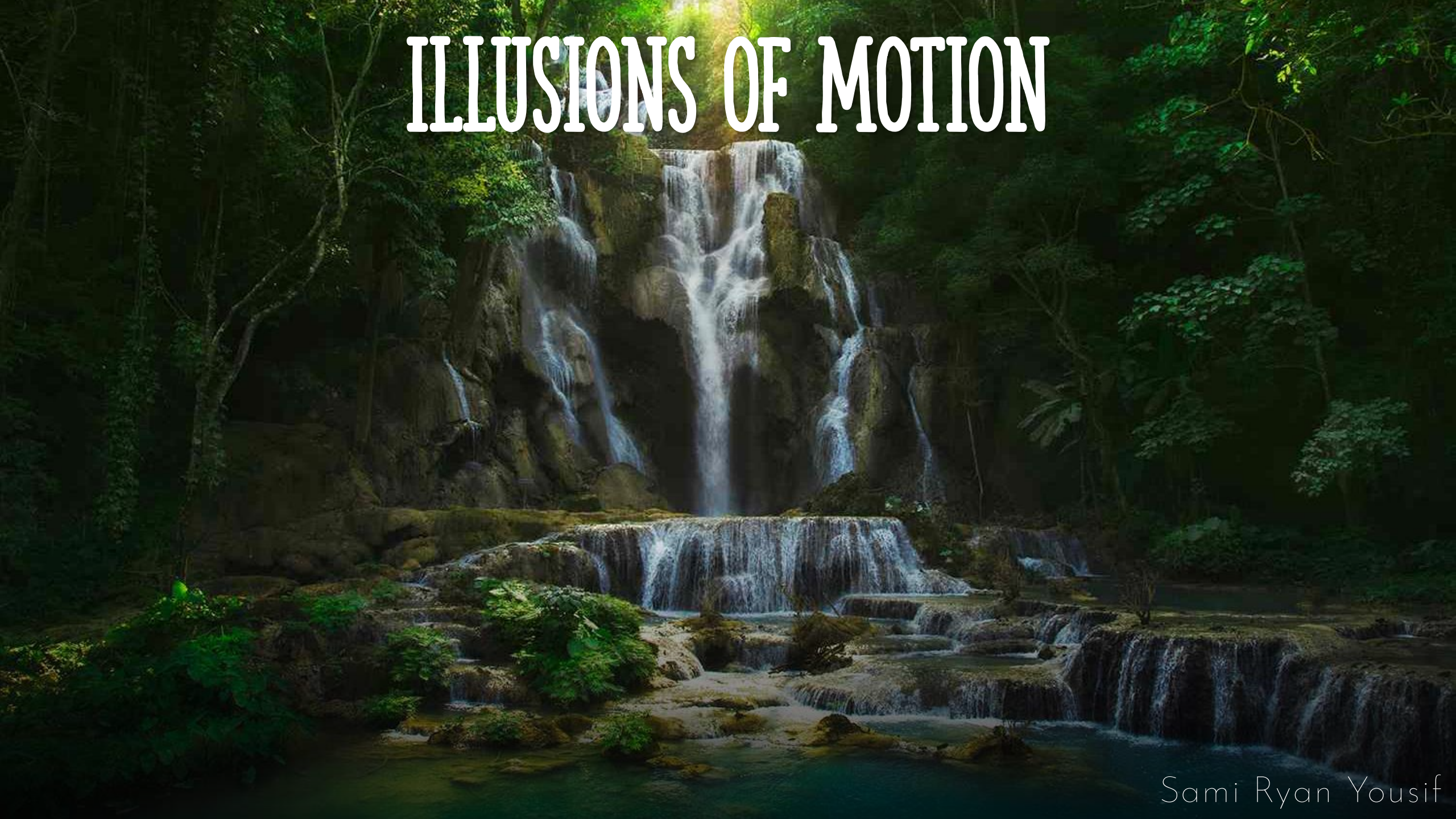
ILLUSIONS OF MOTION

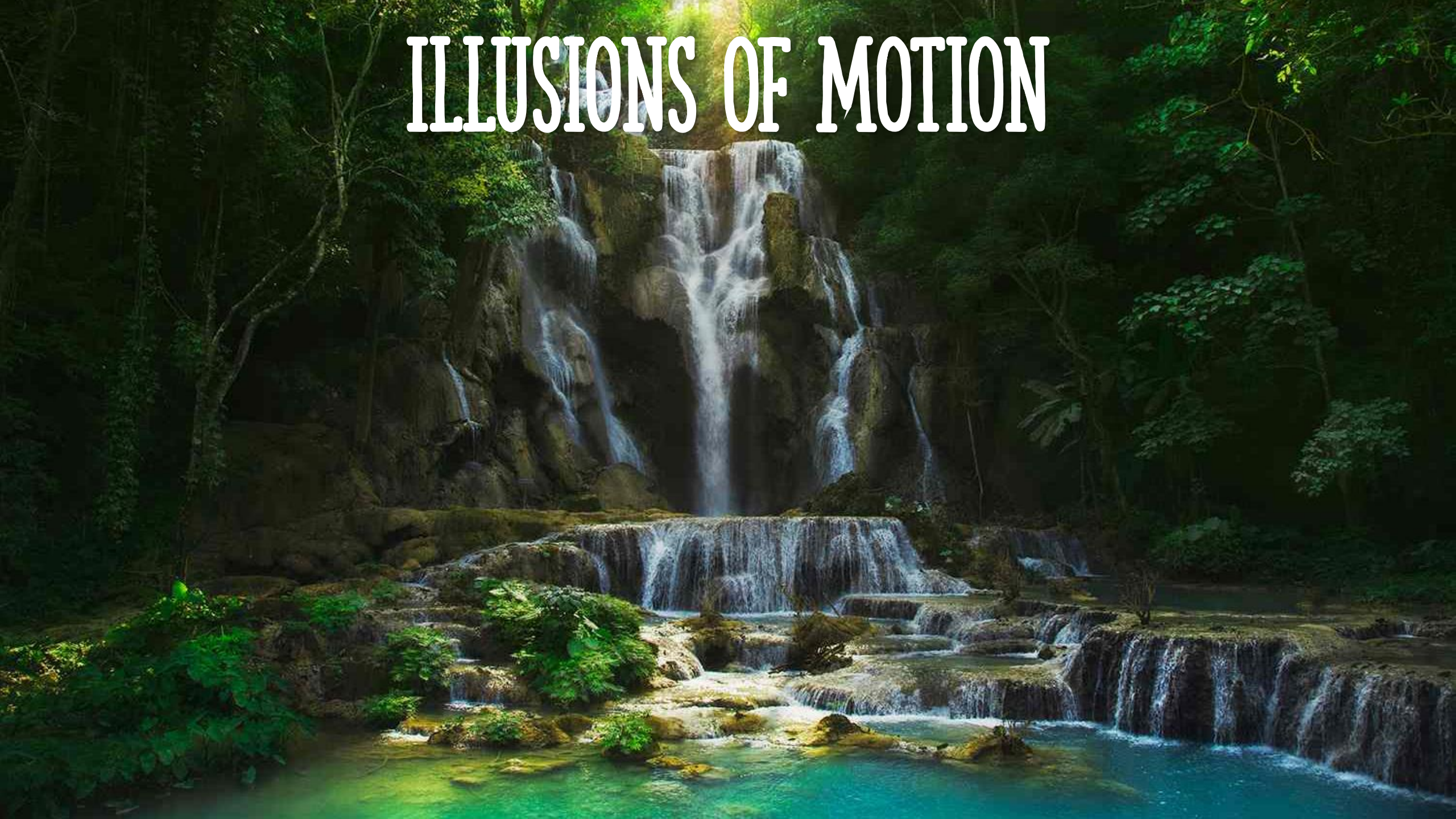


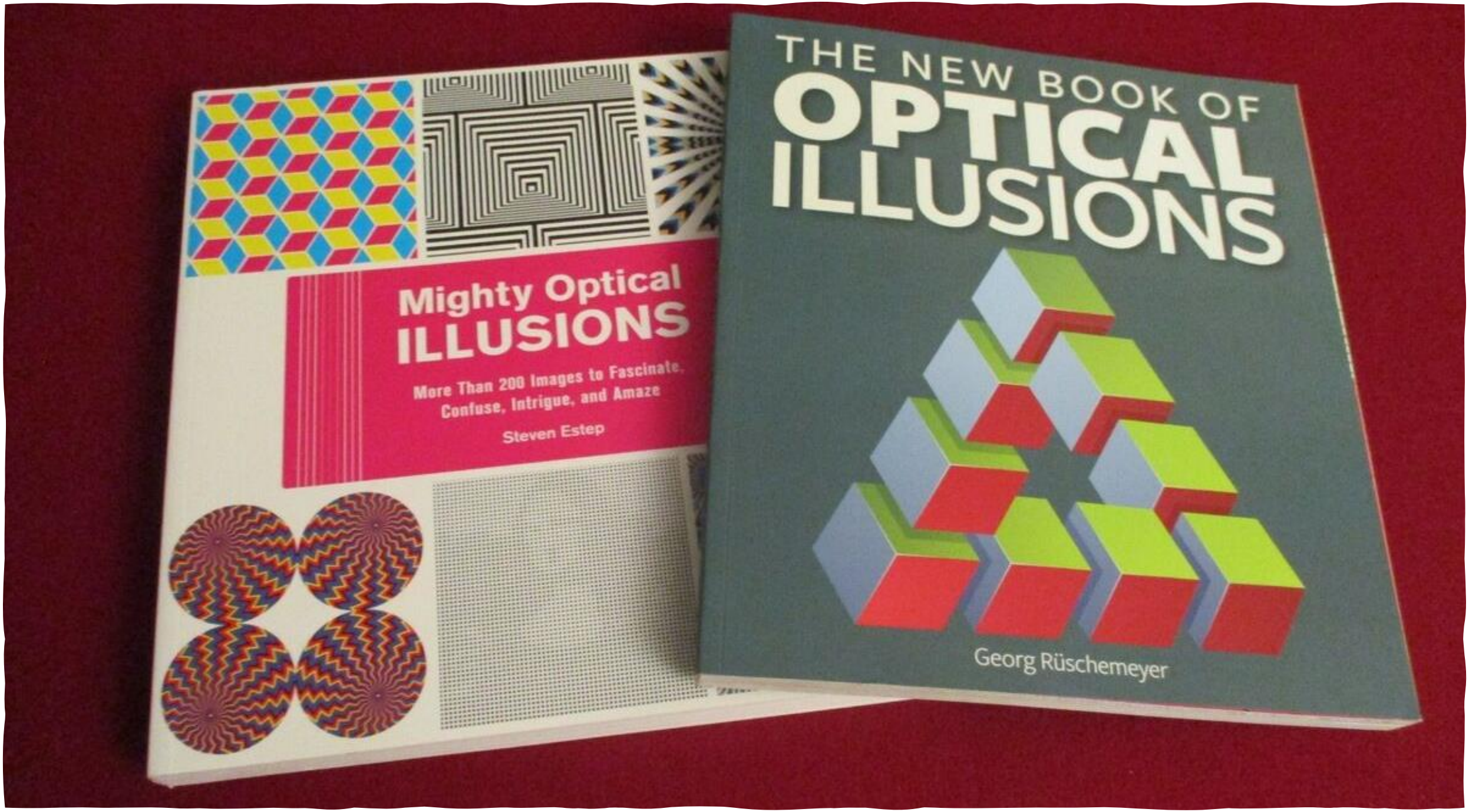
Sami Ryan Yousif

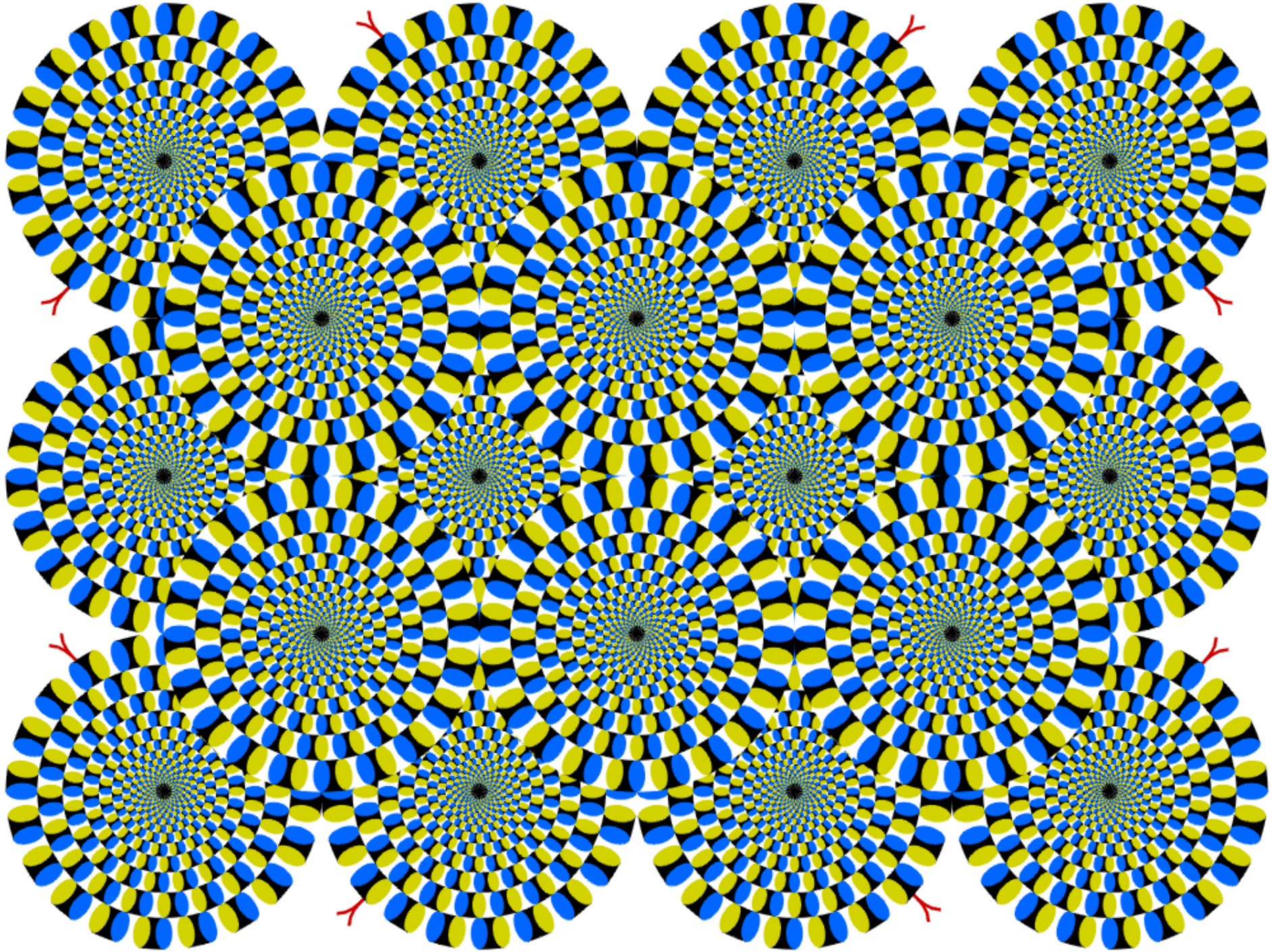
Before we begin: I need your input!

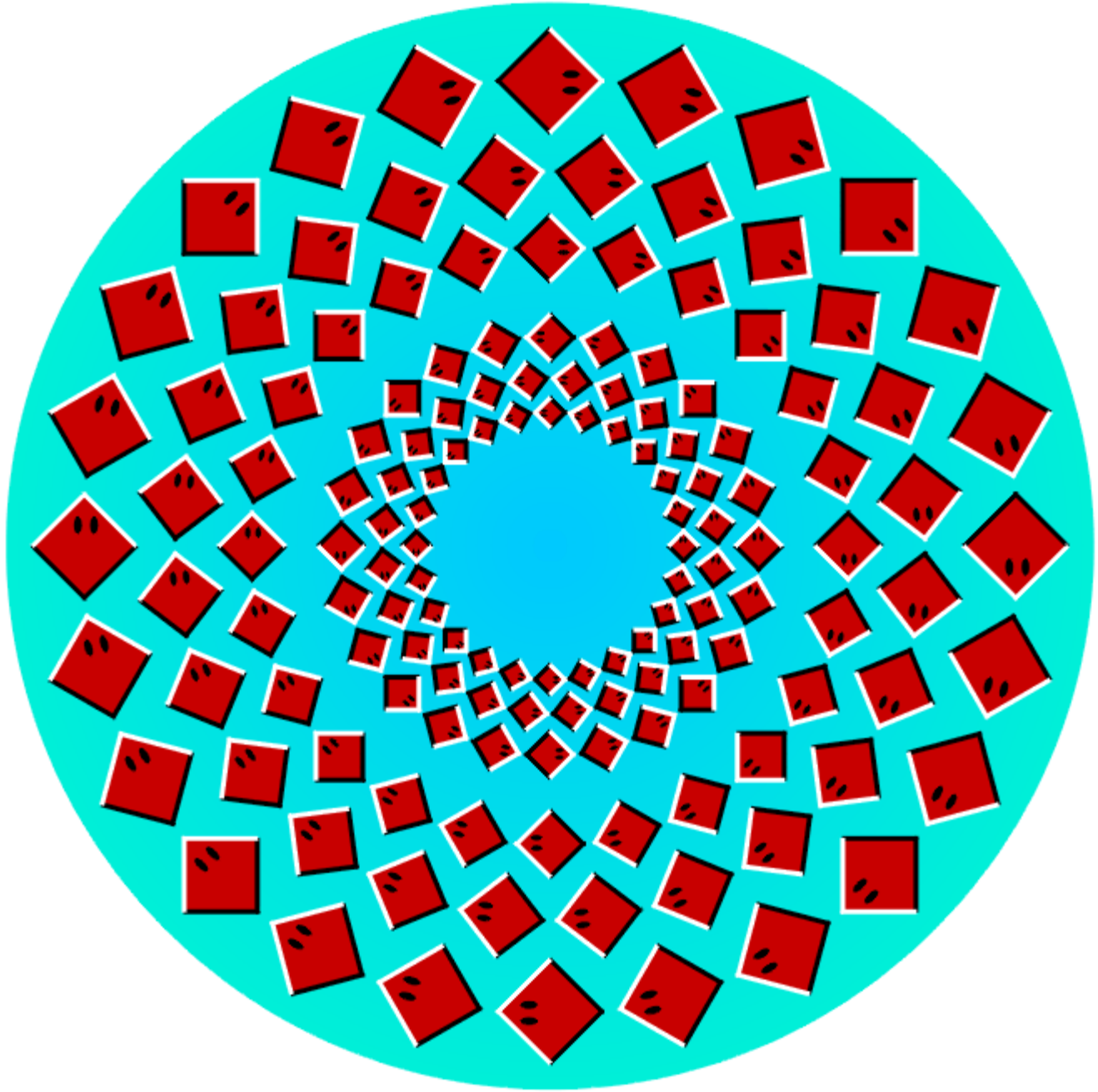
