School of Psychology

University of Nottingham

Navon's (1977) Study of Global vs. Local Perceptual Processing

The Title

- Forest Before Trees: The Precedence of Global Features in Visual Perception

The Abstract

"The idea that global structuring of a visual scene precedes analysis of local features is suggested, discussed and tested. In the first two experiments subjects were asked to respond to an auditorily presented name of a letter while looking at a visual stimulus that consisted of a large character (the global level) made out of small characters (the local level). The subjects' auditory discrimination responses were subject to interference only by the global level and not by the local one. In Experiment 3 subjects were presented with large characters made out of small ones and they had to recognize either just the large characters or just the small ones. Whereas the identity of the small characters had no effect on recognition of the large ones, global cues which conflicted with the local ones did inhibit the responses to the local level. In Experiment 4 subjects were asked to judge whether pairs of simple patterns of geometrical forms which were presented for a brief duration were the same or different. The patterns within a pair could differ either at the global or the local level. It was found that global differences were detected more often than local differences." (pg. 353, Cognitive Psychology, 9, 1977)

The Introduction

- Navon structured his introduction using subheadings:
  - Definitional Framework
  - The Principle of Global Precedence
  - Functional Importance of Global-to-Local Processing
  - Some Empirical Evidence
- Subheadings are generally used for longer research reports.
  - Generally you will not need them.

Definitional Framework

- This section begins:

> "The interpreted contents of a scene can be viewed as a hierarchy of subscenes interrelated by spatial relationships (Winston, 1973; Palmer, 1975)"

- Having introduced the area Navon provides more technical/theoretical detail
- He uses references to other work to show that this is not a new idea (he's avoiding plagiarism)

The Principle of Global Precedence (1)

- The opening lines of Navon's introduction are:

> "Do we perceive a visual scene feature-by-feature? Or is the process instantaneous and simultaneous as some Gestalt psychologists believed? Or is it somewhere in between?"

- By doing this he immediately 'sets the scene' for the reader.

The Principle of Global Precedence (2)

- At the end of this section he states:

> "The idea put forward in this paper is that perceptual processes are temporally organized so that they proceed from global structuring towards more and more fine-grained analysis."

- Navon makes very clear what his general theoretical claim is.

Functional Importance of Global-to-Local Processing

- Navon presents an argument about why this may be important to the cognitive system:

> "In most real situations the task of the human perceptual processor is not just to account for given input but also to select which part of the surrounding stimulation is worth receiving, attending to, and processing….suggest that a multipass system, in which fine-grained processing is guided by prior cursory processing, may be superior to a system that tries to find a coherent structure for all pieces of data simultaneously" (pg. 355, Cognitive Psychology, 9, 1977)

Some Empirical Evidence

- In this section he provides evidence that supports his analysis. For example:

> "The word-letter phenomenon (Reicher, 1969; Wheeler, 1970) is an excellent demonstration of how the mere presence of a higher-level perceptual unit improves later forced-choice recognition of its individual constituents over the case when they are presented alone.." (pg. 357, Cognitive Psychology, 9, 1977)

The inevitability of Global Processing: Experiment 3 (1)

- For this experiment Navon makes clear what the research hypothesis is:

> "We have already seen that in certain conditions when no specific demands are made to the viewer with regard to what should be recognized, his visual system is tuned to pick just the identity of the global pattern. What happens, however, when the viewer is told what to focus at and what to ignore? Can the viewer control his own perceptual processes? And if he does, can he ignore any aspect at will?" (pg. 368, Cognitive Psychology, 9, 1977)

The inevitability of Global Processing: Experiment 3 (2)

- Next he provides an explanation of the experiment he is going to conduct:

> "The basic experimental idea is to use visual stimuli of the type used in Experiment, this time without any auditory stimuli, and to have subjects respond either just to the global level or just to the local level. The assumption is that if they are aware of the other level too, it should interfere with their performance." (pg. 368, Cognitive Psychology, 9, 1977)

- Here Navon has specified a precise hypothesis which he will test in the experiment.

The Method Section

- Like most Method Sections there are subheading (though not the same as the School requires)
  - Apparatus
  - Stimuli
  - Design & Procedure
  - Subjects

The Apparatus (pg. 359)

"The equipment consisted of a display Tektronic oscilloscope with a fast decay phosphor (decays to 90% in .63 msec), a typewriter keyboard, a Krohn-Hite 3550R filter, …etc"

"Auditory and visual stimuli were generated and controlled by a PDP-9 computer equipped with digital-to-analog converters, …etc"

"The display oscilloscope was positioned in front of the subject at eye level. Viewing distance was 50cm,…etc"

The Stimuli (pg. 365)

- Navon uses a figure to show the stimuli.

