



Categories and Concepts

Instructor Manual

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The purpose of this instructor resource module is to provide a guide to teach a brief (50-60 minute) lesson on the psychological theories of categories and concepts. Throughout this module, you will find a list of learning objectives, class design recommendations, identified difficult terms, a detailed description (e.g., step-by-step) of how to conduct the lesson, activities and demonstrations along with several other supporting materials. I hope that the information provided and the lesson constructed will assist you in teaching an engaging, enjoyable and effective lesson.

Learning Objectives

Content Specific Learning Objectives:

- Understand the problems with attempting to define categories.
- Understand typicality and fuzzy category boundaries.
- Learn about theories of the mental representation of concepts
- Learn how knowledge may influence concept learning.

Relevant APA Learning Objectives (Version 2.0)

- Describe key concepts, principles and overarching themes in psychology (1.1)
- Describe applications of psychology (1.3)
- Interact effectively with others (4.3)

Abstract

People form mental concepts of categories of objects, which permit them to respond appropriately to new objects they encounter. Most concepts cannot be strictly defined but are organized around the “best” examples or prototypes, which have the properties most common in the category. Objects fall into many different categories, but there is usually a most salient one, called the basic-level category, which is at an intermediate level of specificity (e.g., chairs, rather than furniture or desk chairs). Concepts are closely related to our knowledge of the world, and people can more easily learn concepts that are consistent with their knowledge. Theories of concepts argue either that people learn a summary description of a whole category or else that they learn exemplars of the category. Recent research suggests that there are different ways to learn and represent concepts and that they are accomplished by different neural systems.

Class Design Recommendations

This instructor’s manual module is presented in one 50 to 60-minute class period. However, if you would like to expand this to more than one class period, there is more than enough information contained in the module to cover over two class periods. Please also refer to the Noba PowerPoint slides that accompany this outline.

Topic Outline

- Introduction
 - Definition of category and concept
- Nature of Categories
- Fuzzy Categories
 - Borderline items
 - Typicality
 - Prototype
- Source Typicality

- Family Resemblance Theory
- Categorical Hierarchies
 - Superordinate
 - Basic
 - Subordinate
- Theories of Concept Representation
 - Prototype Theory
 - Exemplar Theory
- Knowledge
- Conclusion

Module Outline

- **Introduction:** What is the difference between a category and a concept? Categories help us learn and remember information by connecting several concepts that have similar characteristics. For example, the category of *dog* has many different types but share similar commonalities (e.g., canine teeth, mammals, hair of some sort, 4 toes, etc.). Whereas a concept is the mental representation of those categories. Sticking with the dog example, I grew up with working cattle dogs such as Border Collies, Australian Shepherds, and Queensland Blue Heelers. These types of dogs are my mental representations for dog because of my experience with them rather than a Shiatzu or a Dalmatian. More on the nuanced differences between categories and concepts will be discussed below.
- **Nature of Categories:** It has historically been thought that categories are *well-defined* with *necessary features* that are *jointly sufficient* for membership. Meaning, a category was clear cut with features (e.g., characteristics) that were in all examples of the category. For example, a dog is a four-legged animal that barks. However, you can see that this is not always the case.
- **Fuzzy Categories:** As alluded to in the discussion on the nature of categories, categories can be fuzzy and unclear. For example, is a tomato a fruit, gourd, or vegetable? Research

suggests that there are a number of borderline items/members of categories that we cannot agree on and we even change our categorization of these items over time. Another contribution to fuzzy categories is *typicality*. By example, what is the most typical bird you can think of? Is it a roadrunner, turkey, or an osprey? Probably not. Likely it is a robin or sparrow because these are more common and typical of the bird category and are considered the *prototypical* bird. The farther away from the prototype in characteristics, the easier the example becomes a borderline member (e.g., fuzzy category).

- **Source Typicality:** What causes something to be a prototypical example of a category? Research suggests that it has a lot to do with frequency (e.g., how often you encounter the prototype) but has more to do with *family resemblance theory*. This theory suggests things are typical because they are frequent, yes, but also because they do not have features that are common in other categories. For example, robins migrate, fly, sing, hop around whereas penguins, don't fly, less common, swim, wings look like flippers, etc. Thus, robins tend to be more prototypical because of frequency AND features that are uncommon in other categories. Typicality can influence how we process information (e.g., cognition). For instance, for prototypical examples, we categorize them faster, learn them before atypical examples, understand them with greater ease, and say them before atypical examples.
- **Categorical Hierarchies:** As discussed in the Noba module for Categories and Concepts, many categories are arranged in hierarchies and are generally considered to be superordinate, basic, or subordinate.
 - **Superordinate:** This level of hierarchy is very broad and general with several basic and subordinate classification encompassing superordinate categories. For example, mammals, reptiles, fish, and birds are all superordinate categories because they have basic levels (e.g., mammals can be a dog, deer, cattle, etc.) and superordinate levels (e.g., dogs can be a Chihuahua, Dalmatian, Labrador, etc.).
 - **Basic:** This level of hierarchy is categorized as being not too small or not too big and how it would be labeled in a neutral situation. For example, a coastal black bear is too narrow, a mammal is too big or broad, but a bear is at the basic level. These are the most frequent level of hierarchy and are easier to learn than super- or subordinate levels. Basic levels are also easier to *differentiate*. Meaning, it is easy to tell the difference between a deer, dog, trout, and shark (i.e., all basic categories) but more difficult to differentiate between cutthroat, brown, rainbow, and grayling trout (i.e., superordinate classifications of trout).
 - **Subordinate:** This level of classification is hyper-specific and very narrow when compared to basic and superordinate levels. For example, sharks (basic) are fish (superordinate), but there are many different subspecies of sharks (e.g., lemon, great

