Application for Research Assistant in the Learning and Memory Laboratory

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Undergraduate research assistants are sought to work on a variety of projects related to human performance.

Research Statement

My research, broadly defined, is concerned with the cognitive and neural mechanisms of learning and memory. In particular, I focus on the ability of individuals to learn novel categories – that is, the process by which people acquire the ability to assign objects in the environment to different groups. I use a number of methodological approaches in my research, including traditional cognitive experiments with college-aged and elderly individuals, experiments with individuals with neurodegenerative disorders and brain injury due to stroke, and computational modeling. My research encompasses four central issues in category learning: 1) The single versus multiple systems debate; 2) The role of working memory; 3) The utility of conceptualizing category learning as a motor skill; and 4) Investigating the neurobiological substrates of category learning.

Single vs. Multiple Systems of Category Learning

An overarching theme in much of my research is the question of whether category learning is mediated by a single processing system or by multiple, qualitatively distinct systems. Although the idea that there are multiple modes of processing in category learning is not new, there is still great controversy surrounding this topic. One interesting finding that has emerged from this line of research is that the demands of the particular categorization task may, in large part, determine which category learning system is controlling behavior. My work to date has focused on empirically dissociating two classes of tasks: *rule-based* and *information-integration* tasks. Successful performance in rule-based tasks is assumed to require the use of explicit decision strategies that are accessible to conscious awareness. In contrast, in information-integration tasks, accuracy is maximized by implicit strategies that assume information from two or more dimensions is integrated outside of conscious awareness.

The Role of Working Memory in Category Learning

It is generally accepted that category learning depends upon working memory. For instance, many theories of category learning argue for the existence of an explicit, logical-reasoning system that relies upon working memory and executive (selective) attention. In recent years we've learned that this dependence is not necessarily a general feature of all category-learning tasks, but primarily restricted to rule-based tasks. What is not well understood is how this dependence upon working memory might vary across different types of rule-based tasks.

Computational modeling has played an important role in formalizing the link between behavioral phenomena observed in studies of working memory and the underlying neural substrates. We developed a computational model of working memory maintenance that successfully predicts single-cell recording and human behavioral data using simplified quantitative models of the input-output relations of cells in prefrontal cortex, parietal cortex, and the basal ganglia. While this model makes an important contribution to the neurobiology of working memory, it also provides the foundation for a biologically plausible model of rule-based category learning.

Category Learning as an Abstract Motor Skill

An idea that has emerged in the motor skill learning literature is that implicit (i.e., learning that is not accessible to conscious awareness), but not explicit sequence learning is dependent upon a consistent mapping between the stimulus and the response defined by its relative position. I, and others, have shown that a similar result can be found in category learning. Specifically, simply disrupting category-response associations by asking participants to reverse response keys after substantial training is sufficient to interfere with both the decision strategy and accuracy in an information-integration task. Such interference, however, was not observed in a rule-based task that required selective attention to a single, relevant dimension.

The Neural Basis of Category Learning

The goal of my fourth line of research is to investigate the neural substrates of category learning and how they might differ as a function of the strategic requirements of the task. Much of the motivation for my initial research on this topic is motivated by the idea that the different neural systems that have been hypothesized to mediate functionally different memory systems in humans and nonhumans might also serve as neural substrates for qualitatively different category learning systems. For example, the basal ganglia have been implicated in both explicit and implicit memory systems. Thus, one hypothesis is that the basal ganglia are critical for both rule-based and information-integration tasks.

While it is clear that the basal ganglia are involved in category learning, one consistent finding to emerge from my research is that an intact basal ganglia are necessary for learning rule-based tasks, but not necessarily in information-integration tasks. This result has been observed both in individuals with Parkinson's disease (who have basal ganglia dysfunction due to depletion of the neurotransmitter dopamine) and individuals who have had strokes in the basal ganglia.

Interestingly, current work suggests that the impairment in individuals with Parkinson's disease may be limited to cases where they have to ignore irrelevant information. On the other hand, individuals with basal ganglia damage due to stroke have no problem ignoring irrelevant information. Instead, these individuals have difficulty when they have to attend to all sources of information. Why exactly this dissociation exists is an area of active research.

The Motivation-Learning Interface

We all know that goals can have a significant influence on our ability to learn new things. What we do not know, however, is how this relationship works. Furthermore, how important is our current motivational state (e.g., what we are hoping to achieve)? Are we "better" at learning a task when our motivation state matches well with the goals of the task? This line of research attempts to address these and other, related questions.

Duties of the research assistants (RAs):

Ideally, RAs would be able to commit approximately 8-10 hours per week on a flexible basis to work in the lab (although this is negotiable). Most of the work will involve collecting and analyzing the data on studies involving college students. This work is designed to address some of the issues described above and also serves as pilot work for our patient studies. RA's typically work in concert with Dr. Ell and one of the graduate students in the laboratory. Each RA is assigned to one project, usually based on their expressed preference after hearing about the current projects. RA's are trained on how to use the equipment, recruit participants, run the experiments, and analyze the data. They are expected to read the current literature related to their project and participate in weekly lab meetings. Students who have completed some course work in cognitive psychology, statistics, biological psychology, and the neurosciences are given preference (but this is not a requirement). Familiarity with Macs and PC-based computers is a plus. Given the amount of training involved, we prefer students who anticipate being able to work in the lab for a full year.

If interested, please complete and return the application to Dr. Ell (email or mailbox in 301 Little Hall)

Name: _____

Contact Information:

Local Street Address: _____

Local Phone: _____

Local E-mail: _____

Contact Preference (circle one): Phone E-mail Either

Permanent Address: _____

City/State/Zip: _____

Background:

Year in School: _____ Major: _____

Expected Semester and Year of Graduation:_____

Current GPA: _____ PSYC GPA: _____

Psych Experience (Relevant Classes and grades, Research): _____

_____

_____

Psych/Research Interests: _____

_____

Post-College Plans: _____

Special Skills (e.g. computers, acting, statistical software, etc.): _____

_____

Lab Information:

Semester/Year: _____ Number of 492 credit hours (if applicable): _____

Availability

Please indicate your availability during a typical week below:

Example: Monday: 10am – 11am, 2pm – 4pm

Monday:

Tuesday:

Wednesday:

Thursday:

Friday: