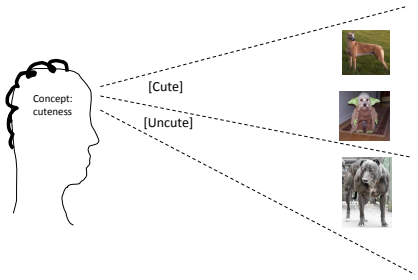
Concepts & Categories

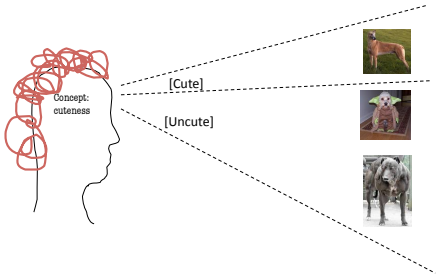
Categories

- A class of things that you treat the same way
  - Objects, events, properties
  - **Not** completely identical instances
    - *Types*, not tokens
  - Learning from experience
    - Want to generalize knowledge about Fido to Spot

Concepts



Concepts



Categories

- How do we get the ones we have?
  - **Built-in**
    - Mama duck
    - *Prey!*
  - Information in world "**clusters**" that way
    - Similarity
  - **Function**/usefulness
    - Easier to communicate w/others if same categories
    - What is this thing *for*?

learning necessary

Concepts

- Allow us to…
  - Treat non-identical things equivalently
  - Understand based on existing knowledge
  - Predict based on prior knowledge
  - Reason about new instances
  - Communicate about knowledge
- Include…
  - Objects
  - Actions
  - Ideas

Concepts

- Hirschfeld (1994, 1996)
  - Children categorizing race
  - Two schools
    - Suburban middle-class (low % minority)
    - City school (strongly integrated)
  - Two ages
    - 7-8 years
    - 11-12 years

Concepts

- Hirschfeld (1994, 1996)
  - Children categorizing race
  - Suburban vs. city
  - Younger vs. older kids
  - Task: judge likeliest offspring
    - AA + AA
    - Ca + Ca
    - AA + Ca

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Implications:
-Blackness is a social construct--*learned*.
-Knowledge trumps social construct.

Suburbs, younger:
Intermediate
Suburbs, older:
AA

City, all:
Intermediate

Concepts

- Locksley et al. (1980)
  - Does knowledge overcome stereotypes?
  - Stereotype: men are more assertive than women.
  - Conditions: read…
    - Name (M or F)
    - Name (M or F) + descriptive paragraph
    - Name (M or F) + paragraph detailing assertiveness
  - First two conditions: M rated more assertive
  - Final condition: M = F!
  - Knowledge *can* thwart 'default' stereotype

Types of objects

- Natural kind
  - Things not made by people
  - Examples
    - Bird
    - Mountain
    - Palm tree
- Artifact
  - Things made by people
  - Might have a 'tighter' similarity structure
  - Examples:
    - Toaster
    - Skyscraper
    - Language?

Defining some categories

- Square
- Refrigerator
- Furniture
- Music

Theories of category structure

- Classical view
- Probabilistic view[s]
  - Prototypes
  - Exemplars

Theories of category structure

- Classical view
  - Defining properties/features
    - (Not quite like \ | / features)
    - Checklist--necessary & sufficient
  - Triangle-OK
  - Furniture-not OK
  - Species-not OK
  - "Art"-*really* not OK (social construct?)

Theories of category structure

- Probabilistic (prototype) view
  - **No necessary features**, but typical ones
    - Builds nest
    - Flies
    - Has feathers
  - More features=more typical
    - Robin is a bird, penguin is a bird
  - Fuzzy category boundaries

Theories of category structure

- Probabilistic (prototype) view
  - Typicality
    - Robin > penguin

Theories of category structure

- Probabilistic (prototype) view
  - Typicality
    - Robin > penguin
    - Central tendency--your average bird