white, hammerhead, reef, etc.).

- **Theories of Concept Representation:** There are two predominate theories that attempt to explain how we mentally represent concepts in our mind. Namely, Prototype Theory and Exemplar Theory.
 - **Prototype Theory:** For this theory, we mentally represent a concept based on summary representation that has weighted features. For example, birds that fly have feathers and obvious wings are weighted higher than birds who swim, small wings and eat fish, and have small feathers.
 - **Exemplar Theory:** This theory suggests that we mentally represent a concept based on a comparison to an exemplar. Exemplar meaning, the ideal example of the concept. For instance, what is the exemplar for fruit? Likely an apple or orange or strawberry. When we see something that is similar (e.g., pineapple) we compare its characteristics to those of the exemplar.
- **Knowledge:** Concepts and categories are great ideas, but there needs to be context to learn concepts and categories. This context is knowledge. That is, concepts and categories by themselves have very little meaning, but when you connect concepts to other knowledge you can create a meaningful connection that is tangible, applicable, and represents the real-world. For example, when learning how to operate a tablet for the first time, you likely drew upon your knowledge of laptops, cell phones, and desktop computers. One aspect of our knowledge of categories and concept is psychological essentialism. Basically, we want to believe that every category has some *core essence* that causes its features. For example, we often believe (erroneously) that the core essence of a fruit is that it is sweet. This is why we often miscategorize tomatoes or peas as vegetables.
- **Conclusion:** The formation of categories and concepts is critical to learning. It is a complex process that we use to think about current, past, and future events to help us make sense of them. It is also important to note that categories and concepts vary across cultures due to cultural influences.

Difficult Terms

Atypical

Basic level

Borderline items/members
Concept representation
Differentiated
Exemplar
Family resemblance theory
Fuzzy categories
Prototype theory
Psychological essentialism
Subordinate
Superordinate
Typicality

Lecture Frameworks

Overview: This lesson is designed to be completed in one 50-60 minute class period. I have designed the lesson to be predominately active and engaging through various activities and demonstrations, while setting up content knowledge with some direct instruction. I end the lesson by having students engage in a classroom assessment technique (CAT) in which they generate test questions based on what they learned during the class lesson (Angelo & Cross, 1993).

- **Warm Up: What is this?** This is a warm up activity that will get your students thinking about what categories and concepts are. It is designed to introduce the topic and should not take longer than 5 minutes. See Activities/Demonstration section for a complete description of how to do this activity.
- **Direct Instruction of Categories and Concepts:** Refer to PowerPoint slides, the Module Outline of this IM, and the Noba module to provide a clear definition of category and concepts for the students.
- **Fuzzy Categories Activity:** The purpose of this activity is to demonstrate the nuanced and sometimes arbitrary nature of categorizing information and how those categories can be truly fuzzy. Refer to the Activities/Demonstrations section for a detailed description of how to do this activity. It should take no longer than 5-10 minutes.
- **Direct Instruction of Fuzzy Categories:** Refer to PowerPoint slides, the Module Outline of this IM, and the Noba module to provide a clear definition of fuzzy categories for the students.

