Informatics 1 Cognitive Science – Tutorial 5

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Week 6

In class we discussed categorization and how conceptual knowledge is organized. The aim of this tutorial is to understand theories of categorization and relations between categories. The second part of the tutorial deals with judgment and decision making.

1 Classical Concepts

This exercise is designed to shed light on some challenges facing classical (or definitional) accounts of concepts and some phenomena that are relevant to theories of concepts and categories.

Under classical accounts, concepts are represented using sets of necessary and jointly sufficient properties. For instance, we might say that a triangle is a polygon with three vertices. If something isn't a polygon, or if it doesn't have three vertices, it isn't a triangle (necessity)[1]. If it has both of these properties, it must be a triangle (joint sufficiency). In the case of mathematical concepts, this can work fairly well, but we'll see it's a bit more difficult for everyday objects and events. If you want a trickier task, replace the word "rabbit" below with "art", or "game". Here's the exercise:

1. Get a sheet of paper (or text editor) and write down (as best you can) the necessary and jointly sufficient properties something must have to be a **rabbit**. When you're done, pass your list to the person on your left (or below you in the tutorial chat).

2. When you receive the list from someone else, come up with a counterexample. This is either (1) something you would call a rabbit, which does not have one of the listed properties, or (2) something that isn't a rabbit but has all of the properties on the list. Update the list of properties to account for your counterexample.

3. Pass the updated list to the next person and repeat the process from step 2. When your original list comes back to you, you're done, at which point it's time to discuss the lists.

Discussion

Compare your lists and discuss the following questions.

- Are the lists effectively the same – do they pick out the same sets of things as being rabbits?
- For each list, what's the last counterexample that someone came up with? Does everyone agree that this counterexample is, or isn't, a rabbit?
- Are there counterexamples where people agree that something is a rabbit, but disagree about the extent to which it's a good, or typical example of a rabbit?
- Does everyone agree that the lists (or some of them) are complete, and admit no new counterexamples?

[1] Naturally, we'll need to define vertices and polgyons as well

2 Similarity-based Concept Models

Imagine you've just been introduced to two new categories for the first time: "daxes" and "grobs". As far as you can tell, daxes and grobs are all identical except for their weights. A person gives you 100 daxes that weigh around 10 kg, and 100 daxes that weigh around 100 kg. The person also gives you 200 grobs that have widely varying weights between 1 kg and 200 kg, with an average of weight of 105 kg.

You now find two new objects (object P and object Q). P weighs 101 kg, and Q weighs 57 kg.

Exercises

1. According to prototype theory as discussed in lecture, is P more likely to be a dax or a grob? Why?
2. According to prototype theory as discussed in lecture, is Q more likely to be a dax or a grob? Why?
3. According to exemplar theory as discussed in lecture, is P more likely to be a dax or a grob? Why?
4. According to exemplar theory as discussed in lecture, is Q more likely to be a dax or a grob? Why?

3 Lotteries

We discussed lotteries in the context of framing effects and prospect theory. When reasoning about the subjective value of decisions in an uncertain environment, it is common to focus on **expected utility,** or the sum of the utilities of different possible outcomes weighted by their probabilities. For example, if we assign a utility of 10 to a coin coming up heads, and a utility of 5 to the coin coming up tails, and believe a heads will come up with probability 0.6, then the expected utility is $0.6 \times 10 + 0.4 \times 5 = 8$. In the following example, we will focus first on monetary gains and losses, rather than utilities.

Suppose we have a lottery in which there are 1000 tickets printed with unique numbers. After all of the tickets have been purchased, one of the ticket numbers will be called out randomly (all are equally likely), and the person with that ticket will win £500.

Exercises

1. What is the expected monetary gain or loss for someone who purchases one ticket for £1?
2. One way to assess whether a person takes a rational approach to decision-making is to see if there are situations where their beliefs lead to guaranteed, avoidable losses. Consider a person who thinks £1 is a fair ticket price for buying or selling a ticket and is willing and able to buy any number of tickets. Is there a way for someone to take this person's money without incurring any risk?
3. What if this person is only willing to buy a single ticket?
4. Under what circumstances, if any, might it be rational for a person to purchase a single ticket for £1, considering only selfish economic concerns, e.g., setting aside any pleasure a person might take in gambling and the possibility that ticket proceeds go to charity? Feel free to use contrived scenarios if necessary.