How should we handle missed material?

ILLUSIONS OF MOTION



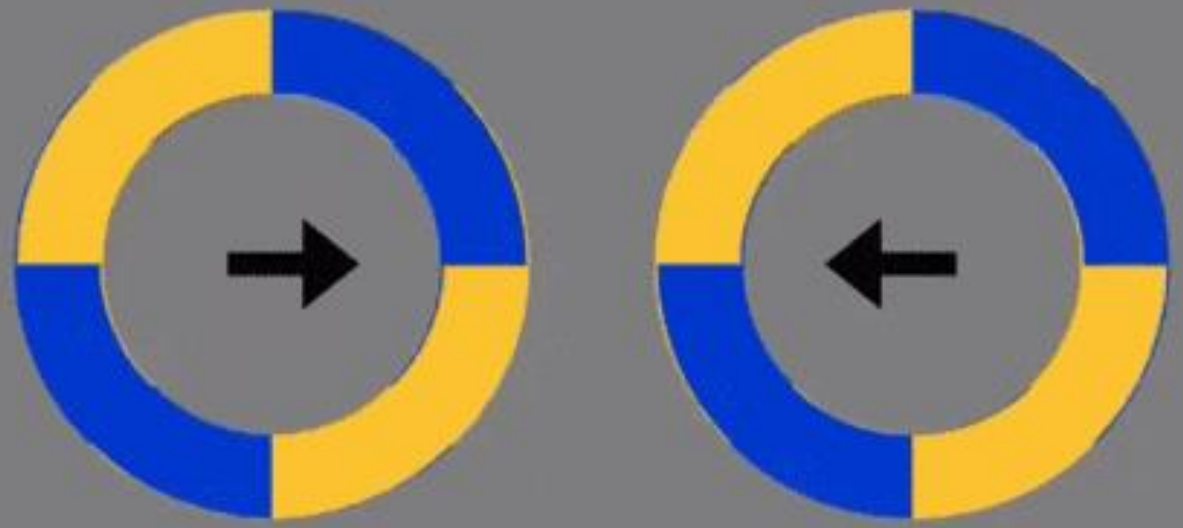

Mighty Optical
ILLUSIONS
More Than 200 Images to Fascinate, Confuse, Intrigue, and Amaze
Steven Estep
THE NEW BOOK OF
OPTICAL
ILLUSIONS
Georg Rüschemeyer



