Kanizsa Square Without Pacmen Created by Selective Edge Adaptation

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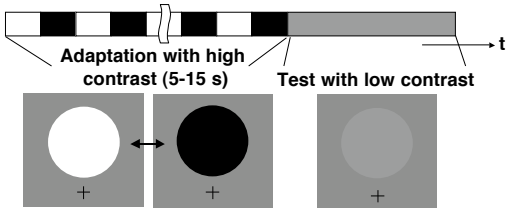
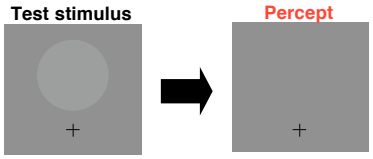
Introduction

High-contrast edge adaptation

(Shimojo & Kamitani, VSS 2001)



Alternation (white <-> black, 1Hz) to cancel/reduce the afterimage

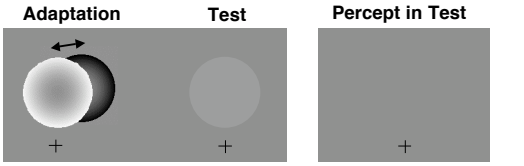


No disk; filled with the background
(invisible for 5-10 s after 10 s adaptation)

Adaptation to a high-contrast stimulus leads to invisibility of a low-contrast stimulus at the same location.

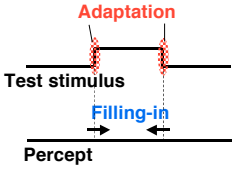
Simply due to contrast adaptation?

Adaptation of edge only

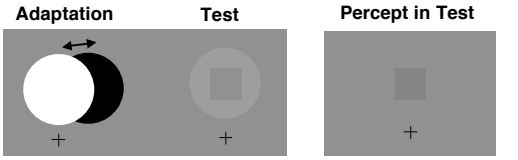


Adapting stimuli whose luminance changes only around the edge (no change in the center) leads to the same effect.

Adaptation of edges, not of overall contrast, is critical (loss of edge signal -> filling-in; cf. Grossberg & Mingolla, 1985).

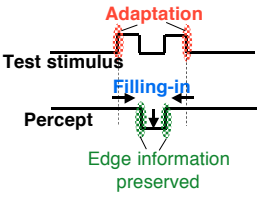


Brightness illusion by edge adaptation

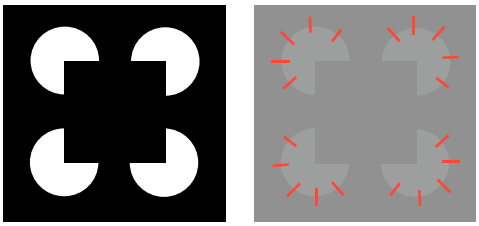


Only the square is visible after selective adaptation of the outer edge.

The square appears darker than the background, even though they have the same luminance.



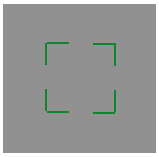
Phenomenology



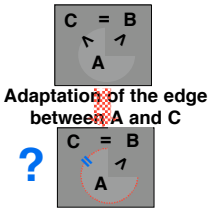
Apply edge adaptation to part of the edges (the arches) in the Kanizsa square.

Questions

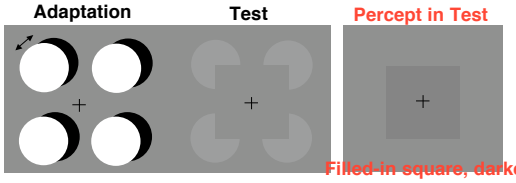
Are the unadapted edges (the corners of the "square") sufficient to produce an illusory surface?



Partial adaptation/inhibition of an edge could lead to an "impossible" relation of brightness. How does vision deal with it?

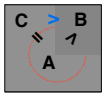


Kanizsa square without Pacmen

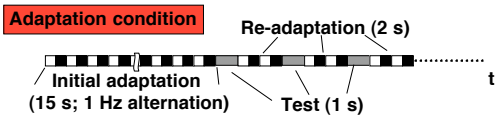


An Illusory square/surface is perceived without Pacmen.

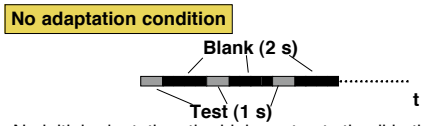
The whole surface appears darker than the background (B < C). The original Kanizsa square is known to induce similar brightness difference (Kanizsa, 1955). Which is stronger?



