Published in final edited form as:

Trends Cogn Sci. 2010 June ; 14(6): 236–237. doi:10.1016/j.tics.2010.03.010.

Informativeness and learning: Response to Gauthier and colleagues

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Gauthier and colleagues (henceforth GWP) raise the importance of type of visual experience in determining learning-related neural changes and suggest that local changes can occur given particular forms of experience [1]. We completely agree that the kind of experience matters. These effects are predicted by the informativeness hypothesis we concluded our review with [2]. However, we question whether the work discussed in [1] has actually demonstrated local neuronal changes.

First, we clarify the terms “distributed” and “local”. Fully distributed implies that all neurons within a larger region show the same effect of learning. In contrast, local implies that learning is restricted to a small set of neurons or small cortical region (e.g. development of a small number of highly selective neurons or patch of cortex). However, our review suggests that learning effects are neither fully distributed nor local, but “partially distributed”, that is, heterogeneous effects that occur across a large cortical region.

Second, the informativeness hypothesis suggests that the role of a neuron in learning will depend on how informative that neuron is for the task at hand. Both bottom-up (e.g. stimulus) and top-down (e.g. task) factors matter, since both stimulus and task will determine which neurons/regions are informative and which not. So, task effects as highlighted by GWP are entirely predicted by this account.

Third, GWP claim that learning to categorize “ziggerins” produces distributed cortical changes whereas learning to individuate those same stimuli produces local changes, limited to part of fusiform cortex close to the fusiform face area (FFA) [3]. However, they observed a positive training effect throughout ventral occipito-temporal cortex in the right hemisphere of participants trained to individuate ([3], Figure 4; “within”, middle panel), which although not significant in any small region-of-interest is suggestive of a (partially) distributed, not local, effect.

Finally, care must be taken in generalizing their result – it may not be the *task per se* that determines the pattern of learning effects, but the specific *information* required. A categorization task requiring fine-grained discrimination may produce results more similar to those observed by GWP in the individuation task.

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So how would informativeness explain the ziggerin results? If occipitotemporal cortex contains pre-existing maps for multiple features [4], such as a shape map and a process map, then the pattern and extent of training-induced changes will depend on which shape features and which processes are task relevant. For example, individuation requires fine-grained discrimination dependent on feature conjunctions [5]. Training effects are abundant throughout fusiform cortex, because that part of the map processes complex combinations of features [6]. However, training effects are not observed in FFA, in contrast to previous studies from Gauthier and colleagues using individuation tasks and against predictions of the expertise hypothesis [7], because ziggerins have few features in common with faces (in contrast to e.g. Greebles and birds).

In sum, GWP are absolutely right to highlight the importance of the type of training, but effects of training task are predicted by the informativeness account we suggest.

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