- **Discuss and Apply Fuzzy Categories:**Ask students what their prototypical bird is. They will likely say robins, sparrows, etc. Then ask them about the three pictures (crested penguin, Guianan cock-of-the-rock, and a platypus). Ask them how they are similar and different. Are they typical? Are they borderline?See PowerPoint for further details.
- **Direct Instruction of Source Typicality:**Refer to PowerPoint slides, the Module Outline of this IM, and the Noba module to provide a clear definition of sources for typicality for the students.
- **Discuss and Apply Family Resemblance Theory:**Have students identify the similarities and differences among humans, ravens, and chimpanzees. The students may answer that two are mammals and one bird. They may connect that all of them use tools and are problem solvers. Use this conversation to illustrate this theory. See PowerPoint for further details.
- **Direct Instruction of Categorical Hierarchies:**Refer to PowerPoint slides, the Module Outline of this IM, and the Noba module to provide a clear definition of categorical hierarchies (e.g., super, basic, and subordinate) for the students.
- **Direct Instruction of Theories of Concept Representation:**Refer to PowerPoint slides, the Module Outline of this IM, and the Noba module to provide a clear definition of the two different theories on concept representation (e.g., prototype and exemplar) for the students.
- **Stop, Think, Discuss Prototype and Exemplar Theories:**The purpose of this discussion is to demonstrate and discuss the two different theories of concept representation (e.g., prototype vs. exemplar theory). See PowerPoint for further details.
- **Direct Instruction of Knowledge:**Refer to PowerPoint slides, the Module Outline of this IM, and the Noba module to provide a clear definition of how knowledge helps form concepts and categories.
- **Student Generated Test Questions:** Use the Classroom Assessment Technique (CAT) “Student Generated Test Questions” to assess students understanding of the material covered in this lesson. Refer to the Activities/Demonstrations section for a detailed description of how to do this activity. It should take no longer than 5-10 minutes.

Activities & Demonstrations

- **Warm Up—What is this?** The purpose of this activity is to introduce the lesson by having students experience category and conceptual formation.
 - Time: 5 minutes
 - Materials: No materials necessary. All the information is provided on the PowerPoint slide.
 - Directions:

- **Fuzzy Categories Activity:** The purpose of this activity is to introduce and demonstrate the nuanced and sometimes arbitrary nature of categorizing information. It should be used as an introduction into the direct instruction of fuzzy categories, borderline items, and typicality.
 - Time: 5-10 minutes
 - Materials: Students will need a writing utensil and a piece of paper to
 - Directions:

- **Student Generated Test Questions CAT:** Use this CAT to assess students understanding of the material covered in this lesson (Angelo & Cross, 1993).
 - Time: 5 minutes
 - Materials: A writing utensil and a piece of paper.
 - Directions:
 - Ask students to write 1 multiple-choice questions.
 - Students should then answer the question and provide a rational for the answer.
 - Ask students to partner up and answer each other's questions.
 - Variation: They can also take the questions home to answer them, or trade with a partner and answer the partner's question. All or some of the questions can be used

on the next quiz or exam.

Additional Activities

Berry, J. W., & Chew, S. L. (2008). Improving learning through interventions of student-generated questions and concept maps. *Teaching of Psychology, 35*, 305-312.

- Berry and Chew describe how to teach student concept maps to improve their learning. This could be an interesting activity to demonstrate category hierarchy and concepts while aiding student learning.

Kiewra, K. A., & DuBois, N. F. (1992). Using a spatial system for teaching operant concepts. *Teaching of Psychology, 19*, 43-44.

- This activity describes sub and superordinate hierarchies of different psychology concepts. It both demonstrates how concepts relate to knowledge but how to organize categories into different hierarchies.

Discussion Points

- Pick a couple of familiar categories and try to come up with definitions for them. When you evaluate each proposal (a) is it in fact accurate as a definition, and (b) is it a definition that people might actually use in identifying category members?
 - This question is demonstrated (partially) in the fuzzy categories activity and the discussion on family resemblance theory. There are numerous directions depending on what you asked students to define.
- For the same categories, can you identify members that seem to be “better” and “worse” members? What about these items makes them typical and atypical?
 - Again, depending on what you choose for the example, students should be able to generate members that are better or worse. Be careful about what you choose as an

example, as it can get quite personal (e.g., love or hate).

- Going around the room, point to some common objects (including things people are wearing or brought with them) and identify what the basic-level category is for that item. What are superordinate and subordinate categories for the same items?
 - Students should easily be able to generate the various levels. Push them to expand on their reasoning of these levels and how they determined the classification of basic and sub or superordinate.
- List some features of a common category such as tables. The knowledge view suggests that you know reasons for why these particular features occur together. Can you articulate some of those reasons? Do the same thing for an animal category?
 - Again, this should be a straightforward question and discussion.
- Choose three common categories: a natural kind, a human artifact, and a social event. Discuss with class members from other countries or cultures whether the corresponding categories in their cultures differ. Can you make a hypothesis about when such categories are likely to differ and when they are not?
 - This discussion point can really get students involved to relate their personal experiences with this content. Of course, be cognizant of potential controversial opinions about different cultures.

Outside Resources

Debate: The debate about Pluto and the definition of planet is an interesting one, as it illustrates the difficulty of arriving at definitions even in science. The Planetary Science Institute's website has a series of press releases about the Pluto debate, including reactions from astronomers, while it happened.