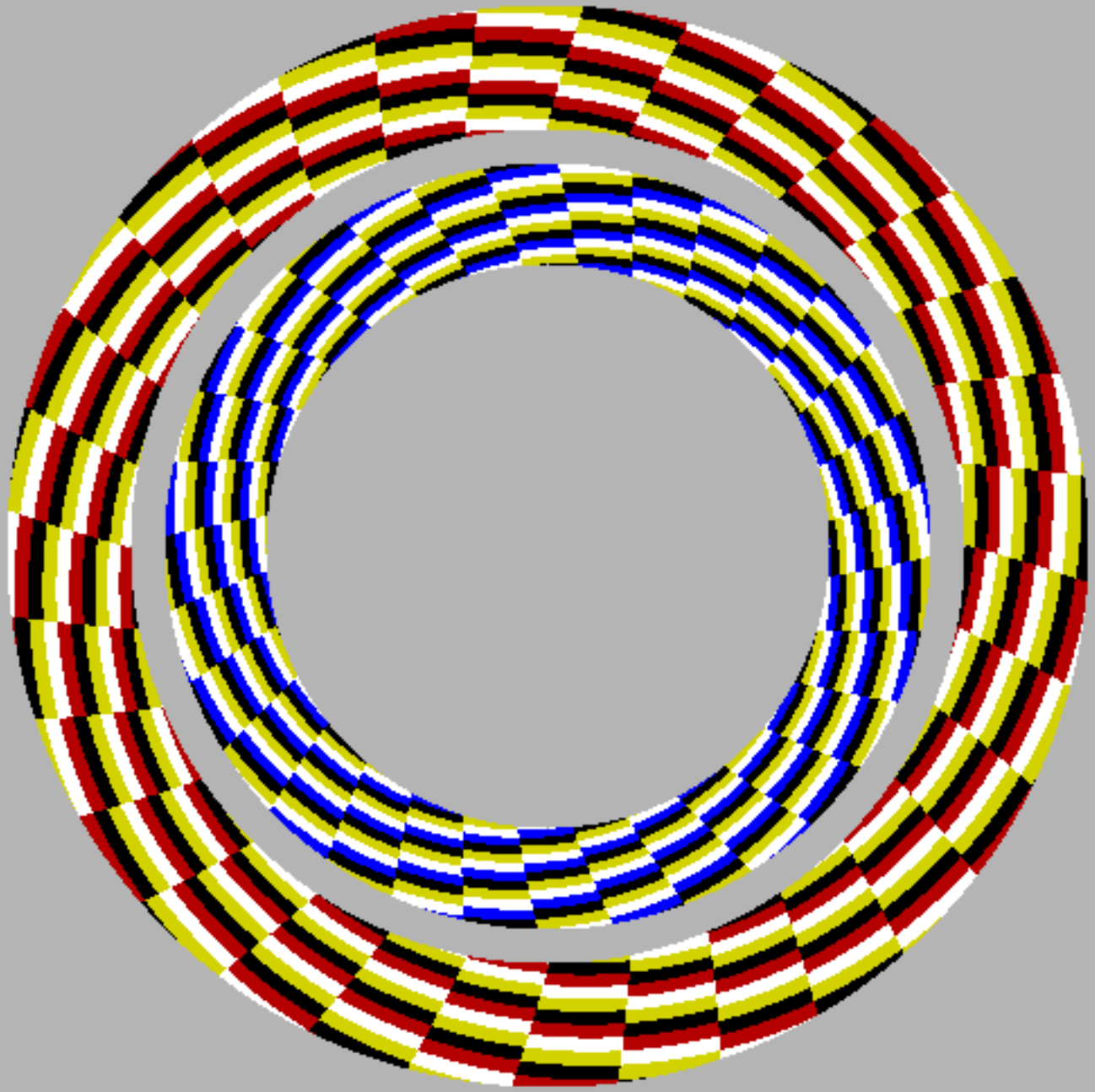


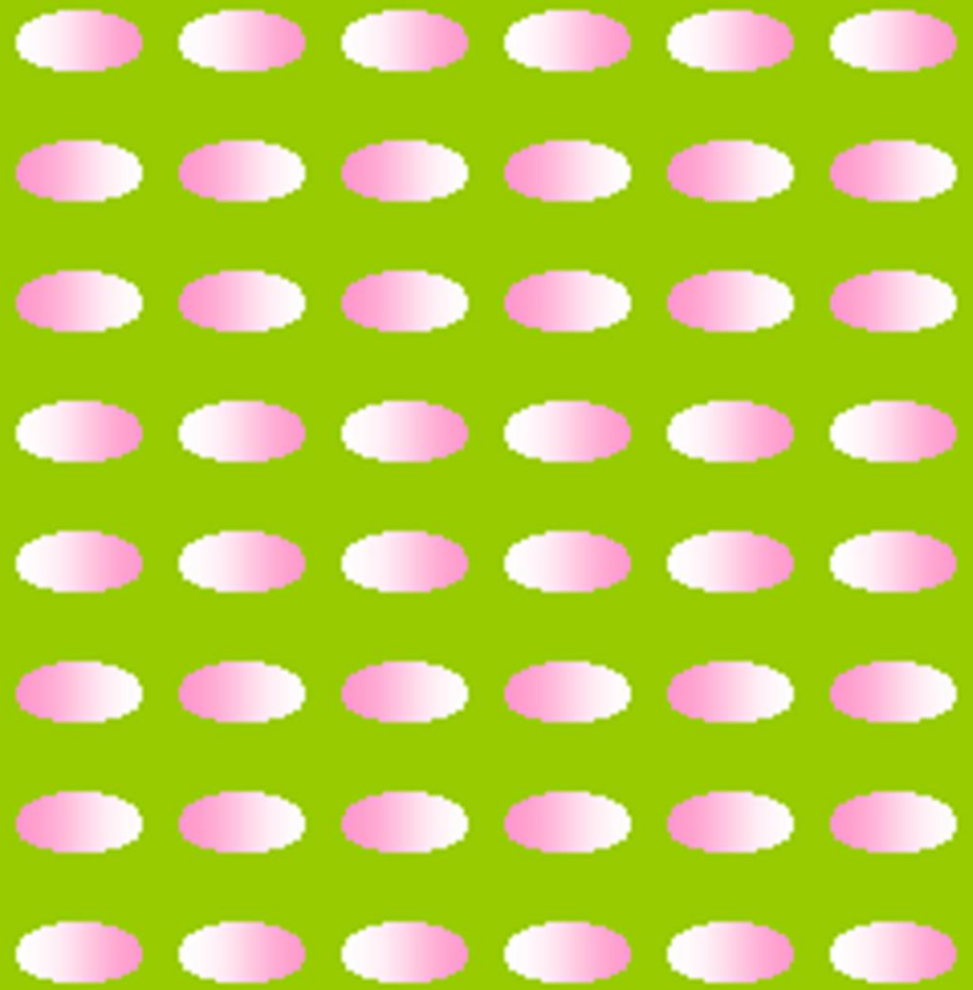
Why?

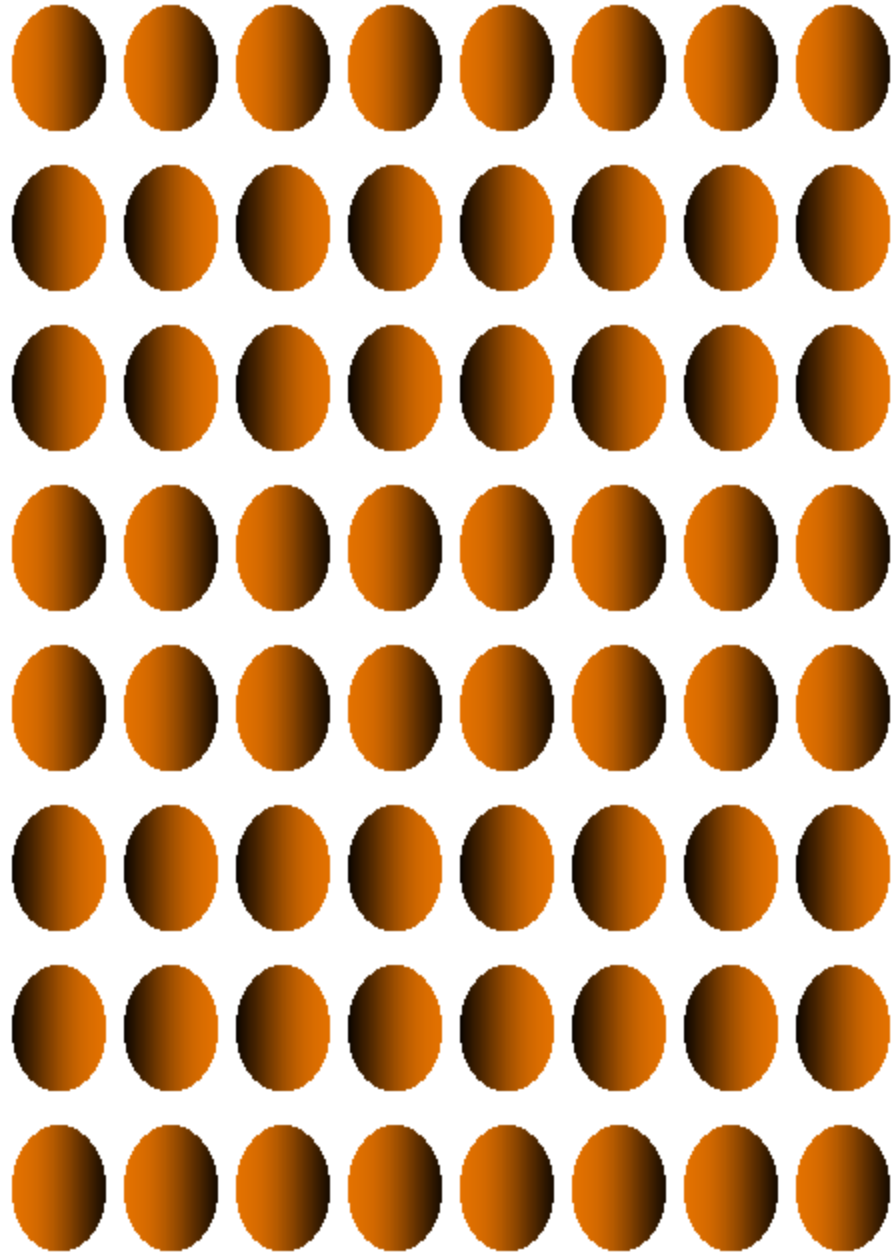
!!

