Classical vs prototype model of categorization

- Classical model
  - Category membership determined on basis of essential features
  - Categories have clear boundaries
  - Category features are binary

- Prototype model
  - Features that frequently co-occur lead to establishment of category
  - Categories are formed through experience with exemplars

Prototype theory

1. Certain members of a category are prototypical – or instantiate the prototype
2. Categories form around prototypes; new members added on basis of resemblance to prototype
3. No requirement that a property or set of properties be shared by all members
4. Features/attributes generally gradable
5. Category membership a matter of degree
6. Categories do not have clear boundaries

Prototype theory

1. Certain members of a category are prototypical – or instantiate the prototype

   Category members are not all equal

   a robin is a prototypical bird, but we may not want to say it *is* the prototype, rather it instantiates (manifests) the prototype or ideal -- it exhibits many of the features that the abstract prototype does

   "It is conceivable that the prototype for *dog* will be unspecified for sex; yet each exemplar is necessarily either male or female." (Taylor)

Prototype theory

2. Categories form around prototypes; new members can be added on the basis of resemblance to the prototype

   Categories may also be extended on the basis of more peripheral features

   axe for guitar

   house for apartment

Prototype theory

3. No requirement that a property or set of properties be shared by all members -- no criterial attributes

   - Category where a set of necessary and sufficient attributes can be found is the exception rather than the rule
   - Labov household dishes experiment
     - Necessary that cups be containers, not sufficient since many things are containers
     - Cups can't be defined by material used, shape, presence of handles or function

Prototype theory

- Wittgenstein's examination of *game*
  - Generally necessary that all games be *amusing*, not sufficient since many things are amusing
  - Board games, ball games, card games, etc. have different objectives, call on different skills and motor routines

-→ categories normally not definable in terms of necessary and sufficient features

Prototype theory

- What about mathematical categories like *odd* or *even* numbers? Aren't these sharply defined?
  - (Armstrong et al. < Taylor) Subjects asked to assign numbers a degree of membership to the categories *odd number* or *even number*

    → 3 had a high degree of membership, 447 and 91 had a lower degree (all were rated at least 'moderately good')

Prototype theory

- Expert vs. folk categories
  - Intuition that some categories are not fuzzy
    - Odd/even numbers, species designations, legal terms
    - Expert categories are defined in precise way by select people
  - (McCrone)

    "We may believe that our brains are swollen with facts about the history of the Roman Empire or the geography of Latin america but such schoolbook learning takes up only a few shelves in a mind stuffed with knowledge about the minute details of everyday living"
  - Folk categories are based on experience and characterized by prototype

Prototype theory

- Some categories can be both expert and folk
  - Ex. Adult - has a precise legal definition
  - Normally we categorize adults based on physical and behavioral attributes

Prototype theory

4. Features generally gradable

   Prototypicality is recursive-- (features or attributes are categories too)