Theories of category structure

- Probabilistic (prototype) view
  - Typicality: the "best" bird (Rosch & Mervis, 1975)
    - Robin > penguin
  - Barsalou (1985)
    - **Central tendency**--your average bird (nat. kinds)
    - BUT goal-derived categories have **ideal**
      - Interview outfit--you don't want an 'average' one
  - Lynch, Coley, & Medin (2000): tree typicality
    - Undergrads: the usual central-tendency effects
      - Most familiar trees were most typical
    - For tree experts, ideals of **height** and **non-weedlikeness**
      - Ideal for natural kind!
      - Expertise (use?) may lead to ideals

Theories of category structure

- Probabilistic (prototype) view
- What's a 'prototype'?
  - Representation that has all characteristic features of a category
  - No individual may have all those properties
  - "Family resemblance"
  - "Central tendency"

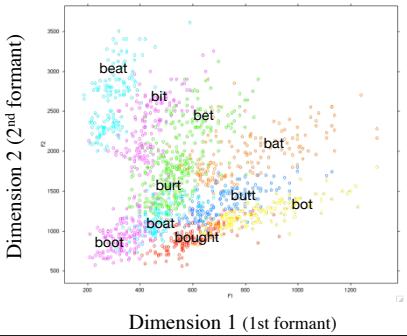
Theories of category structure

- Problems with prototype view
  - Typicality-frequency confound
    - Robins more typical
    - Robins more frequent
    - *Which influences speed?*
    - Lab experiments verify typicality
  - Worse: what about **variability?**

Theories of category structure

- Problems with prototype view
  - Typicality-frequency confound
  - Worse: what about **variability?**
    - Small birds sing, big birds don't
      - ~~The ostrich warbled sweetly at dawn~~
    - Context dependency (typical greeting depends on who it is)
  - Failure of linear separability
    - L.S.: if you combine all the features, can you perfectly predict what falls in what category?
    - **Often you can't,** meaning prototype won't work
    - Also apparently not necessarily easier to learn

Vowels: linearly separable?



Theories of category structure

- Probabilistic 2: **Exemplar theory**
  - Store every example (keep the variation!).
  - Compare new instance to every example.
  - Things that are most similar to the instance in question influence categorization the most.
  - "Resonance"
  - What about that prototype result?
    - More exemplars are similar to central tendency
  - Classic objection: that would require so much storage capacity!

Is storage capacity a problem?

- Mind as computer

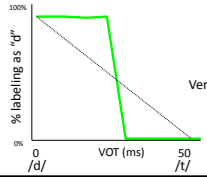
- Brain storage isn't like computer storage

(So exemplar-style ideas aren't so crazy.)

Categories people are interested in

OBJECT categories, like
"Dog"

PERCEPTUAL categories, like
"d"



CATEGORICAL PERCEPTION
(speech sounds, colors)

Very different type of category, but same set of questions and problems

Categorization in speech

- Is this a different problem than other kinds of categorization?
  - Is this a dog? vs.
  - Are these different sounds or the same sound?
  - Dogs are easy to tell apart
  - But different /d/ sounds *aren't* easy to tell apart
- Basic auditory system properties seem to govern some categories
- Others probably group by similarity

Categorization in speech

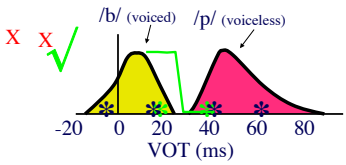
the sound [p] in, say, "a pack":

1. stop vocal fold vibration
2. put lips together
3. release lips and let air through
4. start vocal fold vibration

time between #3 and #4: **Voice Onset Time (VOT)**

VOT is a primary cue listeners use to distinguish [p] from [b] at syllable onset.

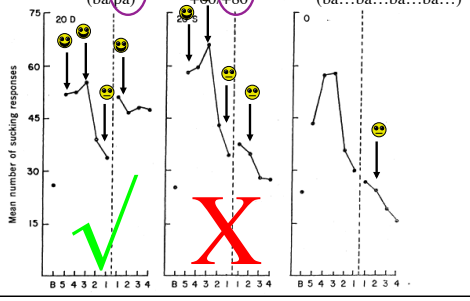
Categorization in speech



Categorization in speech

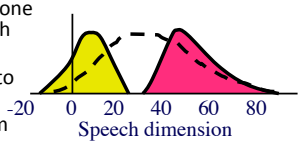
Eimas et al.: 1971

- VOT: +20/+40 (ba/pa) 0/+20, +40/+80 Control (ba…ba…ba…ba…)



