Temporal Characteristics of the Straddle Effect (Buffy Contrast Adaptation) and Modeling with On-Off Neurons

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INTRODUCTION

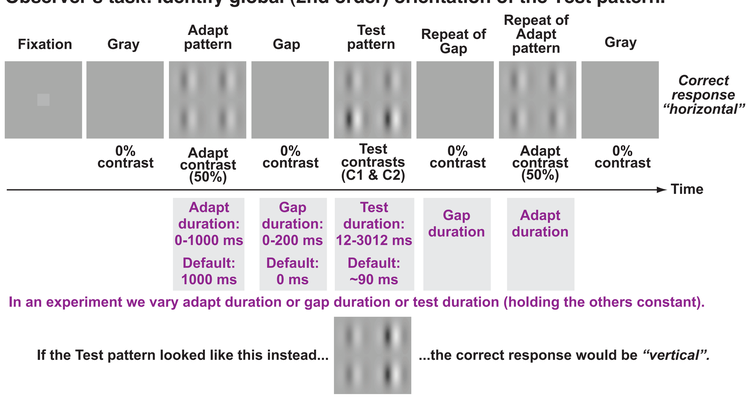
The Straddle Effect: **A Test pattern is difficult to perceive correctly when its contrasts STRADDLE (e.g. 45% and 55%) the Adapt contrast (e.g. 50%). A Test pattern is easy to perceive when both its contrasts are *just* ABOVE (e.g. 55% and 65%) or *just* BELOW (e.g., 35% and 45%) the Adapt contrast.**

The Straddle Effect is seen here as a notch at 50% in the curve of performance versus Average Test Contrast. All experimental results (middle column) that show a clear notch are on a background of pale yellow.

We explain the Straddle Effect with a contrast comparison process that registers magnitude but not sign of contrast change. We investigate its dynamics here.

The basic psychophysical trial

Observer's task: Identify global (2nd order) orientation of the Test pattern.



In an experiment we vary adapt duration or gap duration or test duration (holding the others constant).

If the Test pattern looked like this instead... ...the correct response would be *"vertical"*.

- |C1-C2| is the difference between the two Test contrasts, usually 10% here.
- A *Constant Difference Series* is a bunch of patterns in which |C1-C2| is constant, usually 10% here.
- *Average Test Contrast* = (C1+C2) ÷ 2.
- Feedback as to the correctness of the response always given.
- Each Gabor patch occupied a 1deg square at the viewing distance of 0.9m, with spatial frequency = 2 c/deg and full-width-at-half-height = 0.5 deg.
- Within a trial, all Gabor patches were vertical or all were horizontal.
- The 2x2 Gabor patches in the pattern were centered in a large field of gray.

SUMMARY

The Straddle Effect was well developed with an adapt duration of about 50 ms.

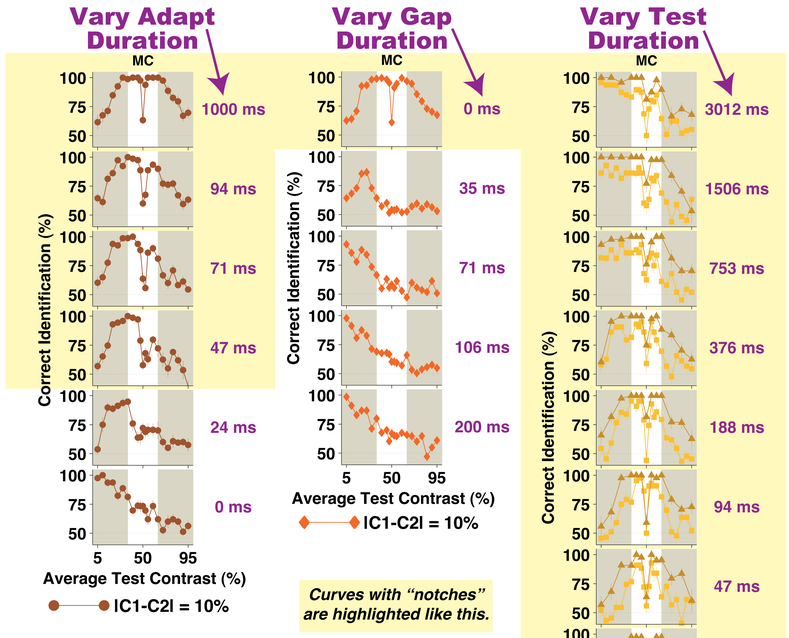
The effect was large with a gap duration of 0 ms and substantially diminished with a gap duration of about 50 ms.

It was found for test durations varying from 12 ms to several seconds.

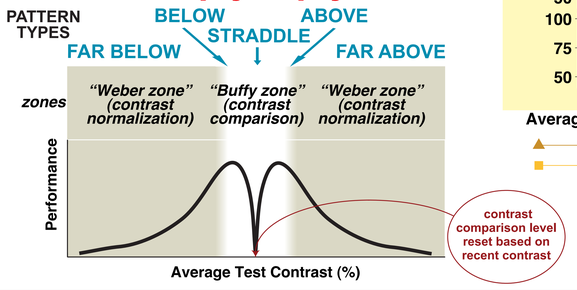
The psychophysical Straddle Effect may reflect the firing of On-Off neurons in areas like MT or even V1. Such neurons respond transiently and positively to both increases and decreases in contrast.

PSYCHOPHYSICAL RESULTS from one example observer

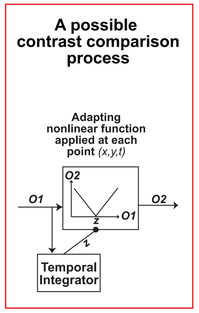
Each curve shows the results for a Constant Difference Series of patterns.

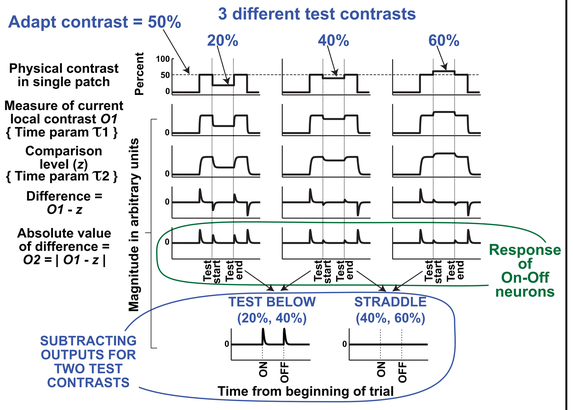


Schematic of psychophysical results

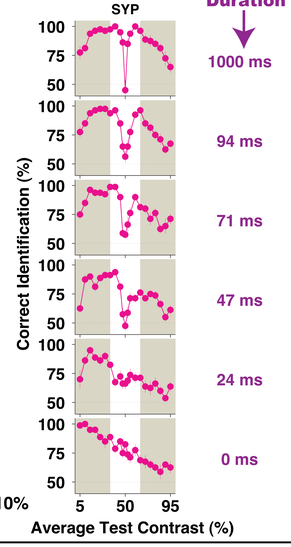


MODELING CONTRAST COMPARISON DYNAMICS





More results



Predictions