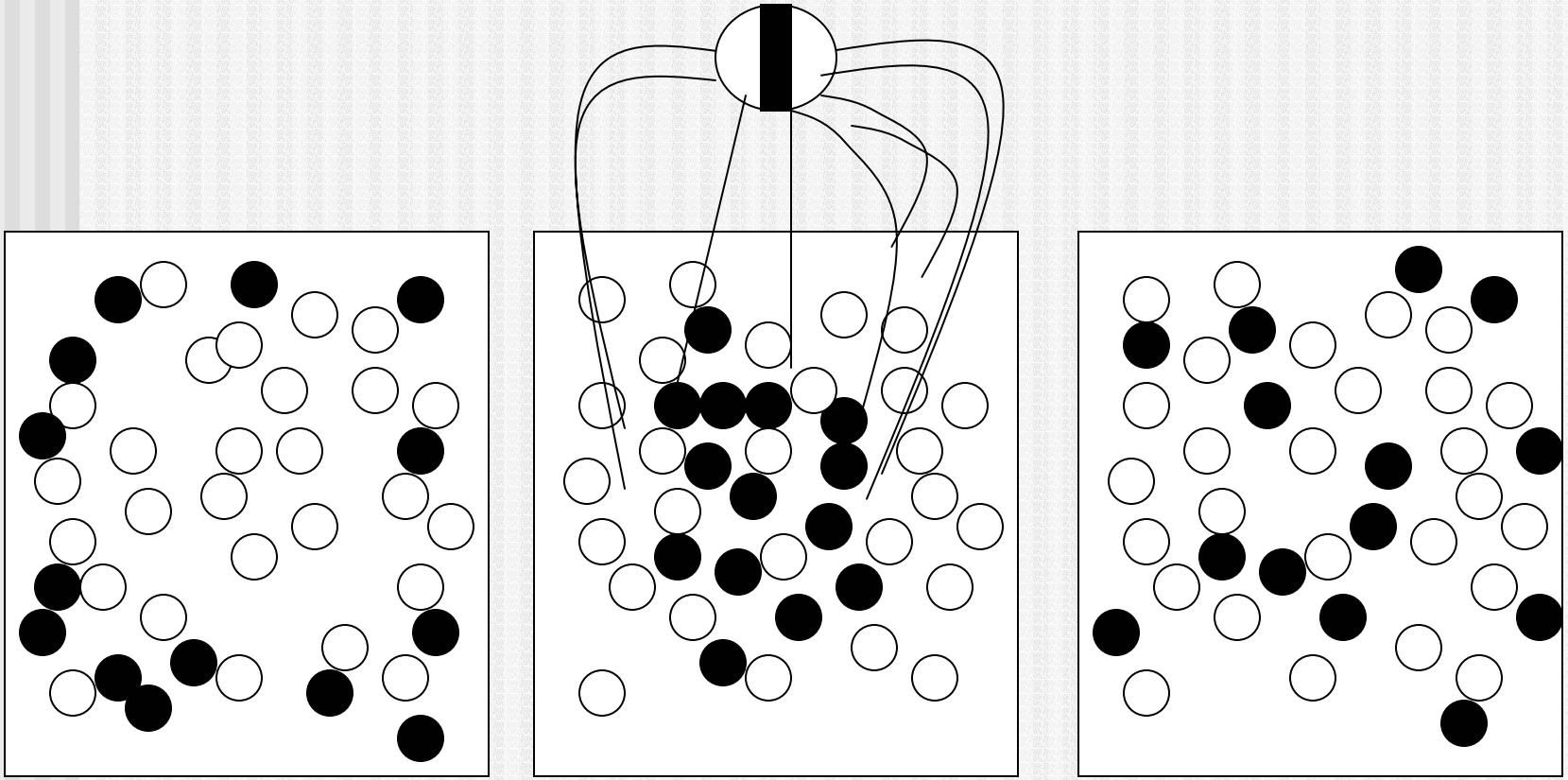
   - the very attributes on whose basis membership in a category is determined are more often than not themselves prototype categories.

   Binary feature - property that can be judged as either present or absent

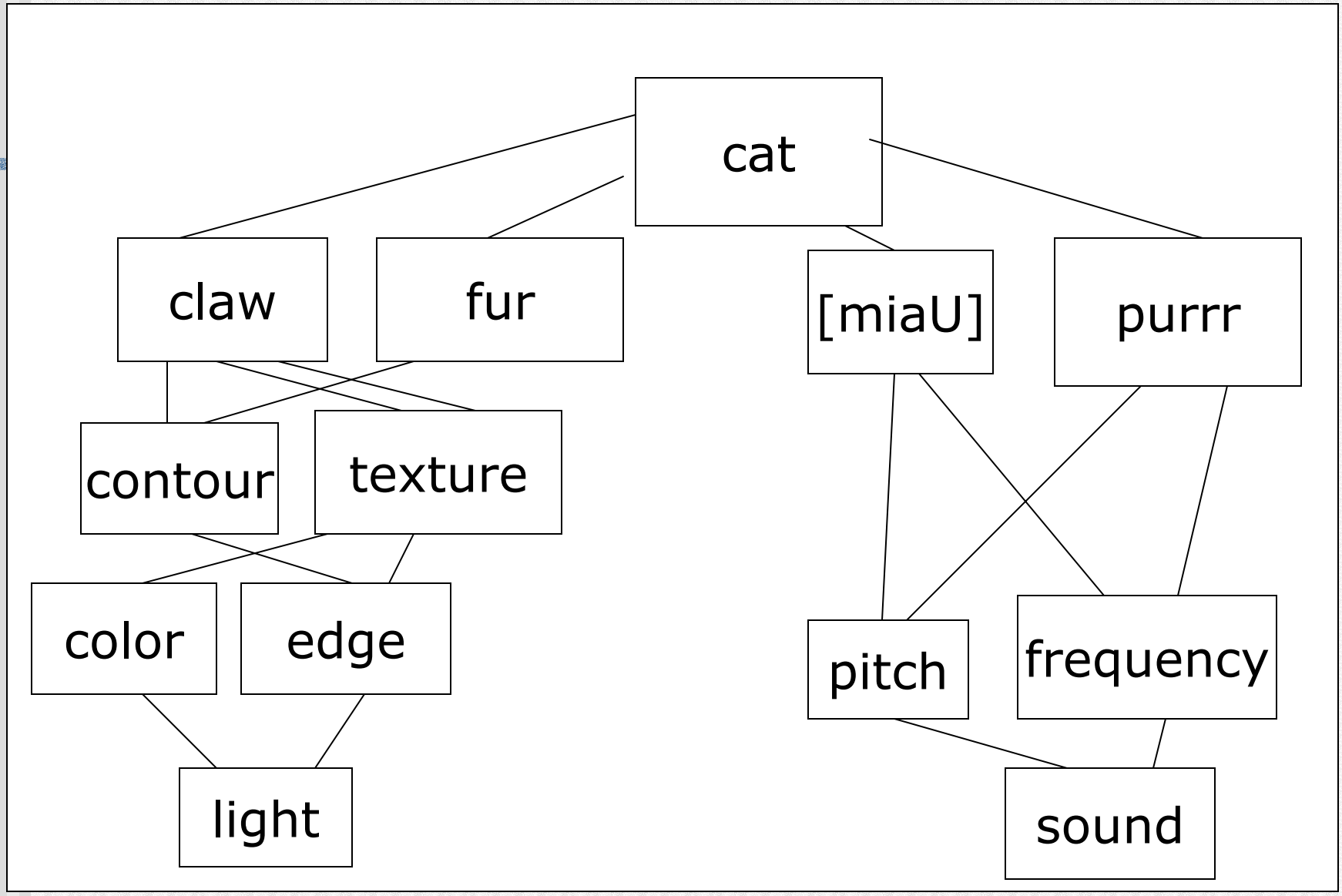
   - rare - even dead or alive, true or false, male or female, left or right have some gray area

