Comments on Palmeri and Cottrell, 2009

Possible themes suggested for posts

- How is object processing related to and different from category processing?
- At what depth does the model explain phenomena (e.g., is a fine-grained mechanistic explanation offered, or is a variable like response time simply assumed to be proportional to some model variable like connection strength)?
- Can you think of a way to unify (a) the phenomenon that the entry level into a categorization hierarchy is deeper (i.e., subordinate) for experts than for novices, with (b) the phenomenon that the entry level for atypical basic-level category members (e.g., an ostrich) is deeper (i.e., subordinate), even for many novices?
- How do purely computational models that were developed with no interest in natural cognition inform psychological models, and vice versa?
- How encompassing of various cognitive phenomena should a model be?

THE CORE FEATURES OF PERCEPTUAL EXPERTISE

1. Novice rules; expert automaticity
Comments on Palmeri and Cottrell

"Novices often rely on explicitly verbalized category knowledge in the form of rules or ideal cases that are acquired from reference manuals or explicit instruction (e.g., Allen & Brooks, 1991) or that are created through induction (e.g., Johansen & Palmeri, 2002). By contrast, although experts have more verbal knowledge about a domain, expert categorization often seems removed from explicit and conscious deliberation (e.g., Brooks, Norman, & Allen, 1991; Sloman, 1996). **What accounts for this shift from conscious deliberation to more automatic decisions?**"
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- Does chunking as described under last lecture's password example account for this shift?
    - Partly perhaps, as chunking removes/mitigates need for prerequisite checking, which might explain speedup in core phenomena 2
    - But what of neural implementations?
    - Can we implement novice "rule following" behavior at a ANN level and then show learning at the ANN level?
        - How are verbally stated rules translated to an ANN

- Is expert automaticity what made old-style AI knowledge acquisition tough?

2. Novices slow; experts fast
Comments on Palmeri and Cottrell

"Novices are slow and deliberate in their decisions, perhaps reflecting their use of explicit rules and strategies. The development of expertise is accompanied by a marked speedup in processing, originally characterized by the power law of practice (Newell & Rosenbloom, 1981; but see Heathcote, Brown & Mewhort, 2000; Rickard, 1997; Palmeri, 1999). **What causes this increase in the speed of decisions with perceptual expertise?"** Palmeri and Cottrell, 2009

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- Related to possibilities to core phenomena 2?
    - Are there any cases where automaticity leads to slowdown?
        - Perhaps only with respect to "interruption effects"?
        - In "speedup learning", is there any analog to "overfitting"?

3. Entry-level shift
Comments on Palmeri and Cottrell

"One important aspect of this speedup is the so-called "entry level shift" (Jolicoeur, Gluck, & Kosslyn, 1984; Tanaka & Taylor, 1991). For novices, categorizations at the basic level ("dog" or "bird") are faster than categorizations at either a superordinate ("animal" or "plant") or a subordinate level ("robin" or "terrier"). The fastest level of categorization is often described as the entry-level into conceptual knowledge. For experts, there is an entry-level shift whereby subordinate-level categorizations are made as quickly as basic-level categorizations (Johnson & Mervis, 1997; Tanaka & Taylor, 1991). **Does this shift reflect a qualitative change in how expert categories are processed, or is it a manifestation of a more continuous quantitative change in the efficiency of processing over learning** (Joyce & Cottrell, 2004; Mack, Wong, Gauthier, Tanaka, & Palmeri, 2007; Tong et al., 2008)?" Palmeri and Cottrell, 2009

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- What is the relationship, if any, with entry level, even by novices, due to typicality?
- Do animals exhibit basic level and entry-level shift effects?
- "entry-level shift whereby subordinate-level categorizations are made as quickly as basic-level categorizations" – is subordinate ever properly faster?
- Is there any information-processing advantage to lower entry?
- In "novices", is basic level identification automatized, and then rule-based for subordinate level?
- How can the continuum in this shift be modeled, as intra-category discrimination becomes more refined?

