HW5 **Name: Shashank Singh**

COVER SHEET

Honor code:

“My responses to these questions represent my own ideas and I have not received undue assistance from any source”

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1) Suppose that the 19 circles in Figure 22.1 on p 603 represent 19 spheres of different sizes and shades of grey. The X axis represents size and the Y axis represents the grayscale value of each sphere.

Jane and Jill are both shown the spheres and asked to remember what they have observed. Jane doesn't group the spheres into categories and simply stores the size and shade of each sphere. For example, she remembers that:

Sphere s1 has size x1. Sphere s1 has shade y1.
…
Sphere s19 has size x19. Sphere s19 has shade y19.

Jill forms four categories that we will label A through D. She remembers that:

Sphere s1 is an A. Sphere s2 is an A. Sphere s3 is an A. Sphere s4 is an A.
Sphere s5 is a B. … Sphere s8 is a B.
Sphere s9 is a C. … Sphere s13 is a C.
Sphere s14 is a D. … Sphere s19 is a D.
As have size xA. As have shade yA.
Bs have size xB. Bs have shade yB.
Cs have size xC. Cs have shade yC.
Ds have size xD. Ds have shade yD.

(a) For our purposes, each sentence in bold above counts as a single piece of information.

How many pieces of information does Jane remember about the spheres? 2*19 = **38**

(b) How many pieces of information does Jill remember about the spheres? 19 + 2*4 = **27**

(c) How are categories useful? Answer this question by describing one advantage of Jill's strategy compared to Jane's.

Jill needs to remember only one piece of information per sphere (the category) and two pieces of information per category. Jane needs to remember two pieces of information per sphere. Since, in general, the number of spheres is far larger than the number of categories, this significantly reduces the storage requirement.

(d) How can categories be harmful? Answer this question by describing one disadvantage of Jill's strategy compared to Jane's.

Before storing or retrieving information, Jill must perform the extra step of categorizing a sphere, which is more complex than simply traversing a list of pieces of information. This may, for some categorizations, be very difficult.

2) An item can simultaneously belong to a subordinate category (e.g. “poodle”), a basic level category (e.g. “dog”) and a superordinate category (e.g. “animal”). Suppose that you learn that an item belongs to category C, where C is either a subordinate, basic level or superordinate category. Otherwise you know nothing about the item.

(a) circle one

You will be able to make the greatest number of inductive inferences about the properties of the item if C is a

subordinate / basic level / superordinate category

(b) Explain your response to part (a)

If C is a subordinate category, then the item is also in any basic level or superordinate category to which C is subordinate, and hence you will be able to make any inductive inferences valid for the the basic level or superordinate categories to which C is subordinate, in addition to those inductive inferences exclusively valid for items in the subordinate category C.

3) (a) What is the “classical view” of concepts? Explain this view in your own words.

The classical view of concepts maintains that a category is defined by a set of rules; that is, an object is of a category if and only if it satisfies the set of rules defining that category.

(b) The chapter discusses phenomena that challenge the classical view. List these phenomena and explain in your own words why each one challenges the classical view.

Phenomenon 1: Some common categories are extremely difficult to define by rules.

Reason why this challenges the classical view:

The number of rules needed to define some commonly used categories is so large (due largely to exceptional cases) that it would be infeasible to verify that these rules are satisfied for everyday classification tasks.

Phenomenon 2: Individuals are inconsistent in many categorization tasks.

Reason why this challenges the classical view:

The classical view gives a deterministic algorithm for determining if an item A is of a category B: verify that each rule defining B is satisfied by A. However, individuals are sometimes inconsistent in categorization, even when the properties of A and the rules defining B are fixed.

Phenomenon 3: People do not treat all members of a category as equally good members of that category; i.e., a categories have varying degrees of membership.

Reason why this challenges the classical view:

The classical view only explains membership (satisfying all rules) and non-membership (not satisfying a rule), and is insufficient to explain partial membership or degrees of membership.

4) Table 22.1 on p 600 specifies 9 stimuli that vary along four dimensions and that are organized into categories A and B. Describe how the concepts A and B would be represented by a rule-based model, a prototype model, and an exemplar model. Your descriptions should be as concrete as possible – in other words, you should describe the actual rules, prototypes and exemplars that would be used by the three models.

(a) Explain how a rule-based model would represent the concepts:

The categories would be represented by a binary function f mapping each of the 16 possible 4-dimensional stimuli to 0 or 1. Then, X would be of category A if f(X) = 1 and B otherwise.

One possibility consistent with the table would be

f(D1,D2,D3,D4) = (D1 AND D3) OR ((D1 OR D3) AND D2 AND D4).

(b) Explain how a prototype model would represent the concepts:

The categories would be represented by prototypical stimuli SA and SB generated so that SA accurately represents most elements of category A and SB accurately represents most elements of category B.

Depending on whether the dimensions could sensibly be considered continuous, the prototypes might be (1,1,1,1) or (0.8,0.6,0.8,0.6) for category A and (0,0,0,0) (perhaps (0,1,0,0)) or (0.25,0.5,0.25,0.25) for category B.

(c) Explain how an exemplar model would represent the concepts:

Each category would be represented by one or more observed stimuli considered highly representative for the category.

An exemplar for A might be (1,1,1,0) and an exemplar for B might be (0,0,0,0).

5) (a) Explain in your own words the basic difference between prototype and exemplar models.

An exemplar model will typically store information about all previous observations of a category, whereas a prototype model will typically store a representative or average observation computed from previous observations of a category.

(b) Describe one advantage offered by prototype but not exemplar models.

A simple exemplar model will require large amounts of information storage, as properties all past observations of a category must be stored. Also, determining whether a new observation is of a category may require comparison with all previous observations of that category. Thus, such a model will be very computationally demanding (in both time and space).

In contrast, in a prototype model, the storage and time demands need not increase linearly (or at all) with the number of observations.

(c) Describe one advantage offered by exemplar but not prototype models.

An exemplar model will have improved categorization of unusual or exceptional items, since such items can simply be compared the few to previous observations of similarly unusual items. In a prototype model, unusual items may be very different from the prototype, and hence may be mis-categorized.