Maye, Werker, & Gerken (2002)

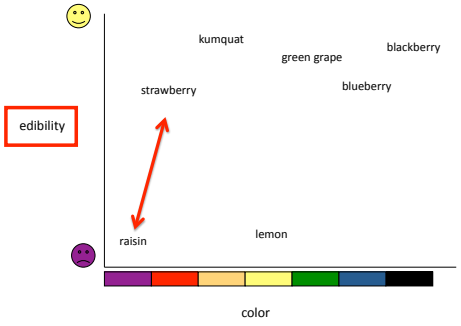
- Two distributions or one distribution of speech sounds
- Incidental exposure to one or other
- Play two sounds from same/different distributions
- Two-lumps: different!
- One-lump: not different!



Similarity and categorization

- Similar things go in the same category.
- But *what counts as similar*?
  - Raisin vs. dried cherry
    - Color? *Relevant for child's art project*
    - Edibility? *Relevant for eating*
  - Similarity is somewhat context-dependent
- What counts as a feature?
  - Plums and lawnmowers

Attentional weighting



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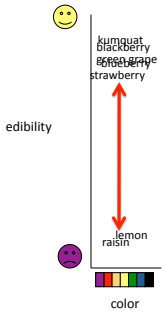

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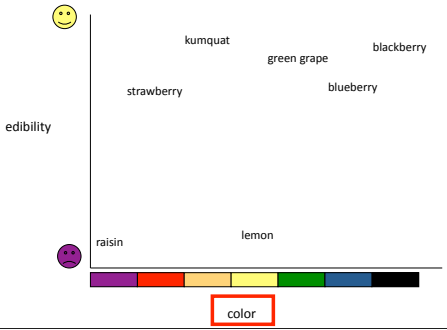

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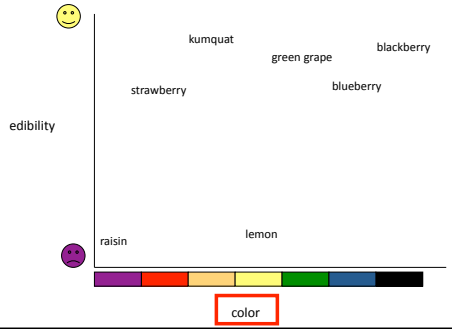

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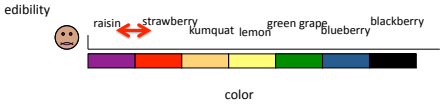


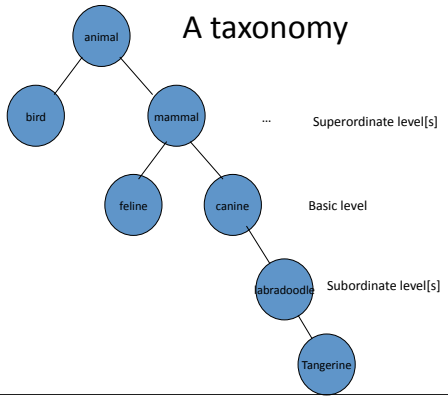
Categories of categories

- Taxonomic categories
  - Organized hierarchically (ish)
- Other categories
  - Less hierarchical structure

The "basic level"

- What you call stuff
  - Dog, not animal or labradoodle
  - Depends on expertise
    - Dog expert: labradoodle
  - Also depends on relevance (expertise may result from relevance)
    - Gourmets: slightly-underripe female eggplant
    - You: freshman/senior; me: undergraduate

A taxonomy



The "basic level"

- Official definition (Rosch et al.):
  - First level learned
  - Names applied to
  - Highest level sharing basic shape/parts
- Converging evidence from multiple cultures:
  - Names are applied at the *genus level*

The "basic level"

- From ethnobiology (how other cultures understand living things)
  - Various cultures seem to categorize plants and animals in the same ways--
  - Particularly at (what became called) the basic level
- These cultures do not include Berkeley undergrads (Rosch, 1976)
  - Basic level was tree/fish, not oak/robin
- Why the conflict?