4. Interference
Comments on Palmeri and Cottrell

"Novices and experts show different patterns of interference. Novices are easily distracted whereas experts may be able to simultaneously engage in other tasks while making expert decisions. Part of this apparent lack of interference may be because experts no longer use explicit verbalizable routines, so concurrent verbal activity does not interfere with performance. But when experts engage in tasks that tap the same representational resources used for other domains of expertise, they suffer interference in ways unseen in novices (Gauthier & Curby, 2005; Gauthier, Curran, Curby, & Collins, 2003; Rossion et al., 2004; see also Curby & Rossion, this volume). **What accounts for these different patterns of interference in experts and novices?"** Palmeri and Cottrell, 2009

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- I am an expert in typing my password, but still suffer from interference – what's going on? Is attention itself a "representational resource"?
- What are caveats generally on this?

5. Treatment of the "irrelevant"
Comments on Palmeri and Cottrell

"Novices can attend to part of a complex object while ignoring irrelevant parts. By contrast, experts show interference from irrelevant variation in an unattended part. For example, in a partmatching task—adapted from work in the face recognition literature (Young, Hellawell, & Hay, 1987)—subjects are asked to attend to the top part of a whole object. After a brief delay, a second object is shown with the irrelevant bottom either matching or mismatching the bottom of the first object. When judging whether the top is the same or different, novices are unaffected by the irrelevant bottom, whereas experts show facilitation when the irrelevant bottom would lead to the same decision, and interference when the irrelevant bottom would lead to a different decision (Cheung, Richler, Palmeri, & Gauthier, 2008; Gauthier et al., 2003; Richler et al., 2008). However, the direction of this interference depends upon the objects of expertise—for example, Chinese readers do not suffer this interference when viewing Chinese characters, while novices do (Hsiao & Cottrell, 2008). **What causes this nominal processing cost associated with expertise, and what explains when the expert will show this cost?"**
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- Is this related to the first core characteristic – that novices may be following rules and experts are automatized?
- The assertion of irrelevance is artificial

6. Expert generalization
Comments on Palmeri and Cottrell

"Experts generalize their knowledge. Experts can learn to categorize and identify new objects more quickly than novices, and can discriminate novel objects better than novices, at least so long as the new objects are similar to other objects in their domain of expertise (i.e., they vary systematically in the same way as other learned objects; Gauthier & Tarr, 1997, 2002; Tanaka, Curran, & Sheinberg, 2005)."
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- Would novice rules constitute generalization?
- Is this because experts operate as effectively at a subordinate level? They are trained with finer grained features?

7. Sensitivity to orientation
Comments on Palmeri and Cottrell

"The ability of experts to generalize is also limited in specific ways (Palmeri, 1997). Experience is often limited to particular viewpoints. In much the same way that face recognition is impaired by inversion, expert object recognition is impaired by inversion as well (Diamond & Carey, 1986). For example, experts are highly sensitive to changes in the configuration of features, but only when objects are presented in a familiar orientation (Maurer, LeGrand, & Mondloch, 2002; Mondloch, LeGrand, & Maurer, 2002; Gauthier & Tarr, 1997). **What does this limited generalization and sensitivity to orientation or viewpoint imply about how experts represent their perceptual knowledge?"**
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Palmeri and Cottrell, 2009

- Implications of specific to general learning, as well as general to specific
- If no experience with inverted faces (or other face/object orientations) then how might experts generalize – they are experts with limited/biased observations

8. Brain activity
Comments on Palmeri and Cottrell

"Finally, experts show different patterns of brain activity than novices. For example, with fMRI it has been shown that the fusiform face area (FFA) is not just involved in face recognition but is activated by objects of expertise in real-world experts such as birders (Gauthier, Skudlarski, Gore, & Anderson, 2000; Xu, 2005; but see Grill-Spector, Knouf, Kanwisher, 2004) and by objects of expertise created in the lab (Gauthier & Tarr, 1997, 2002). Similarly, event-related potential (ERP) markers for face recognition, such as the N170, which shows highest amplitude for faces, also show higher amplitude when observing objects of visual expertise over objects that are not (Tanaka & Curran, 2001; but see Scott, Tanaka, Sheinberg, & Curran, 2006). **Why are brain areas that are devoted to one domain of expertise, in this case faces, recruited for another domain of expertise? What is different about an expert domain such as letter perception, which recruits different brain areas entirely** (Gauthier, Tarr, et al., 2000; Wong & Gauthier, 2006)?"

Palmeri and Cottrell, 2009