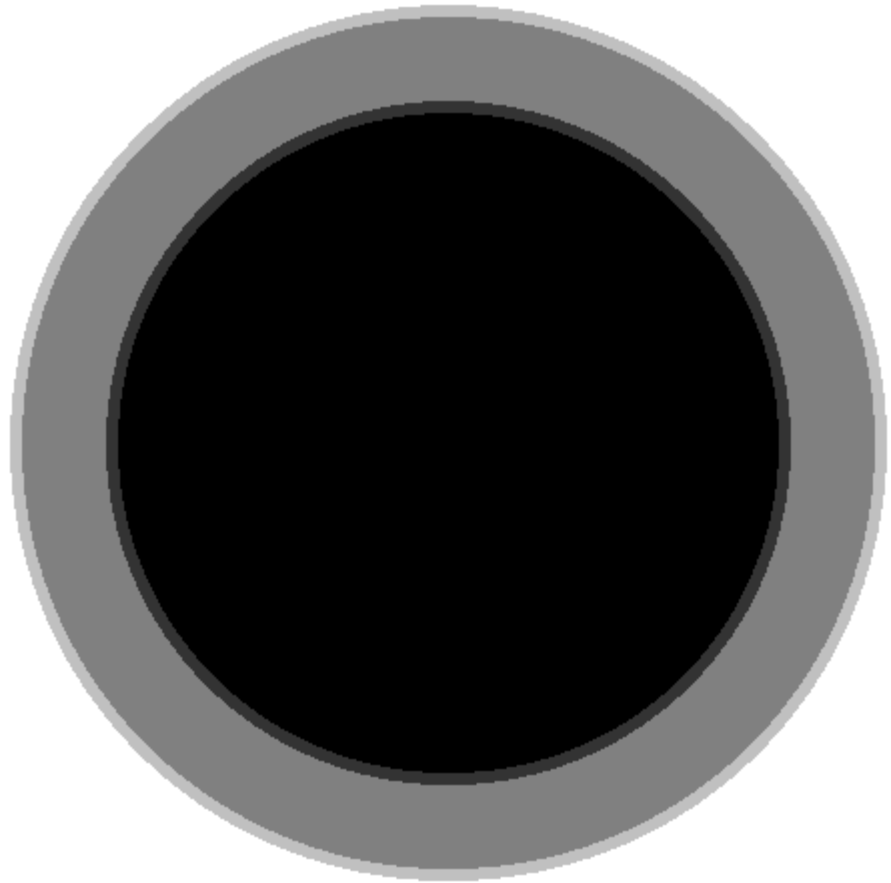


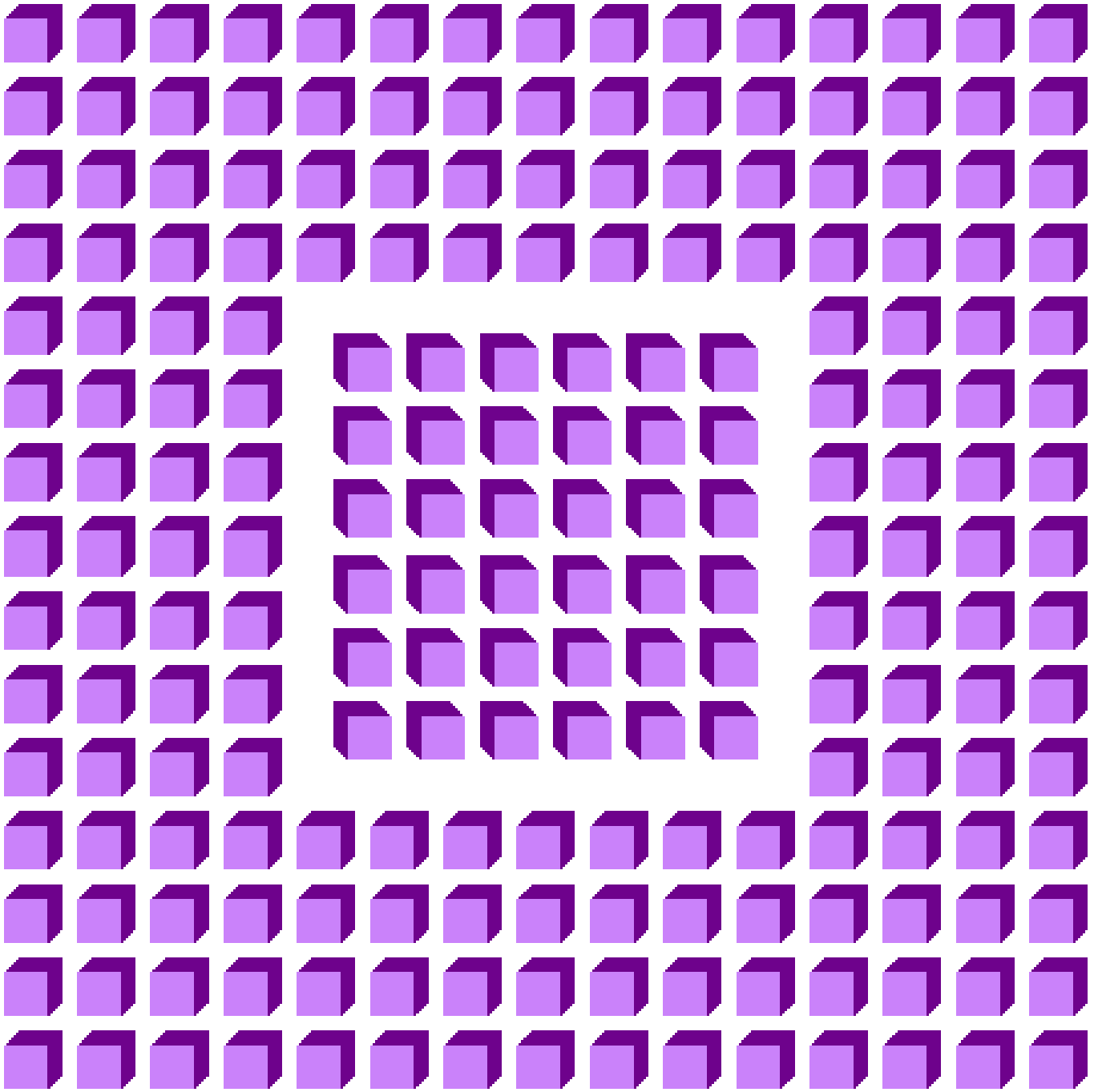
Akiyoshi Kitaoka

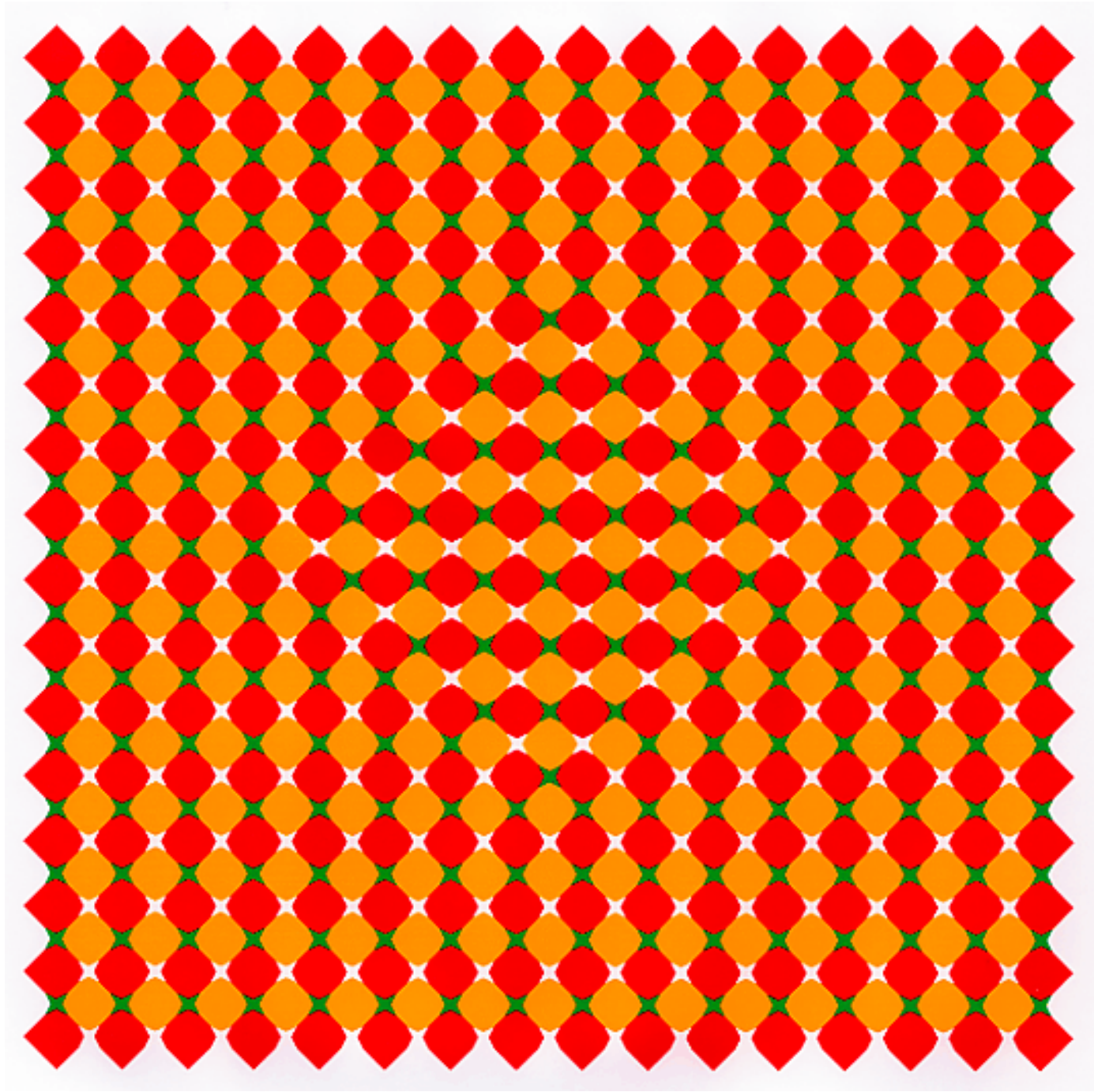


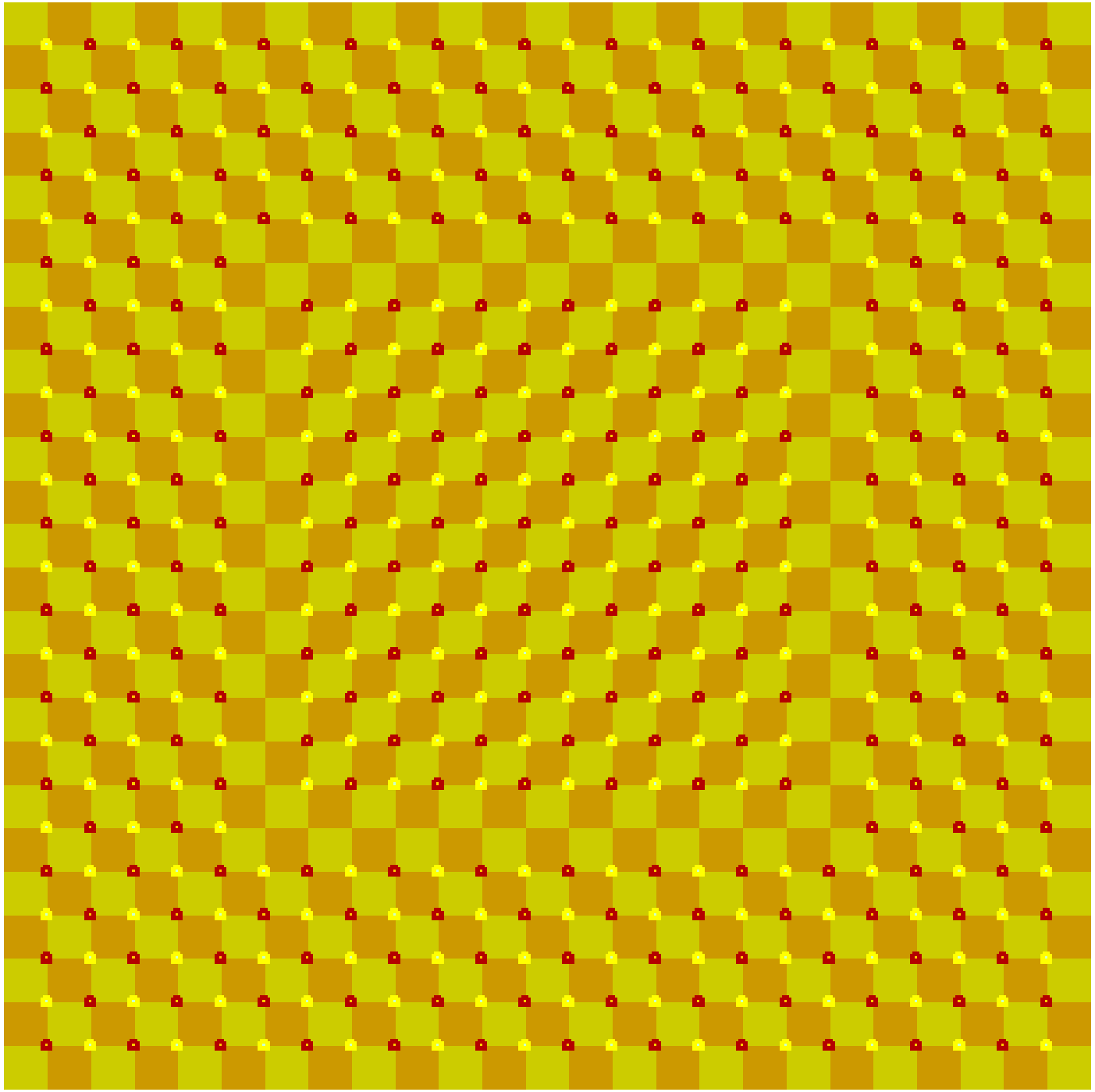


