Stimulus Processing and Task Dependency

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Stimulus processing has been studied in the seventies by Garner (1970). He suggested that there were two kinds of stimuli: separable and integral. The former were stimuli for which one dimension could exist without the other and the later were just the opposite. It was possible to distinguish these two kind of stimuli *a posteriori* using MDS. The problem with this classification was that it did not always hold (see Garner, experiment 3).

Moreover, Garner's classification led to inconsistent predictions. The reason for this inconsistency lied in the fact that task demands were not taken into consideration: there might as well exist two kinds of tasks: one in which we must separate stimulus dimensions (disjunctive) and one in which we must integrate stimulus dimensions (conjunctive).

Hypothesis

We postulate the existence of an interaction between task demand and stimulus type. When there is a match between task demands and stimulus type, the task should be easy to learn. When there is a mismatch between task demands and stimulus type, the task should be harder to learn.

Methodology

Material: We used two sets of stimuli: the first was integral (Gabor patches) while the second was separable (CCC; Cousineau & Shiffrin, submitted). The stimuli used are shown in Figure 1.

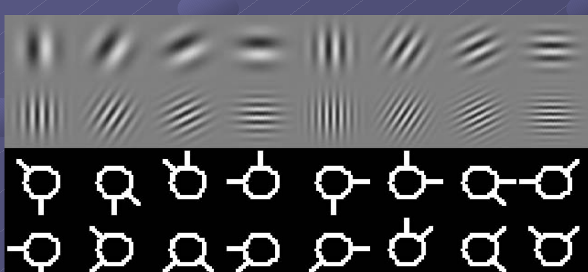
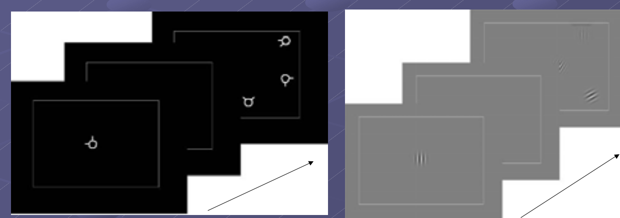


Figure 1: Stimuli used in the experiment.

Procedure: We used two tasks: visual search for whole objects (vsw; conjunctive task demands) and visual search of parts (vsp; disjunctive task demands). The display always contained three objects and each stimulus was composed of two independently varying parts. Each task could be performed with each set of stimuli. The participants were trained on one of the four resulting conditions for four sessions. Figure 2 shows typical trials.



vsp-ccc vsw-gab

Figure 2. Typical trials from two of the four conditions.

Result

All the following response time analysis were conducted on correct responses for which the stimulus was present (hits). The learning curves are shown on Figure 3.

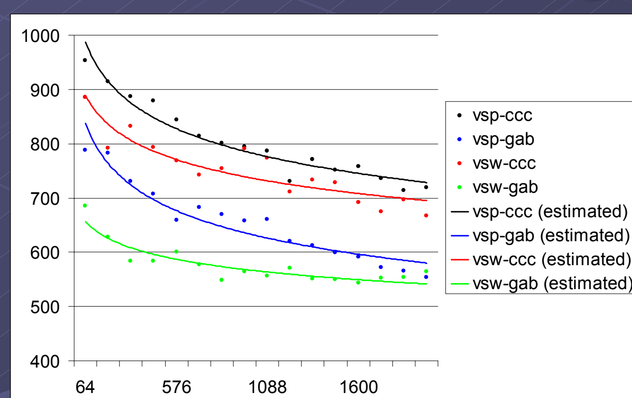


Figure 3. Learning curve by group.

As can be seen on Figure 3, the participants were able to learn the task whether or not there was a match between task demands and stimulus type. Moreover, we can see that responses to Gabor patches were always faster then responses to CCC. However, these main effects on the mean RTs are insensitive to the most relevant aspect of the data: the learning rate.

We used PASTIS to estimate the best fitting parameters of a block-averaged power curve (Cousineau, Hélie and Lefebvre, submitted). The estimated parameters are shown in Table I.

Table I: Individual estimated parameters averaged by groups.

	Asymptote	Amplitude	Curvature
* vsp-ccc	626.2	1349	0.47
vsp-gab	311.1	1109	0.19
vsw-ccc	475.7	877.6	0.19
* vsw-gab	492.2	1154	0.47

* Represent conditions in which task demands matches stimulus type

The curvature represent the learning rate. We see a faster learning rate when there is a match between task demands and stimulus type (match: 0.47; mismatch: 0.19).

Conclusion

As was shown in the present experiment, training and stimulus type influenced performances when learning is studied on a discrete basis (using mean RTs). These results support Garner's original predictions.

However, when one wants to study learning as a dynamic process, analysis of means are insufficient. Therefore, the learning process must be studied using a more complete descriptive model: the learning curve. By studying learning as a continuous process, we were able to demonstrate that learning rate is the result of a match or mismatch between task demands and stimulus type. A finer-grained analysis therefore provides a more complete explanation of learning by taking into account it dynamic component.