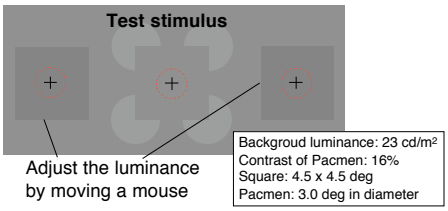
Experiments: *measure brightness induction*



After long initial adaptation, short test and re-adaptation periods alternated to maintain the illusory percept.



No initial adaptation; the high-contrast stimuli in the adaptation condition were replaced by a blank screen.

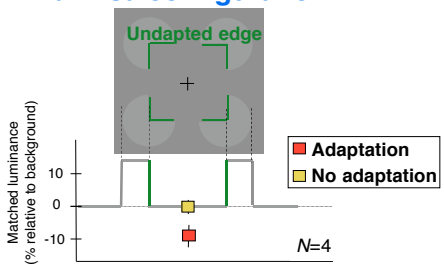


Task: Adjust the luminance of the flanking squares to match with the brightness of the illusory surface (based on the brightness around the center of the squares). Test and re-adaptation (or blank) were repeated until the subject completed the matching.

Two squares were presented, just to avoid possible eye movements to one side.

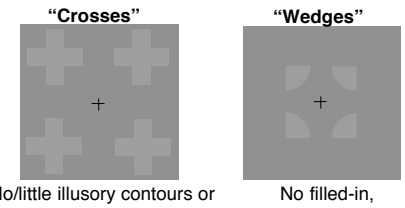
5 trials were repeated for each condition.

Brightness induction in the standard Kanizsa configuration



Brightness induction is stronger when Pacmen are invisible (**Adaptation**) than when visible (**No adaptation**). The effect in the original Kanizsa square is almost undetectable with this method.

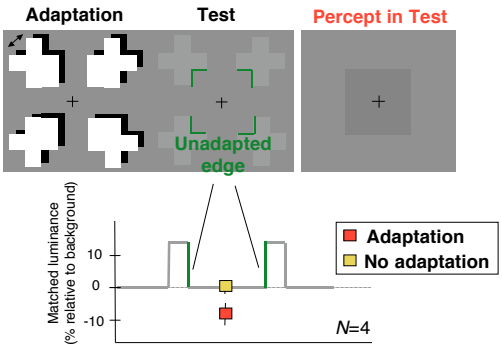
Test stimuli producing no illusory surface by themselves



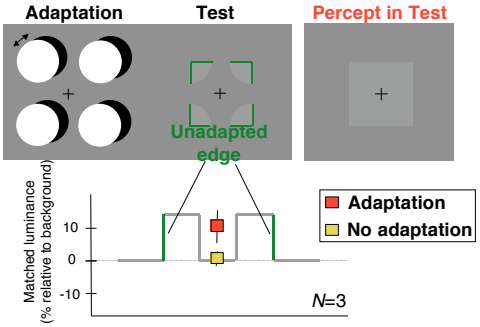
No/little illusory contours or surface (Kanizsa, 1955).

No filled-in, homogeneous surface

The same unadapted edges lead to an illusory surface, regardless of difference in other (adapted) edges?

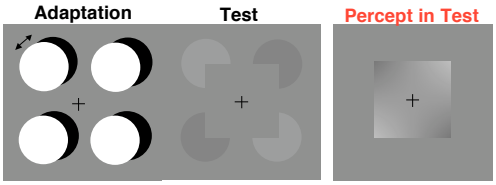


An illusory surface, which is not seen in the test stimulus alone, is formed by leaving the edges for the “corners” unadapted.



A filled-in surface is created by adaptation of the inner edges (not as completely filled as others though). The surface is brighter in this case, since the unadapted edges are brighter inside.

Gradual brightness induction: An observation (see demo)



The test stimulus have both darker and brighter Pacmen.

They create a surface with gradual brightness change, consistent with the signs of the edges (which side is brighter/ darker). But why not gradual brightness change in the background?

Summary and Conclusion

By applying edge adaptation to part of the edges of the Kanizsa square, an illusory surface, which does not accompany Pacmen, can be created.

The edge adaptation led to even stronger brightness induction than in the original Kanizsa square.

A similar illusory surface can be created by leaving the same edges unadapted, even in test stimuli which do not induce an illusory surface by themselves.

The results suggest that visual surfaces can be formed based on local edges and filling-in process between them, rather than global luminance profiles, or spatial context of visual shapes. Selective edge adaptation may unmask the potential ability of edges to form global, filled-in surfaces.