Probing the Mental Representation of Relation-Defined Categories

Ava Y. Du & Alexander A. Petrov
Department of Psychology, The Ohio State University

John E. Hummel
Department of Psychology, University of Illinois

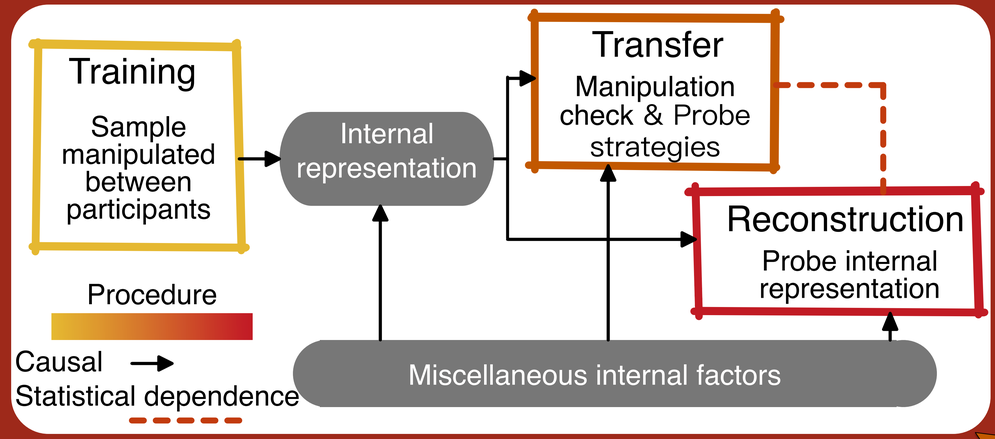
In T. Fitch, C. Lamm, H. Leder, & K. Tessmar-Raible (Eds.) (2021). Proceedings of the 43rd Conference of the Cognitive Science Society (pp. 2024-2030). Vienna, Austria. http://alexpetrov.com/pub/cogsci21/

Motivation

Ever since Wittgenstein's (1953) observation about the "family resemblance" nature of concepts, cognitive psychologists have thought of concepts as lists of features. However, many important concepts are better conceived not as collections of features but as relations between things (e.g., Barsalou 1985; Gentner & Kurtz, 2005).

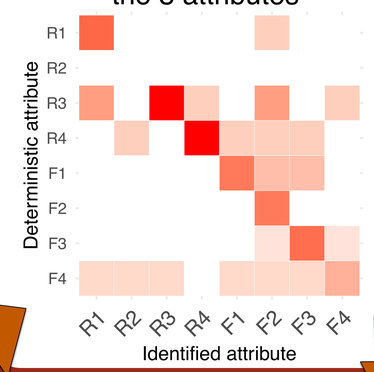
The distinction between feature- and relation-based concepts is important for several reasons: unlike feature-based concepts, it has been argued that (i) only humans understand relation-based concepts (Penn, Holyoak, & Povinelli, 2008), (ii) relation-based categories cannot be learned by simple statistical associative systems (Doumas, Hummel, & Sandhofer, 2008), and (iii) a "good" member of at least some relation-based categories is not represented by the "typical" one, but the "ideal" one (Kittur, Holyoak, & Hummel, 2006).

A central goal of the present study is to explore how relation-based concepts are represented differently from feature-based ones. We propose an *extreme-value hypothesis*: the "goodness" of a member of at least some relation-based categories is not a function of its similarity to the prototype, but of the degree to which it instantiates extreme values of the relevant relations.



Transfer results

Fraction of people who heeded the 8 attributes



1st: Training

Task: A classic two-category classification task -
whether the micrograph reflects disease Azolitis (A) or Leporidis (L)?

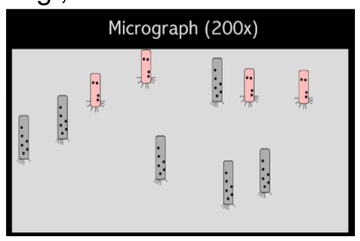
Each micrograph contained diseased (pink) and healthy (grey) cells that varied on four dimensions: (D1) #cells, (D2) #organells, (D3) #hairs, (D4) length.

72 OSU students were recruited. For each subject, one relation OR one feature was deterministic (100% diagnostic of the correct disease), while other relations and features were probabilistic (75% diagnostic).

E.g., R1 was 100% diagnostic

Instances	Stimulus Dimensions							
	R1	F1	R2	F2	R3	F3	R4	F4
Azolit.1	**A***	l	A	a	A	a	A	a
Azolit.2	A	a	L	l	A	a	A	a
Azolit.3	A	a	A	a	L	l	A	a
Azolit.4	A	a	A	a	A	a	L	l
Lepor.1	**L***	a	L	l	L	l	L	l
Lepor.2	L	l	A	a	L	l	L	l
Lepor.3	L	l	L	l	A	a	L	l
Lepor.4	L	l	L	l	L	l	A	a

E.g., Azolit.2



R1 #pink cells < grey cells **A!**

F1 #pink cells = 4 **A!**

R&F #organelles per pink = 4 & shorter, more hairs in pink **A!**

2nd: Transfer

Task: A classic two-category classification task -
whether the micrograph reflects disease Azolitis (A) or Leporidis (L)?
New trials to probe the strategies

E.g., Whether heed D1?

Instances	Stimulus Dimensions							
	R1	F1	R2	F2	R3	F3	R4	F4
T1.1	A	l	O	o	O	o	O	o

R1 #pink cells < grey cells **A!**

F1 #pink cells = 8 **L!**

R&F #organelles per pink = 6 & equal length & #hairs in pink and grey cells **??**

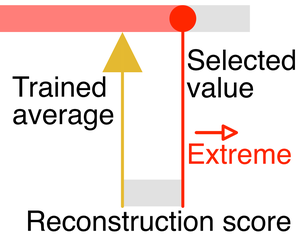
D1 trials

Strategy Type in D1: R / F / NA

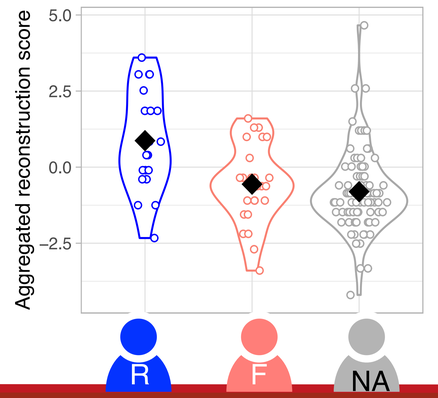
3rd: Reconstruction & Results

Task: construct a good member of Azolitis or Leporidis by adjusting the attributes of pink cells using sliders.

E.g.



We aggregate reconstruction scores across all four dimensions.



Conclusions

- When experienced a relation or a feature that is 100% diagnostic of the correct category, people focus on that attribute. Moreover, the utility of the relation (or feature) promotes a relational (or featural) mind-set to use other partially diagnostic relations (or features).
- Whereas people who learn a feature will tend to reproduce values closer to the mean value, people who learn a relation will favor extreme values that instantiate the relation, suggesting that relation-based concepts are represented as the extreme members.

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