<http://www.psi.edu>

Image Search: It can be interesting to get a pictorial summary of how much diversity there is among category members. If you do an image search for familiar categories such as houses, dogs, weddings, telephones, fruit, or whatever, you can get a visual display on a

single page of the category structure. Of course, the results are probably biased, as people do not just randomly upload pictures of dogs or fruit, but it nonetheless will likely reveal the typicality structure, as most of the pictures will be of typical exemplars, and the atypical ones will stand out. (This activity will also demonstrate the phenomenon of ambiguity in language, as a search for “house” will yield some pictures of the TV character House, M.D. However, that is a lesson for a different module.)

<https://www.google.com/>

Self-test: If you would like to run your own category-learning experiment, you can do so by following the link below. It works either in-browser or by download. When downloaded, users can put in their own stimuli to categorize.

<http://cognitrn.psych.indiana.edu/CogSciSoftware/Categorization/index.html>

Software: Self-test Categorization Applet - This software allows you to conduct your own categorization experiment.

<http://cognitrn.psych.indiana.edu/CogSciSoftware/Categorization/index.html>

Web: A Compendium of Category and Concept Activities and Worksheets - This website contains all types of printable worksheets and activities on how to categorize concepts. It includes word searches, picture sorts, and more.

<https://freelanguagestuff.com/category/>

Web: An interesting article at Space.com argues (I believe correctly) that the term planet will not and should not be defined.

<http://www.space.com/3142-planets-defined.html>

Web: Most familiar categories have simple labels such as planet or dog. However, more complex categories can be made up for a particular purpose. Barsalou (1983) studied categories such as things to carry out of a burning house or ways to avoid being killed by the Mob. Interestingly, someone has published a book consisting of people’s photographs of things they would carry out of a burning house, and there is also a website showing such collections. Try to analyze what is common to the category members. What is the category’s prototype?

<http://theburninghouse.com/>

Evidence-Based Teaching

Jacobs-Lawson, J. M., & Hershey, D. A. (2002). Concept maps as an assessment tool in psychology courses. *Teaching of Psychology*, 29, 25-29.

- This article describes how to create concept maps as a way to assess student learning.

Miserandino, M. (1991). Memory and the seven dwarfs. *Teaching of Psychology*, 18, 169-171.

- Miserandino discusses three different separate activities to demonstrate various cognitive functions including categories and concepts. These activities can be used for the purposes of experiential learning activities on categorization and conceptual development.

Links to ToPIX Materials

Activities, Demonstrations, or Handouts: KWHL Charts. K = Know, W = What to know, H = How to know, and L = what you have learned. This could be used to introduce concepts and categories.

<http://langwitches.org/blog/2011/07/21/upgrade-your-kwl-chart-to-the-21st-century/>

Books and Films: Daniel L. Schacter (2002). The Seven Sins of Memory: How the Mind Forgets and Remembers

<http://topix.teachpsych.org/w/page/39235307/Memory>

In the News: • Secrets of a Mind-Gamer: How I trained my brain and became a world-class memory athlete.

http://www.nytimes.com/interactive/2011/02/20/magazine/mind-secrets.html?_r=0

Videos/Audio: Stephen Chew's video of how to generate concept maps.

<http://topix.teachpsych.org/w/page/19981017/Memory%20Video>

Teaching Topics

Teaching The Most Important Course

https://nobaproject.com/documents/1_Teaching_The_Most_Important_Course.pdf

Content Coverage

https://nobaproject.com/documents/2_Content_Coverage.pdf

Motivating Students

https://nobaproject.com/documents/3_Motivating_Students_Tips.pdf

Engaging Large Classes

https://nobaproject.com/documents/4_Engaging_Large_Classes.pdf

Assessment Learning

https://nobaproject.com/documents/5_Assessment_Learning.pdf

Teaching Biological Psychology

https://nobaproject.com/documents/6_Teaching_Bio_Psych.pdf

PowerPoint Presentation

This module has an associated PowerPoint presentation. Download it at https://nobaproject.com//images/shared/supplement_editions/000/000/255/Categories%20and%20Concepts.pptx?1475795247.

About Noba

The Diener Education Fund (DEF) is a non-profit organization founded with the mission of re-inventing higher education to serve the changing needs of students and professors. The initial focus of the DEF is on making information, especially of the type found in textbooks, widely available to people of all backgrounds. This mission is embodied in the Noba project.

Noba is an open and free online platform that provides high-quality, flexibly structured textbooks and educational materials. The goals of Noba are three-fold:

- To reduce financial burden on students by providing access to free educational content
- To provide instructors with a platform to customize educational content to better suit their curriculum
- To present material written by a collection of experts and authorities in the field

The Diener Education Fund is co-founded by Drs. Ed and Carol Diener. Ed is the Joseph Smiley Distinguished Professor of Psychology (Emeritus) at the University of Illinois. Carol Diener is the former director of the Mental Health Worker and the Juvenile Justice Programs at the University of Illinois. Both Ed and Carol are award-winning university teachers.

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