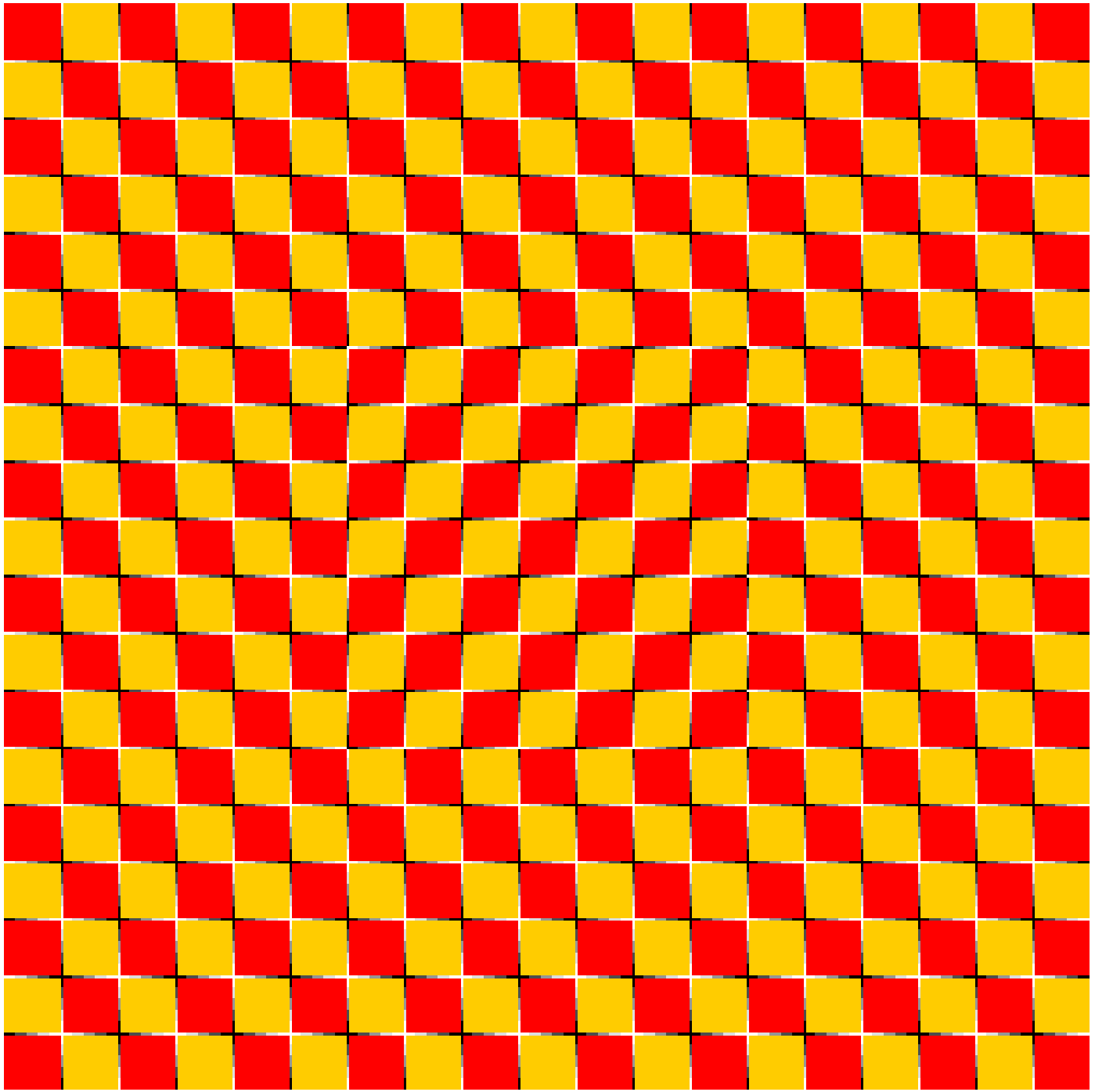


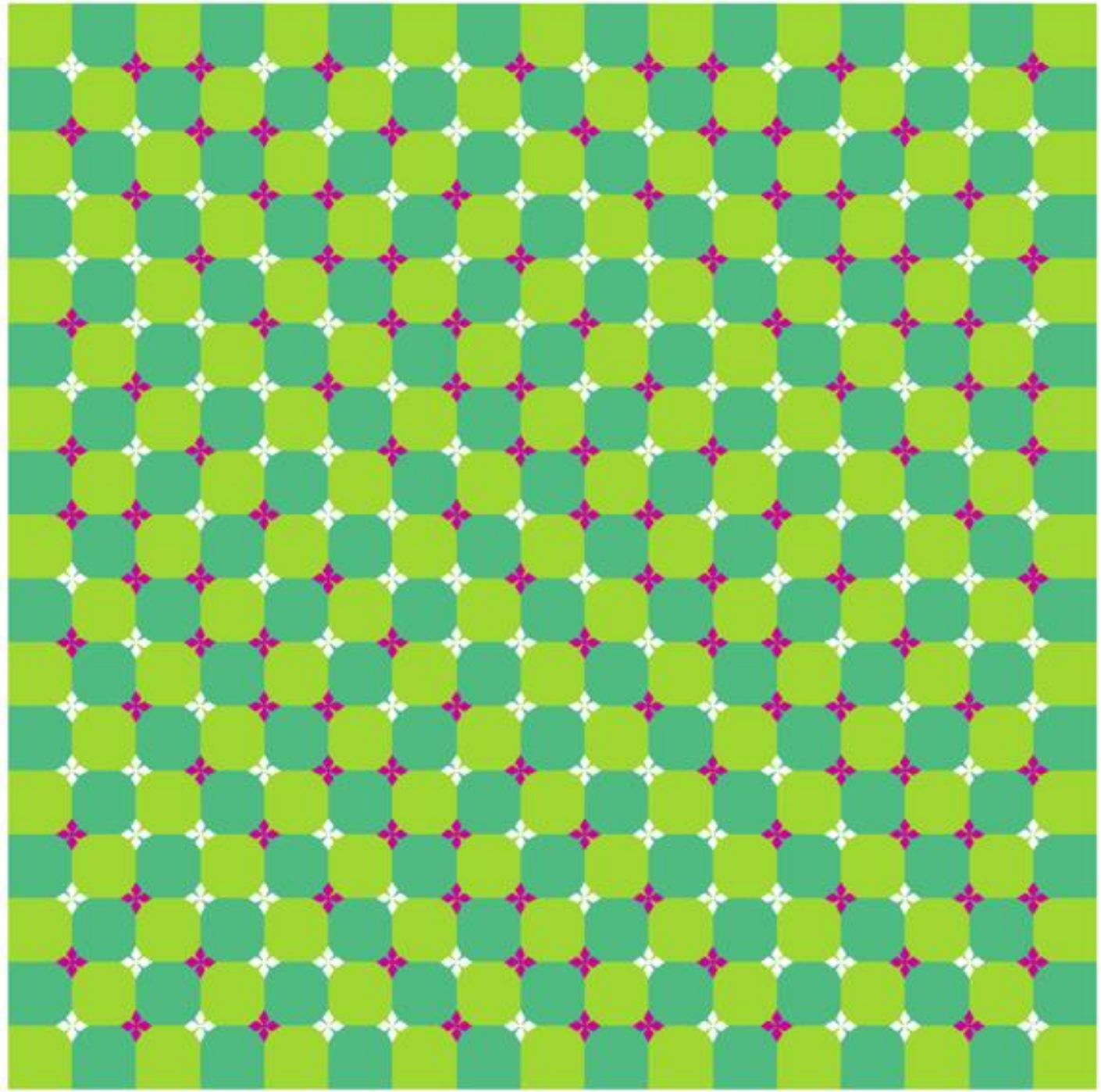


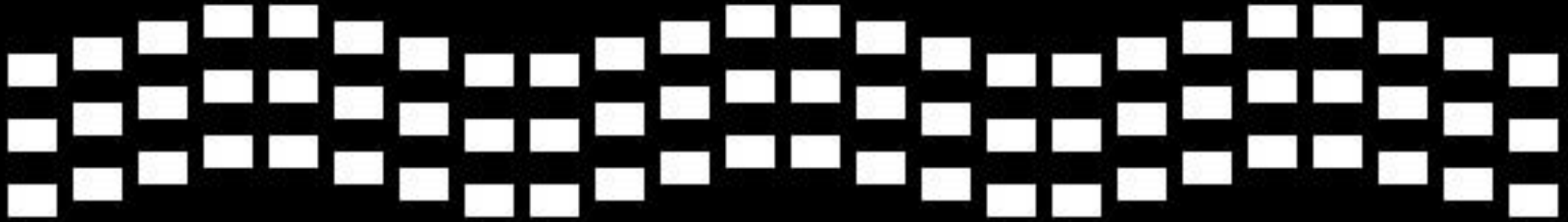


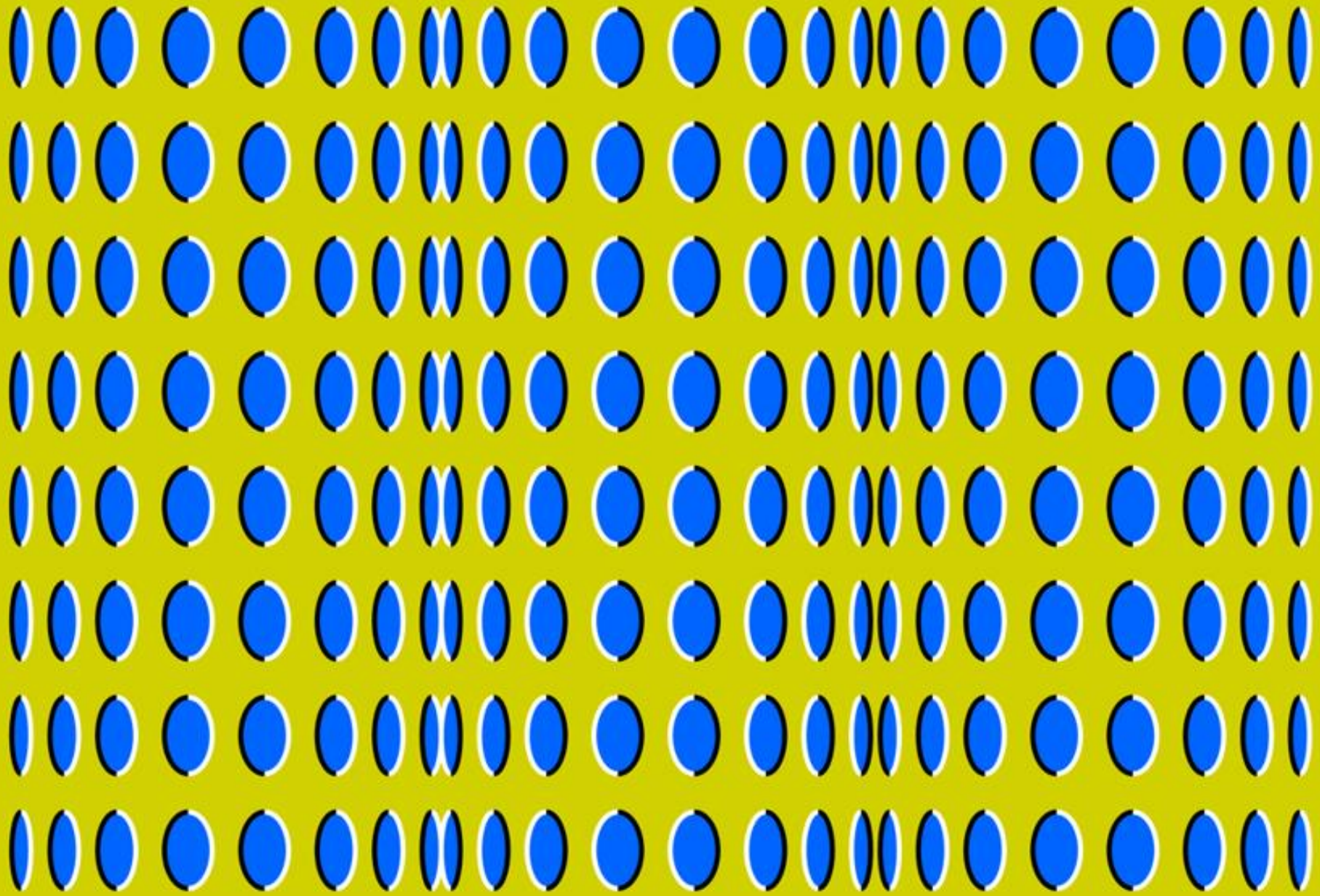