Prototype theory

- Most features are in some way gradable
- note even the notion of gradable is gradable--some categories are much more gradable than others like tall as opposed to dead
- Some neurons are on or off, some have variable outputs. Often they have thresholds. What it takes to make the cell fire is gradable.
  - Visual receptor cells fire in response to correct input
  - Edge detectors give variable response



Bad input good input intermediate


cat
claw
fur
[miaU]
purrr
contour
texture
color
edge
pitch
frequency
light
sound

Prototype theory

5. Category membership a matter of degree

   - (Rosch) Subjects asked to what extent items belonged to a category (rate 1-7)
     - Ex. *Furniture*
     - *Chair, sofa, couch, table (~1)*
     - *Lamp, stool, piano (~3)*
     - *Ashtray, fan, telephone (~7)*

Prototype theory

- Membership a matter of co-occurrence of features
- Prototypes have more co-occuring features, features with high *cue validity* (conditional probability
- Frequency of encountering probably not a factor
  - Do we encounter tables and chairs more frequently than mirrors and clocks?

Prototype theory

- Hedges
  - Phrases that signal a qualification of the truth of some claim
  - *Par excellence, loosely speaking, strictly speaking, in that, as such*

Ex. *Par excellence* picks out central members of category

1. A robin is a bird *par excellence*
2. ?A turkey is a bird *par excellence.*

Prototype theory

Loosely/strictly speaking pick out extend or tighten the category respectively:

1. ?*Loosely speaking*, a chair is a piece of furniture
2. *Loosely speaking*, a telephone is a piece of furniture

1. ?*Strictly speaking*, beans are vegetables.
2. *Strictly speaking*, rhubarb is a vegetable.

Prototype theory

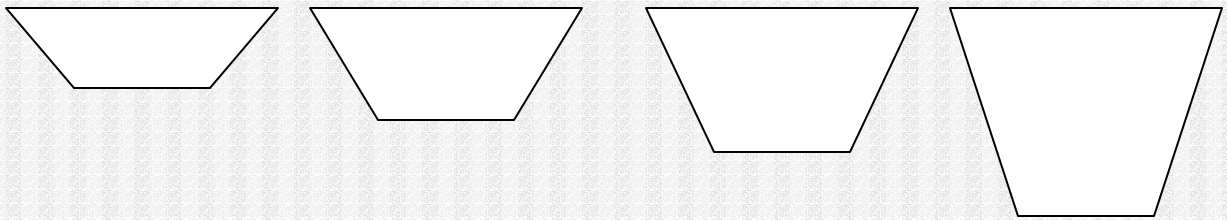
In that spells out reasons for assigning an entity to a category when it shares only more peripheral attributes of that category.

1. *He killed Alice *in that* he murdered her.
2. He killed alice *in that* he did nothing to keep her alive.
3. She's a friend of mine *in that* I've known her for years, but we're really not that close.

Prototype theory

6. Categories do not have clear boundaries

Examples from Labov



Prototype theory

- Prototypes can be ideal case or typical case (stereotype)
- (Lakoff) consider the prototypical husband vs the ideal husband.

