledge in Artifactual Categorization” (account #22-563-32).

**Research Question 2:** Do qualitative differences in expertise influence the representation of semantic categories?

*Hypothesis 2a:* If qualitative differences emerge across expert groups in the natural domain (i.e., biologists, ecologists), then differences in confidence and gradedness may occur in biological categorization according to the domain of expertise.

*Hypothesis 2b:* If qualitative differences emerge across expert groups in the artifactual domain (i.e., engineers, mechanics), then differences in confidence and gradedness may occur in artifactual categorization according to the domain of expertise.

Data collection to address Hypothesis 2a and 2b necessitate IRB approval.

**Research Question 3:** From a developmental perspective, how does expert knowledge affect the representation of semantic categories?

*Hypothesis:* The development of expertise leads to increased confidence and increased absolute category judgments in a given category domain.

Further data collection among experts is needed to confirm (or refute) this hypothesis. Preliminary evidence between experts and novices suggests the likelihood of increased confidence and absolute category judgments, though this comparison is between participants. Future research is warranted to examine the
developmental trajectory of category expertise using a within-participants methodology.

Research Question 4: Does expert knowledge in one domain (e.g., natural kinds) influence the category structure of the other domain (e.g., artifacts)?

_Hypothesis 4a_: If expert knowledge is domain-specific, then expert knowledge in one domain will not affect the representation of semantic categorization in another domain.

_Hypothesis 4b_: If expert knowledge is domain-general, then expert knowledge in one domain may influence the representation of semantic categorization in another domain.

Future research is warranted to confirm (or refute) Hypothesis 4a and 4b.

**Activity 1:** Gather data from individuals that possess expert (or naïve) knowledge in a given domain. Several domains of expertise will be used (i.e., biology, ecology, architecture, mechanical engineering) to test the hypotheses.

Activity 1 has been partially completed. Data collected from experts in the fields of ecology and architecture has been gathered. In addition, data collection from novices have been gathered throughout the Spring semester. To date, further data collection from individuals in the biological and mechanical engineering domains remain for future investigation. (See also my Faculty Research Grant entitled, “The Role of Expert Knowledge in Artifactual Categorization,” account #22-563-32, for more information on data collection among architectural experts.)

**Activity 2:** I would like to fund two part-time research assistants on this project. This will allow research assistants to receive hands-on training aimed to sharpen their critical-thinking skills. To illustrate, these part-time research assistants will partake in conducting literature reviews, data collection, and data analysis. In addition, partial funding of two research assistants provides me the opportunity to mentor students and increase my research productivity.

Activity 2 has been partially achieved. Two research assistants (Jade Ziegler, Cassie Davis) worked in my laboratory throughout the Spring semester. These part-time research assistants conducted literature reviews, collected data, and organized raw data for further data analysis.

**Activity 3:** Create and organize an event for high school students. In collaboration with upper-level psychology students and community volunteers (i.e., industry experts in South Bend area), the purpose of this event is to expose high school students to issues, concerns, and questions that are addressed by local experts in the community. The overarching goal is to dispel any naïve understandings that may students have about local
job and career tracks by allowing students to interact with community experts. This event also affords civic engagement among undergraduates and community volunteers.

Activity 3 has not been implemented at this time. Given the amount of collaboration and resources necessary to execute such an event, further granting support from external agencies is needed to implement this program.

**Activity 4:** Organize a course aimed for advanced undergraduates that examines how people think about concepts and categories. The central theme of the course would focus on categorization inside and outside the classroom. Consistent with this theme, students will have the opportunity to participate in service-learning projects. These activities encourage students to become active members in the community by applying in-class learning to real-world issues in South Bend. In addition, service-learning projects may promote the understanding of psychology as a science to community members.

Activity 4 has been organized and planned for future classroom instruction.

**Development of Specific Products:**

To date, this research project has produced a manuscript that reviews and documents preliminary findings from this research investigation. Although this research project merits further data collection to solidify results suitable for the academic community, findings of this project have been informally presented at the 46th Annual Meeting of the Psychonomic Society. Consequently, the presentation of these findings has strengthened research collaborations with other scholars in the field of categorization and cognition.

In addition, a proposed syllabus has been designed to teach advanced undergraduates theoretical and empirical issues regarding categorization and knowledge representation. As part of course requirements, students would read philosophical and psychological readings that address the representation of concepts and categories inside and outside the classroom. In addition to these core readings, students would propose a research project that integrates theoretical and empirical findings, and extends these prior findings to current research questions for scholarly inquiry.