The "basic level"

- Various cultures vs. undergrads
  - Knowledge levels (high vs. low)
  - Measures (naming vs. feature listing)
- Comparable measures: Coley et al. '97
  - Itzá Maya vs. undergrads
  - Instead of naming, **reasoning** ("Robins have mites…do cardinals?")
  - Same outcome: genus level
- What's 'normal'?

Non-hierarchical categories

- E.g. social ones
  - You can be a doctor/wife/PTAmom/guitarist all at the same time
  - None are higher/lower than others
  - *Frequency* and *recency* affect category activation
  - Bob is a salesman. Kim is a doctor. Jane is a ____
    - Expected: occupation (e.g. graphic designer)
    - Not expected: species (poodle)

An aside: *grain size*

- Keep in mind that a lot of these examples are about "high-level" categories.
- But many researchers are interested in cases where the individual instances might not be as discriminable (like speech sounds).
- In these cases, grouping by similarity may be the default.

Psychological Essentialism

- Concept of *Female-ness*
- XX vs. XY
  - genetically determined
- But we use other cues to determine gender
  - Hair length (except for hippies), facial hair, height, clothing, secondary sex characteristics, cultural conventions

Psychological Essentialism

- Why do we do this?
  - Good strategy for learning
    - Things that look alike share deeper properties
    - Often TRUE

    Hair length, facial hair, height, clothing, secondary sex characteristics, cultural conventions – for female

Psychological Essentialism

- Why do young children say their mothers can't be fire-fighters?
- Why do art collectors pay more $$$ for an original than for an exact copy?

Psychological essentialism

- P.E. is the idea that certain categories (like *mom*, or *original*) have an underlying reality that can not be observed directly.

Where does P.E. come from?

- Cognitive Development
- We tend to organize categorization principles in terms of specific kinds of concepts.
  - Psychology (theories about people)
  - Physics (theories about the physical world)
  - Biology (theories about living things)

    Children: adding things to a toaster vs. a pig

    ex. pig will not turn into a zebra, "pig-ness"

Summary on Psychological Essentialism

- Things that are superficially similar tend to be similar in deeper ways
- Categorization allows for inference and access to relevant knowledge
  - (ex: theories of biology).

Categories and Reasoning

- **Ad hoc categories**: categories that are spontaneously created, typically in service of some goal

Guess the ad hoc category:

- Pepper, room, tree, pool, mall, rabbit, see

  Double letters!
- Pets, photos, baby, computer, favorite pillow

  Things to take out of your house when it's on fire

Conceptual combination

- How do we understand the meaning of novel concepts derived from combina concepts? Not as simple as it se
  - Chocolate rash vs. red rash

    XXX
    - Red rash = rash that is **red**
    - Chocolate rash = rash that is **brown**?
    - Chocolate *causes* rash
  - Land yacht vs. luxury yacht

    ???
    - Luxury yacht = large boat that is expensive and luxurious
    - Land yacht = large boat … on land?!
    - Big "floaty" car, or RV

- Conceptual combination allows us to produce a virtually unlimited set of new concepts

Conceptual combination

- How do we do this?
  - Selective modification model (Smith & Osherson, 1984)
    - Create *new prototype* from adjective-noun combos

    Example: "brown apple"

    Activates the prototype of apple, then color information is added where red is replaced by brown

Problems with Selective modification model

- Some researchers think we can't have a separate prototype for *every* adjective-noun combination--*too many* (Me: why not?)
- Typicality of combined concepts can't be predicted from the typicality of the 2 separate concepts
  - Combined concepts don't have all the properties of each concept

    Ex: "pet bird"

    Salient property is that it lives in a cage, but neither pets nor birds typically live in cages.

Context dependence of Conceptual combinations

- "Sit in the apple sauce chair"
- Is conceptual combination really about the structure of concepts? Or is it about the pragmatics of language use?
  - People can generate new category names on-the-fly when trying to collaborate on a task (Brown-Schmidt, Tanenhaus et al.)
- Categories seem to be organized around our goals.