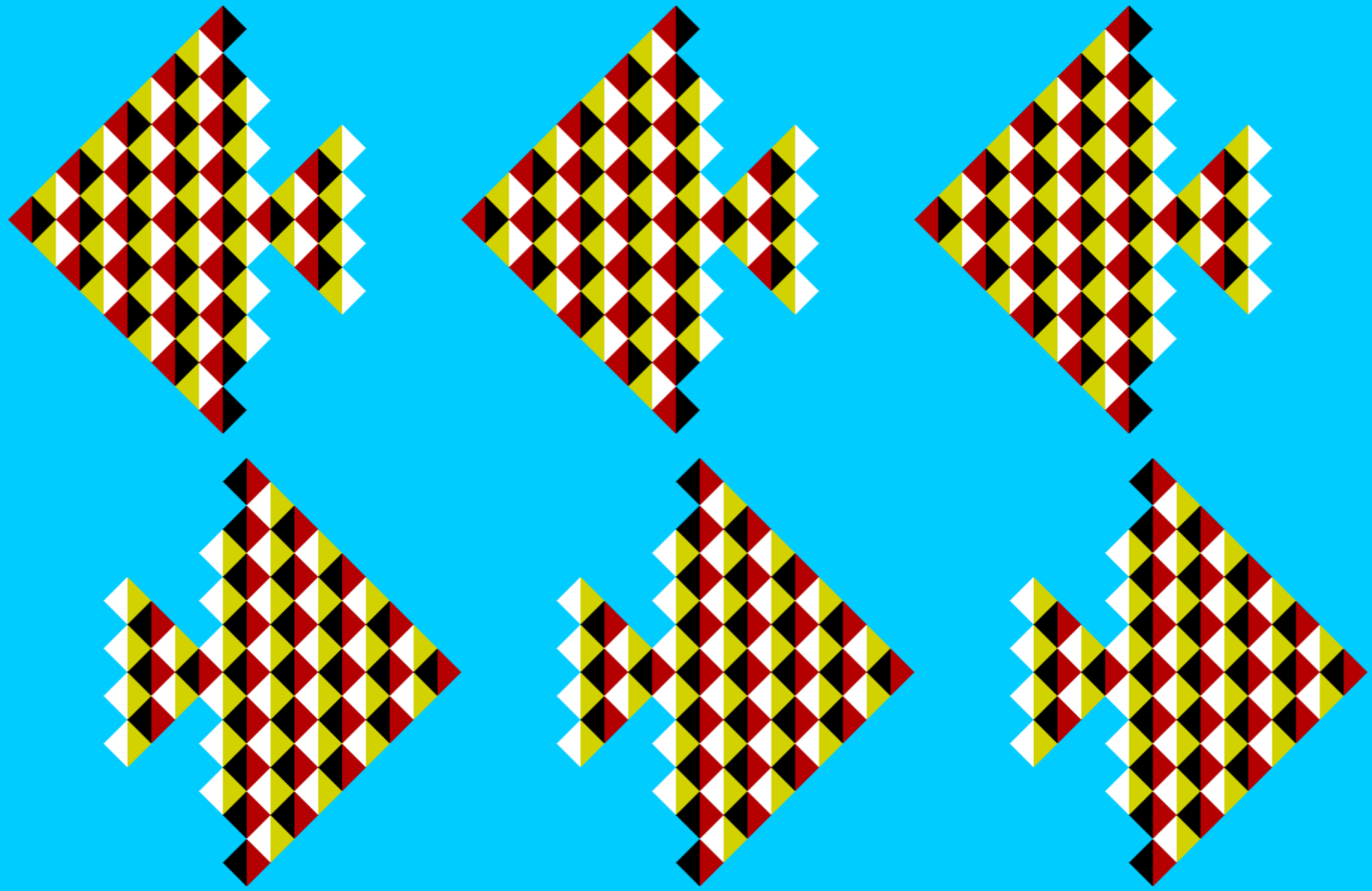


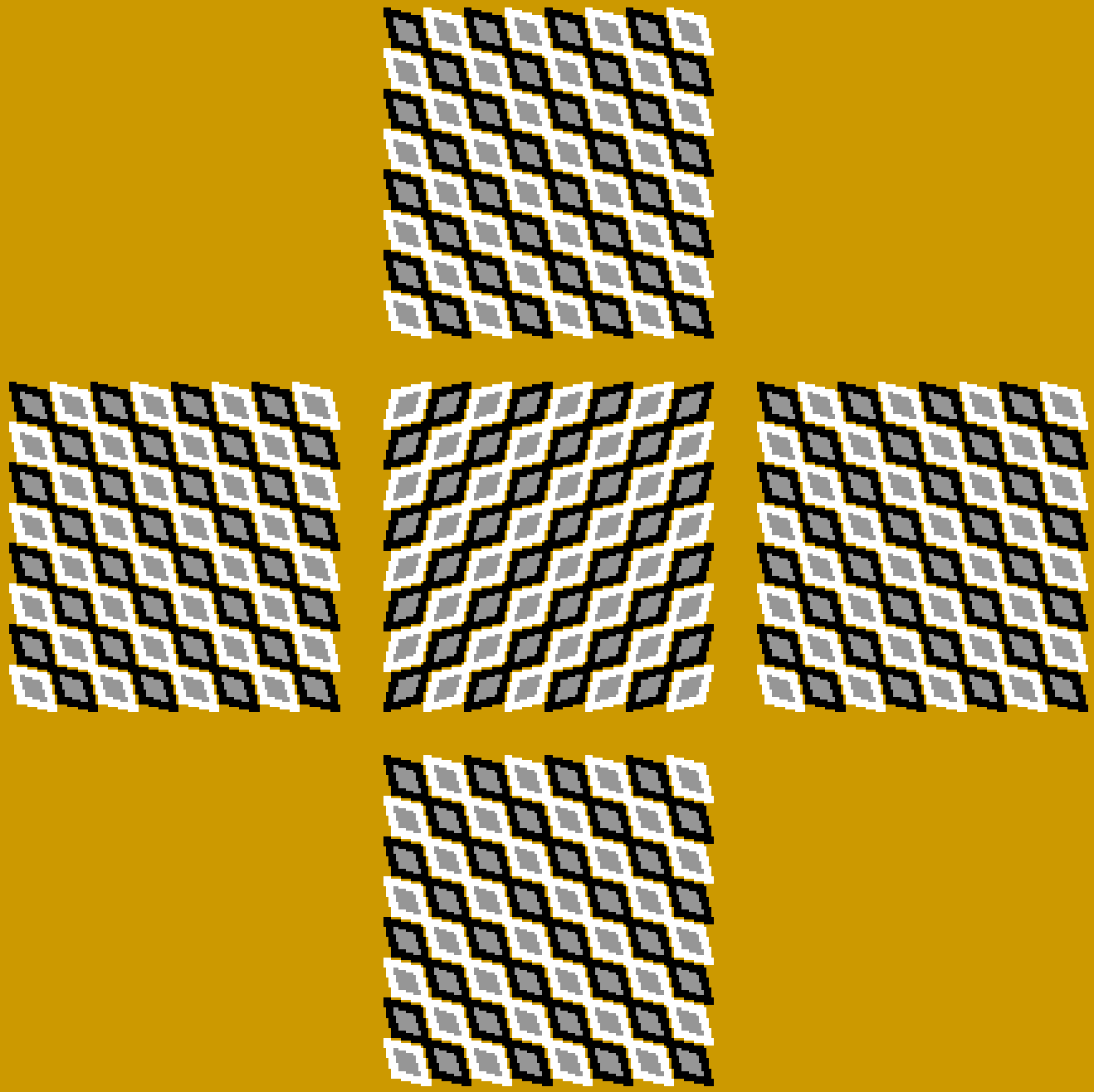


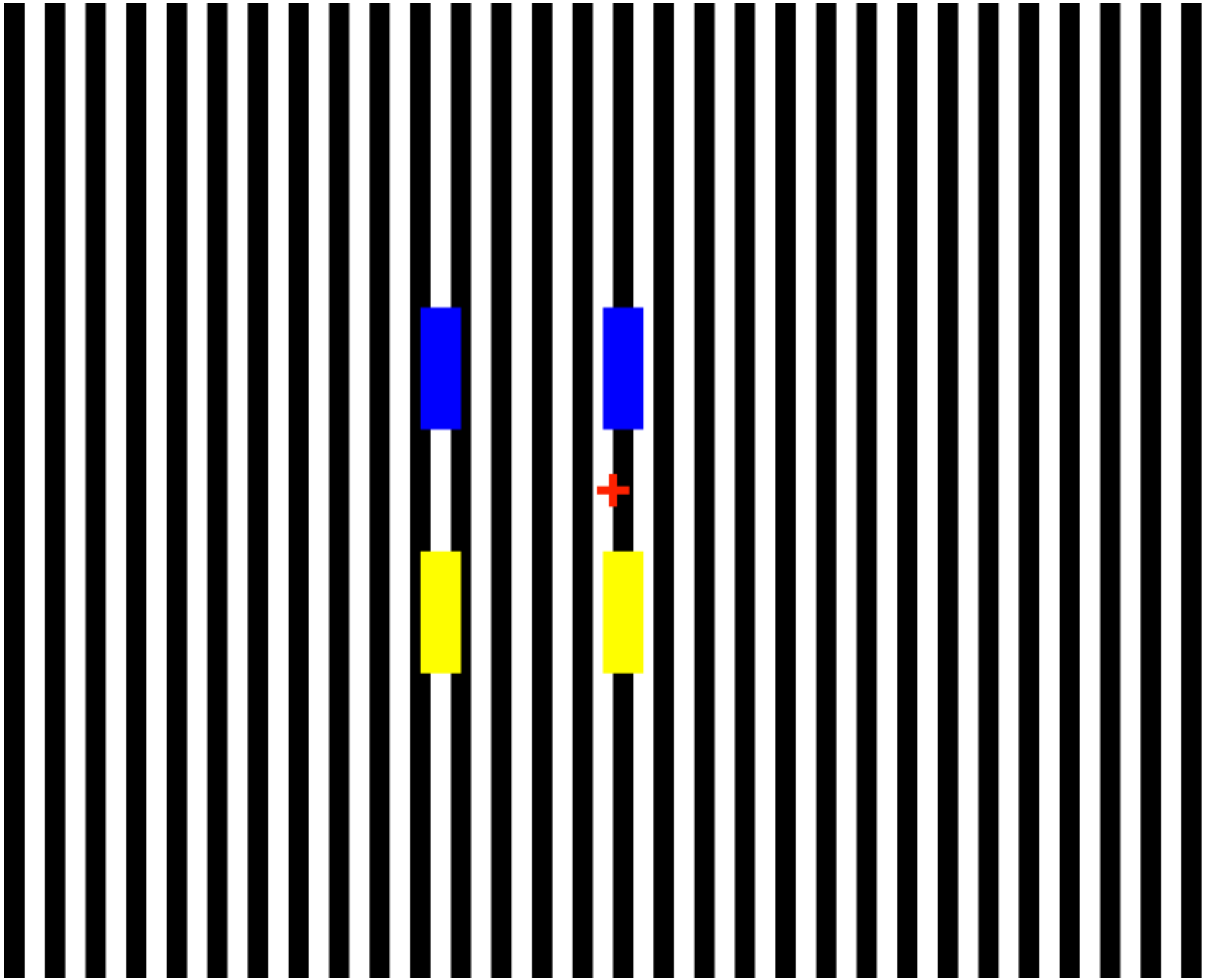


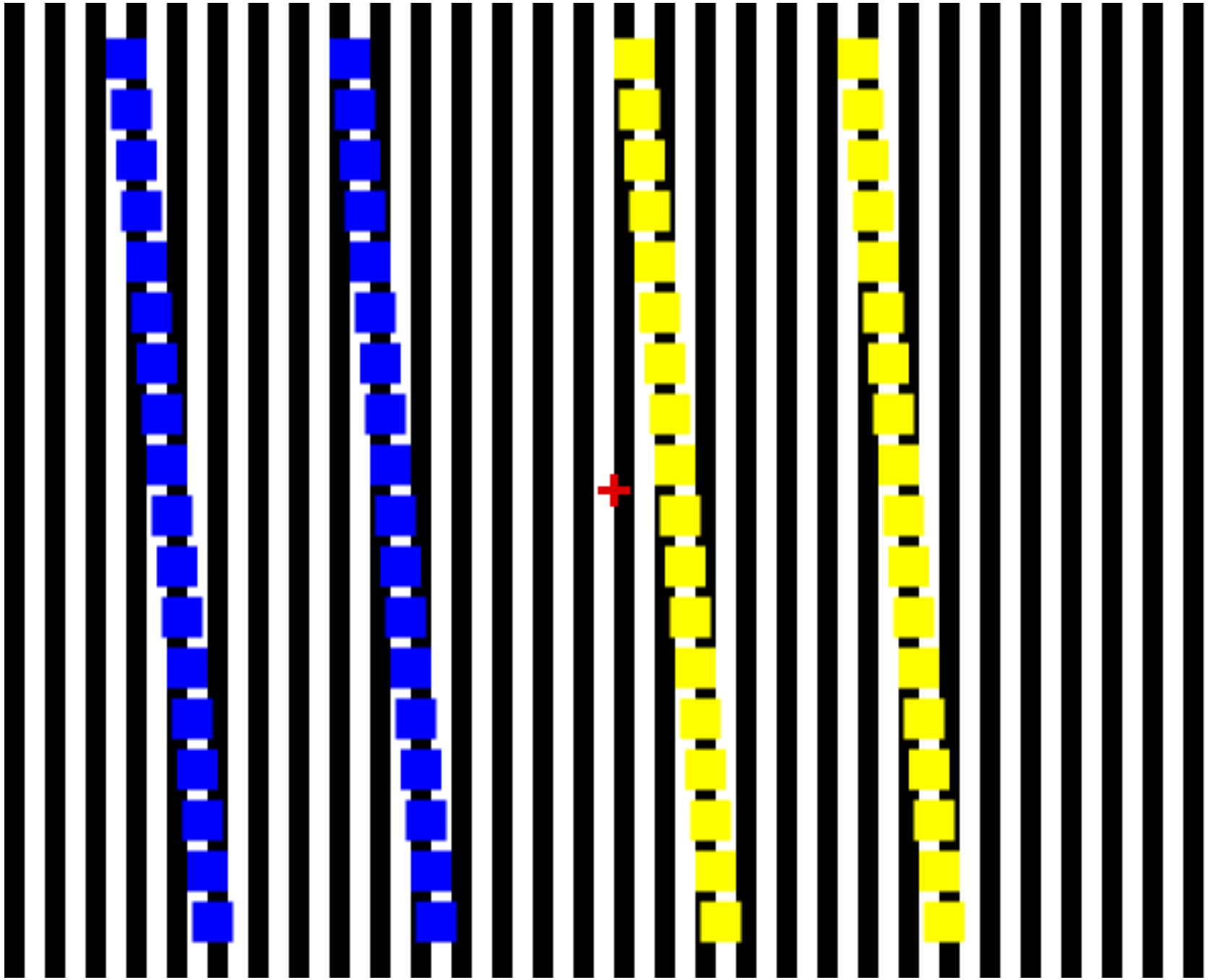


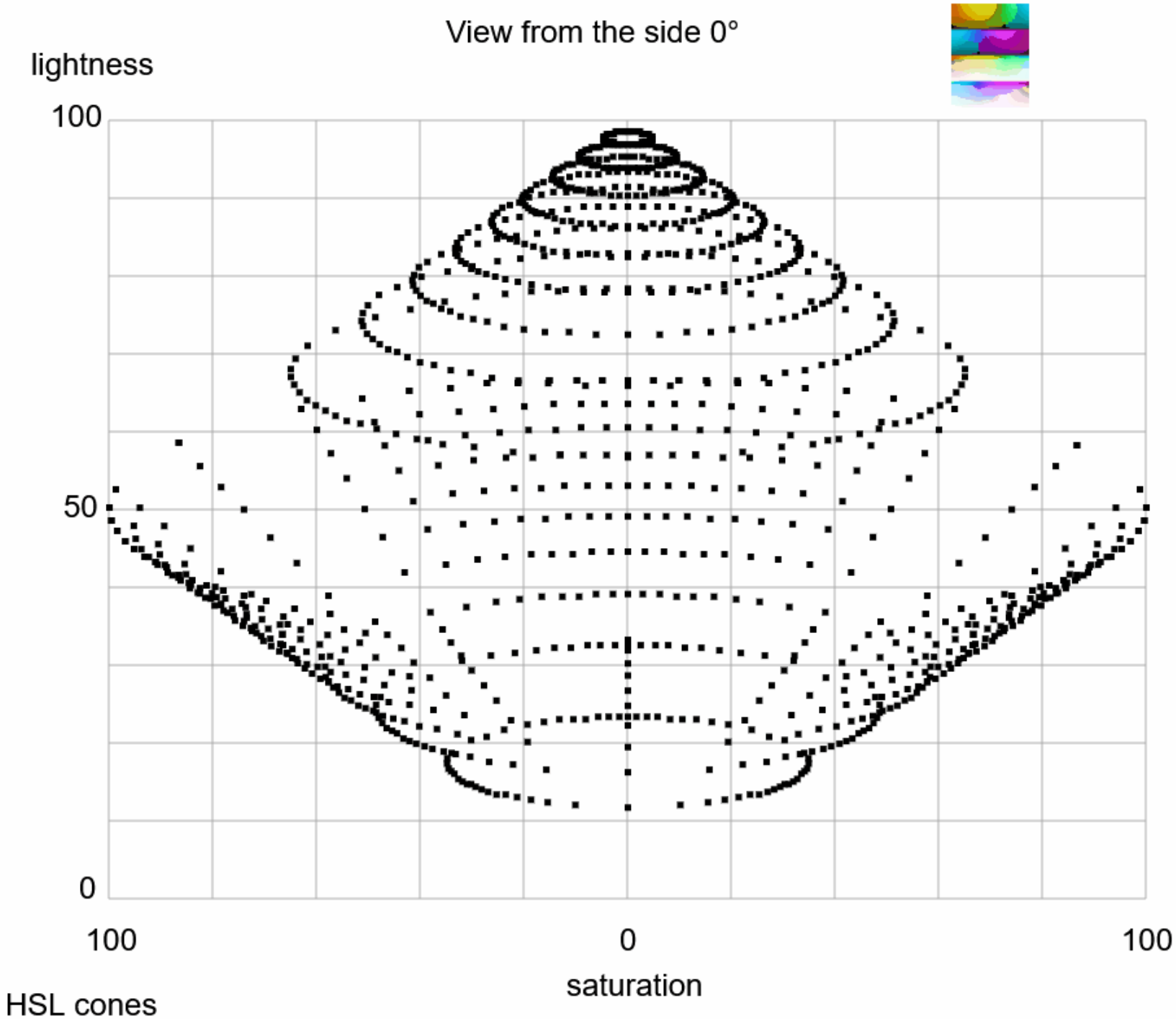