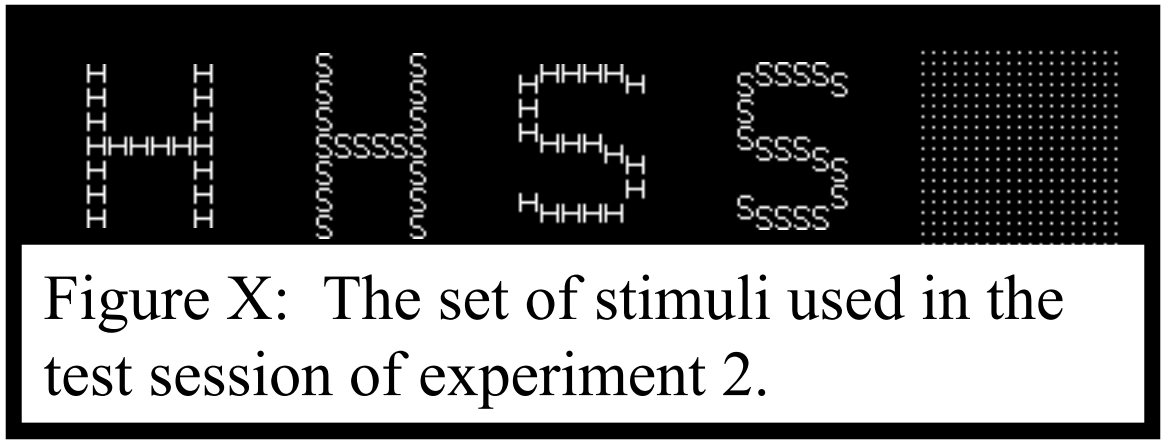

Figure X: The set of stimuli used in the test session of experiment 2.

- But he also make sure that he refers to the stimuli in the text

Design and Procedure (1)

"In each trial of the experiment the subject saw a stimulus of the type presented in Fig. X. Each subject was run through two attention conditions: In the global-directed condition the subject was supposed to indicate whether the global character was H or S….In the local-directed condition the subject was supposed to indicate whether the element character was H or S. Each trial was proceeded by a 50-msec waning beep. The beep started simultaneously with the onset of a fixation point on the center of the oscilloscope that remain in the field for 500 msec. The stimulus followed the offset of the fixation immediately and it appeared randomly at either of the four quadrants of the oscilloscope….the stimulus was presented for 40msec and was immediately masked by a square of 33x33 dots….Both accuracy and latency measured from the onset of the stimulus were recorded for each trial." (pg. 369, Cognitive Psychology, 9, 1977)

Design and Procedure (2)

"Each subject was run individually in one session. There were 288 trials in a session. After every block of 36 trials the subject was given a rest period of about 20 sec. The necessary randomisations were done for each block independently. Each of the stimuli appeared six times in a block in a random fashion, and each spatial position at which the stimulus could appear was used nine times in a block in a random fashion. One attention condition was administered in the first six blocks, and the other one in the last six blocks. Half the subjects received the global-directed condition first, and the other half received it last. The first two blocks for each condition were considered as practice blocks." (pg. 369, Cognitive Psychology, 9, 1977)

Subjects

"Fourteen subjects were run. All of them were undergraduates at the University of California, San Diego, who participated in the experiment as part of their course requirement. The subjects were also paid a monetary bonus that depended heavily on accuracy and slightly on speed. The subjects were asked to be as fast as they could while making as few errors as possible. None of the subjects had participated in Experiments 1 or 2, and all had normal or fully corrected vision." (pg. 369, Cognitive Psychology, 9, 1977)

The Results (1)

- The results section begins with the descriptive statistics (including a measure of overall performance)

  "The overall error percentage was 3.3%" (pg. 369, Cognitive Psychology, 9, 1977)

  "Mean Latencies to correct responses are plotted in Fig. * as a function of the attention condition and the consistency of the stimuli." (pg. 369, Cognitive Psychology, 9, 1977)
- Navon does not give a measure of variability (dispersion)
  - You must give a measure of dispersion
  - A table rather than a graph makes this easier.

The Results (2)

- A table showing the means and standard deviations for the different attentional conditions for both task situations

	Global-directed	Local-directed
Consistent	462 (39)	573(43)
Conflicting	477 (40)	664(52)

The Results (3)

- Navon writes:

  "All the differences are nonsignificant at the .05 level, except for the ones between the conflicting consistency condition to each of the other ones when attention is directed at the elements, p<.01…" (pg. 370, Cognitive Psychology, 9, 1977)

  "In the local-directed condition the mean latency in the 'conflicting' trials was higher than the mean latency in 'consistent' trials…." (pg. 370, Cognitive Psychology, 9, 1977)

The Discussion

- Navon begins his discussion of this experiment with:

  "The results of this experiment indicate that the global pattern is responded to faster than the elements. Moreover, whereas people can voluntarily attend to the global pattern without being affected by the local features, they are not able to process the local features without being aware of the whole" (pg. 371, Cognitive Psychology, 9, 1977)

- Later he states:

  "…the finding that attention cannot be efficiently diverted from the whole may be interpreted as support to the notion that global processing is a necessary stage of perception prior to more fine-grained analysis." (pg. 371, Cognitive Psychology, 9, 1977)