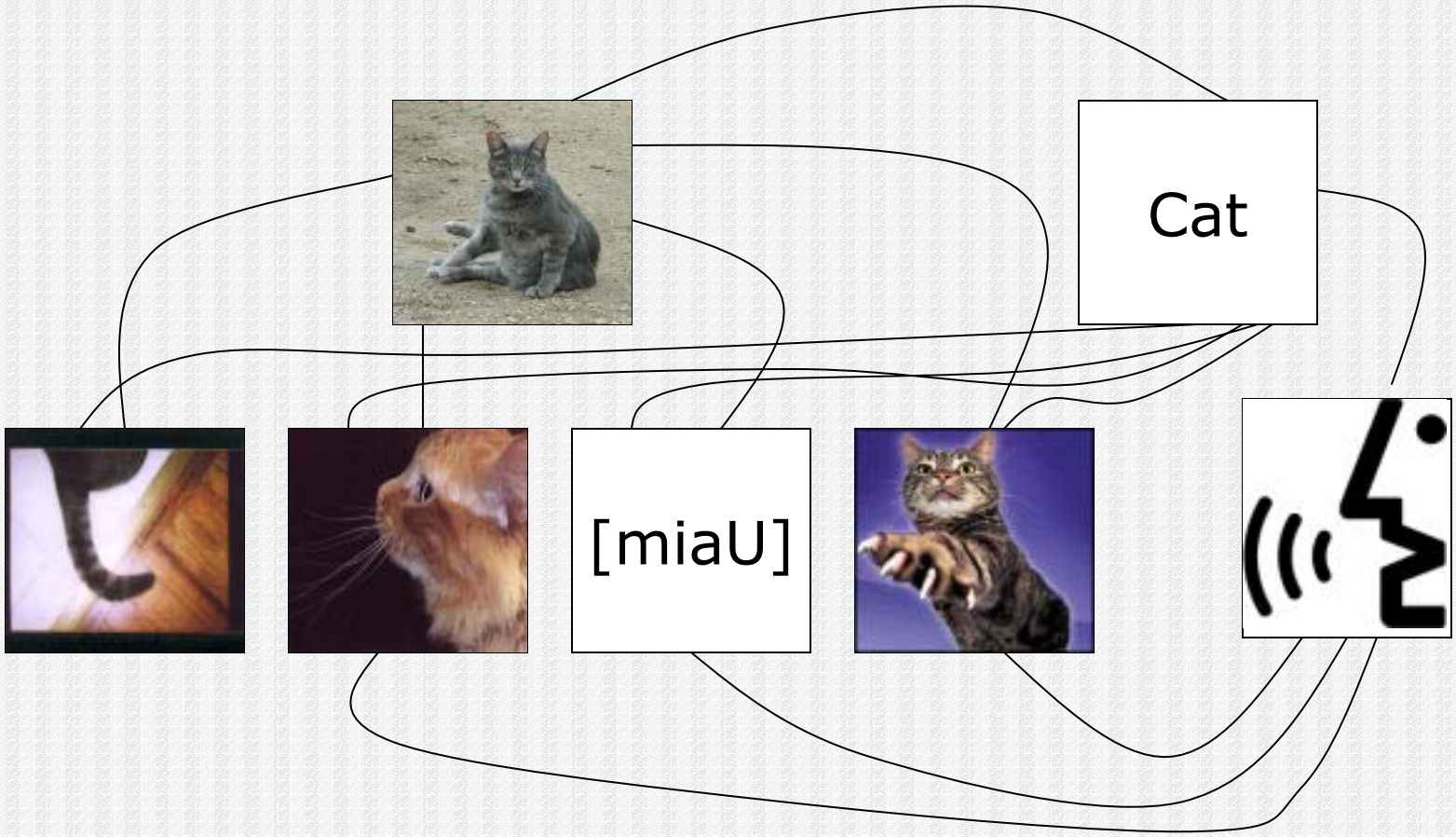
Prototype theory

- Prototype logic
- Stereotyping - chunking
  - Attributing properties of the prototype to anything assigned to the category
    - Is Reno east or west of San Diego?
    - REM
    - Sociocultural stereotypes

Prototype theory

- Prototype model is consistent with associative model of cognition
- Hebbian learning – the more things co-occur, the stronger their representations are connected
- Prototypes inhere in strong connections between category and features.
  - features have different degrees of centrality for the category
    - Head shape > meow > tail > chase mice
  - Members possess different patterns of features

Prototype theory



Categories - who decides?

- Embodied theory of meaning- categories are not pre-formed and waiting for us to behold them. Our need for categories drives what categories we will have
- Basic level categories - not all categories have equal status. The basic level category has demonstrably greater psychological significance.

Basic level category

- Basic level category
  - Based on our optimal interaction with the environment

1. Highest level at which a single mental image can represent the entire category
   - Chair, screwdriver, dog (basic)
   - Furniture, tool, animal (superordinate)

Basic level category

2. Highest level at which category members have similarly perceived overall shapes.

   cat, but not *animal*,

   hammer, but not *tool*

3. Highest level at which a person uses similar motor actions for interacting with category members

   Separate motor programs for interacting with chair, bed, table, but not for interacting with *furniture*.

Basic level category

- Basic level terms are used in subordinate categories

  claw hammer, tack hammer