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Adaptation Effects on Word Recognition Times: Evidence for Perceptual Representations

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Abstract

We present evidence for the involvement of perceptual feature detector cells in the initial stages of processing lexically activated concept knowledge. Participants were slower to respond to names for oriented objects after being adapted to gratings of matching orientation, relative to opposite orientation. The data are consistent with the view that knowledge is perceptually based at a fundamental level, and inconsistent with alternative views that perceptual representations are generated at a later stage based on amodal representations.

Perceptual Representation: Adaptation Effects

The view that knowledge representations have a perceptual basis has been supported in a variety of methodological approaches. However, many of these studies may provide limited evidence for the importance of perceptual processing. Perceptually based aspects of knowledge may be generated in a later phase based on an initial, perhaps perception-unrelated representation, or they may be the knowledge that gets activated initially. Influential theories in this domain (e.g., Barsalou, 1999) assume the latter, and need to be tested accordingly.

With the goal to test whether perceptual representations are the foundation of knowledge processing as opposed to a by-product, we examined participants' response times to names for objects that had standard, vertical or horizontal orientations after exposing them to grating patterns that were in the same or opposing orientation as the object. When processing such grating patterns, specialized orientation detector neurons in the visual cortex become activated (Hubel & Wiesel, 1959). After certain exposure times, these neurons adapt, leading to lower sensitivity. We predicted that if access to a perceptual representation is by necessity part of accessing object concepts, response times to object names should be slowed down after adaptation of neurons that process critical object primitives (Treisman, 1986). Specifically, adaptation to matching orientations should slow responses relative to adaptation to the opposite orientation. In contrast, response times should be equal (or faster via priming) for matching grating patterns if such cells are not involved in initial processing.

Method

Twelve graduate students who volunteered to participate in the experiment viewed grating patterns for time durations

that have been shown to create and maintain adaptation of the feature detectors for vertical and horizontal orientations. Subsequent to viewing patterns, they performed a lexical decision task on names for vertical vs. horizontal objects.

A set of items with standard vertical or horizontal orientations was rated with respect to variables that may influence perceptual processing, such as their height to width ratios and view invariance. These ratings served as covariates in the analyses.

Results & Discussion

Adaptation effects were observed for items with strong view invariance and high ratios. A 2 (grating orientation: vertical vs. horizontal) x 2 (word orientation: vertical vs. horizontal) repeated measures ANOVA revealed an interaction of grating orientation and word orientation on response time, which was slower when grating and object orientation matched (Table 1).

Table 1: Response Times per Syllable (in msec.)

Object	Grating	
	Vertical	Horizontal
Vertical	463.40	326.30
Horizontal	294.58	435.74

Conclusions

Our data suggest that perceptual representations are an integral part of knowledge activated during the initial processing of words for oriented objects. These data are consistent with the assumption that conceptual processing activates brain regions that are involved in processing of the actual related percepts. This finding lends stronger support to theories of perceptually based representations than other, related studies because the adaptation effects on response times are inconsistent with the view that perceptual representations are activated at a later stage and are merely by-products of a potentially amodal representation.

References

- Barsalou, L.W. (1999). Perceptual symbol systems. *Behavioral and Brain Sciences*, 22, 577-660.
- Hubel, D.H., & Wiesel, T.N. (1959). Receptive fields of single neurons in the cat's striate cortex. *Journal of Physiology*, 148, 3574-591.
- Treisman, A. (1986). Features and objects in visual processing. *Scientific American*, 255, 114-125.