Relational and Role-Governed Categories: Views from Psychology, Computational Modeling, and Linguistics

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Introduction

Concepts are central to human cognition, structuring our thoughts and allowing us to generalize our experiences, predict the future, and control our surroundings. The study of concepts in cognitive psychology has largely focused on categorization of individual objects based on descriptive features, e.g., a *bird* is an animal with wings and a beak (Rosch, 1973). In this respect it has diverged from other fields of cognitive science, such as linguistics, which focuses on argument structure and composition, Yet a significant new thread of research has emerged in the psychology of categorization, re-examining the role of relational structures in concept representation (Markman, & Stilwell, 2001; Gentner & Kurtz, 2005). This emerging field studies stable representation of relations ("relational categories"), e.g. X is *visiting* Y, and natural categories defined by the role objects play in events, e.g., a *guest* is a person who is visiting somebody else, or a *catalyst* is an entity that precipitates a change of state. This perspective unifies research on categorization with other areas in cognitive science in which relational representations have long been central: analogical and causal reasoning (Gentner, Holyoak & Kokinov, 2001), scripts and schemas (Shank, 1982), and lexical semantics (Dowty, 1979), amongst others.

While theories of relational and role-governed categories show promise for advancing the psychology of concepts, research in this direction is just beginning. What's more, researchers are spread across departments and often unaware of each other's work. The goal of this symposium is to bring together scientists from different disciplines to discuss their work, and to be a forum to discuss important next directions.

Symposium Structure

This symposium will include a series of four talks on relational and role-governed categories from varied research methods and perspectives. The first talk will present psychological experiments investigating how people form and use these categories. The second presents computational models of relational theory and role-governed category learning. The third will discuss research on lexical semantics, contrasting the roles relational nouns and non-relational nouns play in semantic composition. The fourth will tie the others together, and discuss the place this research has in the study of categorization more broadly.

We now discuss each of the participants and their presentations in turn.

Micah B. Goldwater is a PhD candidate in the Cognition graduate program in the department of Psychology at the University of Texas at Austin. He works under the advisement of Arthur Markman and Catharine Echols investigating conceptual representation, analogical reasoning and language processing in infants, children and adults. This research makes novel connections across these fields by focusing on how experimental findings relate to real world behavior. Throughout graduate school, he has been an active member of the Cognitive Science Society, having presented and published his research in a variety of venues.

Goldwater's presentation will describe experiments using both behavioral and neurological measures investigating the nature of relational and role-governed categories, and how they contrast with feature-based categories. These experiments examine the connection between relational structures and role-governed categories by showing that instantiating a novel relational representation licenses novel role-governed categories. He will also discuss the conditions

under which objects will be categorized based on their common relational role, as opposed to shared features or thematic association, revealing mechanisms of role-governed category formation. Finally, he will discuss how role-governed and feature-based categories are differentially used "in the wild" to label (or "tag") images on the world-wide-web.

Noah D. Goodman is a research scientist in the Department of Brain and Cognitive Sciences at MIT, and a member of the Computer Science and Artificial Intelligence Laboratory. He studies the computational basis of human thought, merging behavioral experiments with formal methods from statistics and logic. Goodman has developed structured-Bayesian approaches to concept representation and applied these ideas both within traditional concept-learning and in a broad array of related areas including causal reasoning, and social cognition. Goodman has published widely in psychology, cognitive science, and artificial intelligence, including several papers that have received computational modeling prizes from the Cognitive Science Society.

Goodman's presentation will consider computational formalisms for capturing the representation and learning of relational and role-governed concepts. He will describe a modeling approach that combines logical representations with Bayesian techniques for describing inference under uncertainty. This formalism captures a range of standard effects for feature-based concepts while extending naturally to role-governed concepts. Goodman will discuss how computational formalisms help to situate role-governed concepts within the landscape of concepts studied by cognitive scientists and tie them to conceptual change in childhood, and compositionality ideas of formal semantics.

Stephen Wechsler is an Associate Professor of Linguistics at the University of Texas at Austin. He holds a PhD in Linguistics from Stanford University. A specialist in syntactic theory, his two main research areas are the syntax-lexical semantics interface and morphosyntax. His first book (Wechsler, 1995) addresses the first area; his second book addresses the second area; and his third book (Oxford UP, in progress) will return to the first area.

Wechsler's presentation will focus on insights that have been gleaned from recent work on the semantic composition of nouns, both relational and non-relational, with their surrounding syntactic contexts. When in construction with a relational noun, verbs of possession and genitive possessors express an argument of the noun (*John has a sister; John's sister*), while non-relational nouns in the same constructions give rise to interpretations involving possession (*John has a car; John's car*) and certain other semantic or discourse relations. This deep connection between possession and predication can be seen in patterns of sublexical scope, systematic polysemy and idiom formation. Wechsler will explore a middle ground between lexical decomposition and constructional approaches.

Gregory L. Murphy is Professor of Psychology at New York University. He received a PhD in Psychology from Stanford University and has previously held professorships at Brown University, and University of Illinois Urbana-Champaign. He has been a leader in the field of categories and concepts for more than 25 years, as he has literarily written the book on the topic (Murphy, 2002) and published one of the field's most cited papers (Murphy & Medin, 1985) that continues to challenge all models of categorization more than 20 years later. His research has focused on category learning, induction, and the representation of word meaning

Murphy will serve as the symposium's discussant. His presentation will discuss the conflict between "normal" taxonomic categories, like dogs, cars, and parties, and a number of different category types that have received less attention in the literature. These include script categories, thematic categories, role-based categories, and goal-derived categories. There is some controversy over whether such categories are "real," in the sense that they are spontaneously used and represented in memory. The talk will address both the evidence of such "reality" and the more theoretical question of whether such things should be called categories at all--and whether that makes a difference. Using this perspective he will tie together the previous three talks and present this area's next set of challenges.

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