

Hemispheric and Cross-Dimensional Transfer of Perceptual Learning Effects under Easy and Hard Conditions

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Introduction

Ahissar & Hochstein (Nature, 1997) found that perceptual learning transfer across positions or orientation depends on the spatial conditions of the task: Learning effects transfer for easy tasks (large target-distracter difference) and are considerably specific with harder conditions. These differences are presumably related to cerebral modification site: hard are seen as requiring low-level (specific) representations while easy tasks are performed using high cortical level mechanism alone. These tasks were always performed with test arrays in the center of the test screen. More recently, we introduced eccentric search arrays (Pavlovskaya et al., 2001), which are now exploited for testing transfer of learning effects between hemispheres. We also ask if learning effects will transfer across visual dimensions and if this transfer also depends on task difficulty.

Methods and Results.

We used 7x7 search arrays containing a target element on half of the trials and presented laterally at 5.5° right or left of fixation. Target differed from distracters in color or orientation. In addition, this difference could be large, making the task easy (e.g. distracter orientation 60° , target 20°) or difference could be small, making task hard (target 40°). Arrays were presented for 16 ms, followed by a mask (150 ms) after a variable Stimulus-to-mask Onset Asynchrony (SOA). Easy and hard tasks were performed during separate interleaved sessions, generally 2 sessions/day. Subjects were trained for up to 12 sessions of 1,000 trials divided into 50 blocks (with a single SOA of 20 trials each (10 left; 10 right)).

1st experiment

9 subjects were trained on orientation search in one hemifield and on color search in the other hemifield. Following training, subjects were tested with color and orientation tasks, with each trained task moved to the other (new) hemifield – testing for cross-hemisphere transfer. We found transfer for easy tasks and not for difficult tasks. However, the method used left an ambiguity that the transfer we found for the easy tasks could be interpreted as transfer across tasks: color in one hemifield to orientation to the same hemifield and vice versa.

2nd experiment

We trained 8 subjects to search for a novel search dimension – a gap in the target line element – in one hemifield, and for the usual orientation (or color) search task in the other. Then we tested the subjects on the trained orientation (or color) task in the hemifield where they had learned the gap task, and the other – novel – dimension, color (or orientation) in the hemifield that had been trained with the original orientation (or color) dimension. We again found complete transfer for the trained dimension for easy cases, suggesting that the transfer was due to a hemifield transfer.

3rd experiment

Here we tested the possibility of cross-task transfer directly. 12 subjects trained visual search with a single dimension, either color or orientation in both hemifields. Then, those trained with color were tested with orientation search and those trained with orientation were tested with color search. The results were unambiguous: For easy conditions, there was complete transfer from task dimension to task dimension, and for the hard task there was no transfer.

Conclusions

We find nearly complete hemifield and cross-dimensional transfer for easy conditions and no transfer for difficult conditions. Our results support the notion that feature search with easy conditions is performed at high cortical levels where representations are multi-dimensional.

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References

- Ahissar, M. & Hochstein, S. (1997). Task difficulty and the specificity of perceptual learning. *Nature*, 6, 401-406.
- Pavlovskaya, M., Ring, H., Groswasser, Z., Keren, O. & Hochstein, S. (2001). Visual search in peripheral vision: Learning effects and set-size dependence. *Spatial Vision*, 14, 151-173.