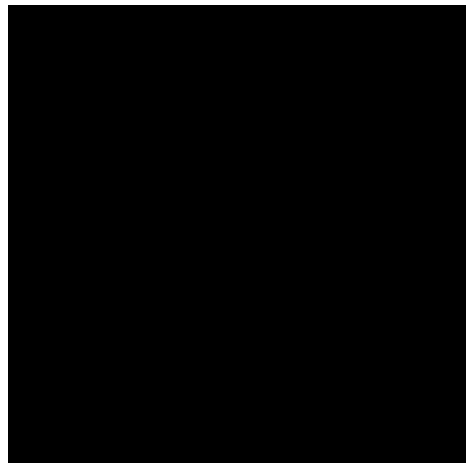







View from the side 0°
lightness
100
50
0
100
0
100
saturation
HSL cones

Illusions of motion also occur naturally!



!!

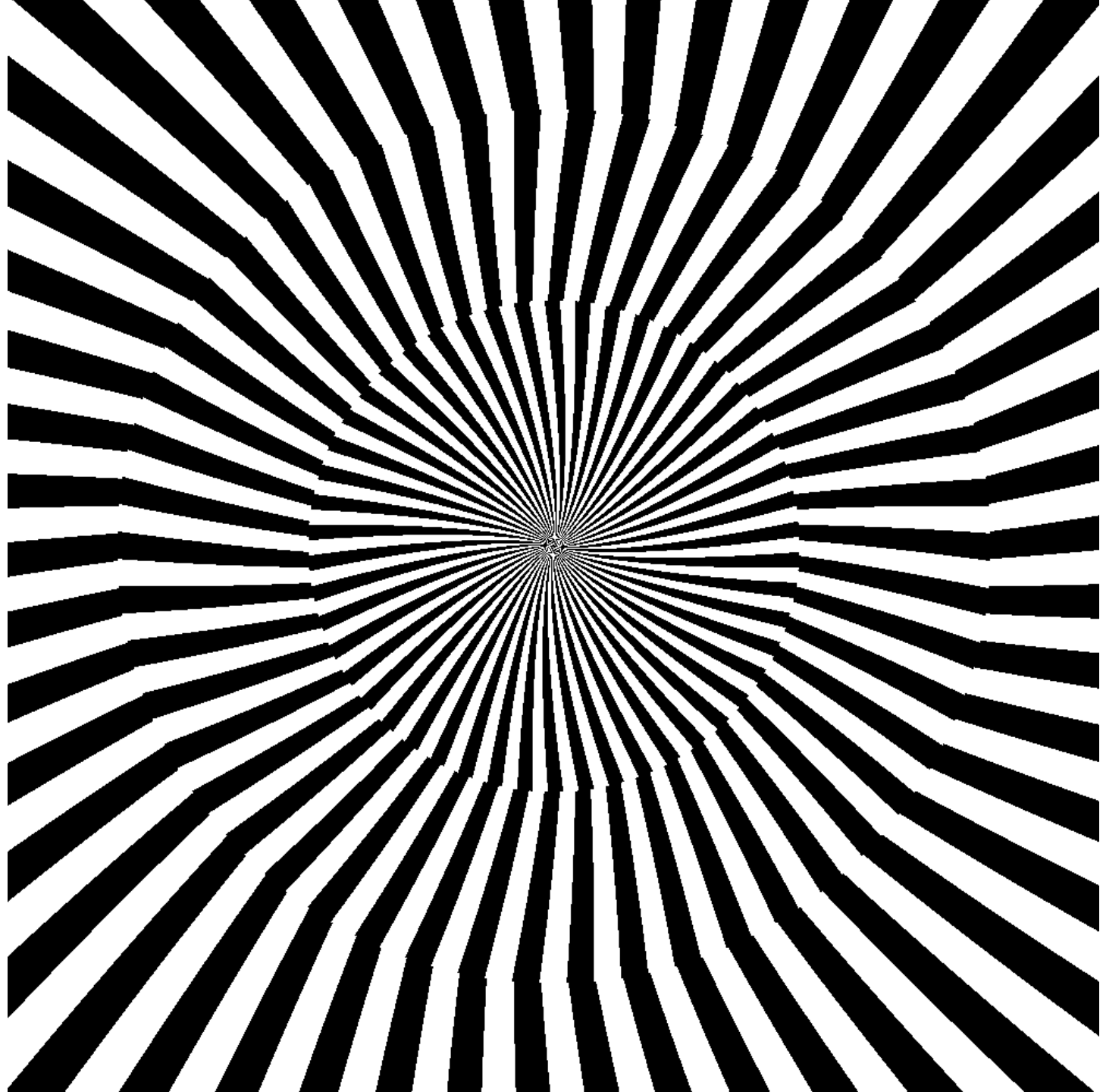
“Phi phenomenon / apparent motion”

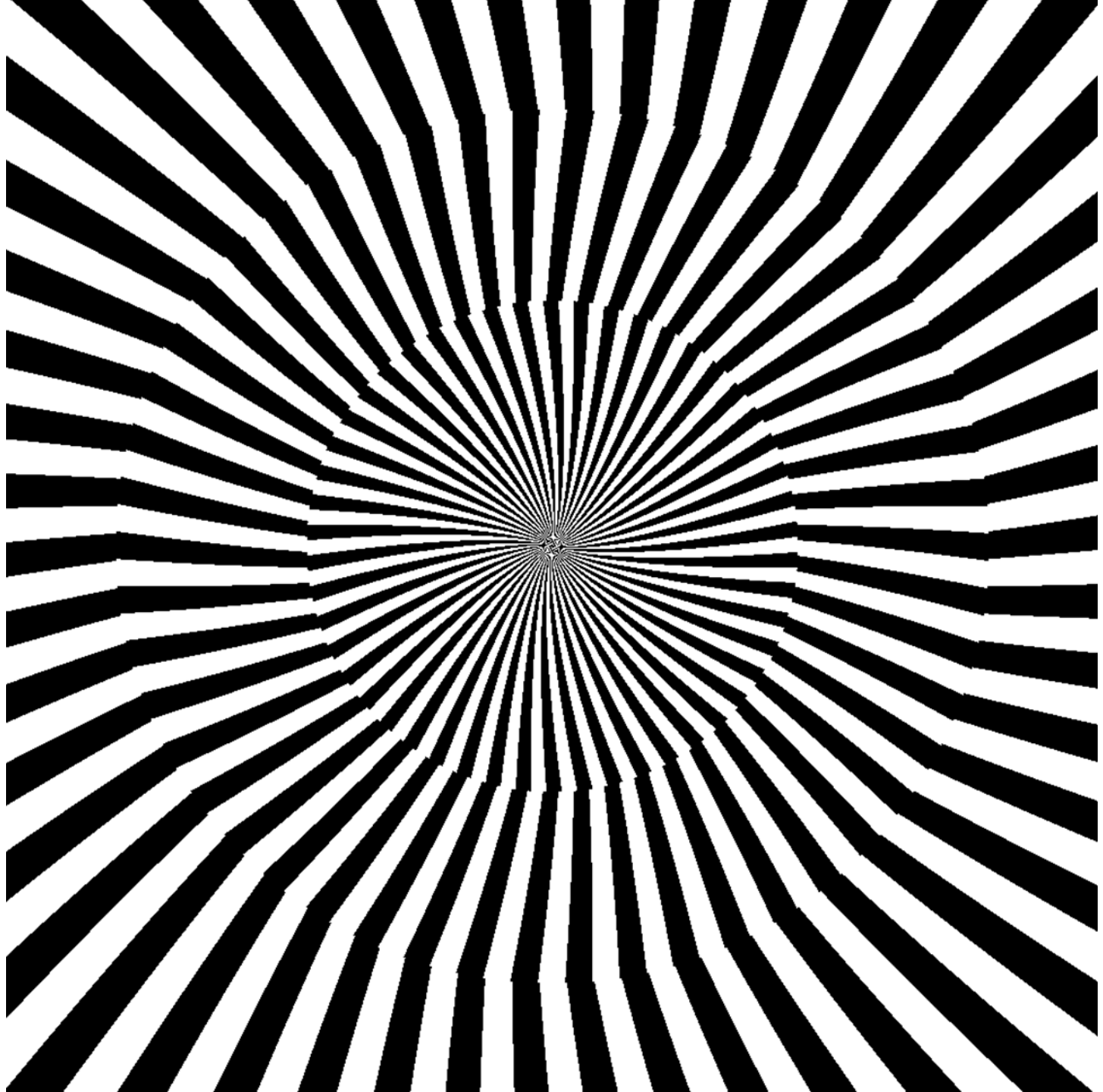
The visual system distinguishes between *light* and *color*.

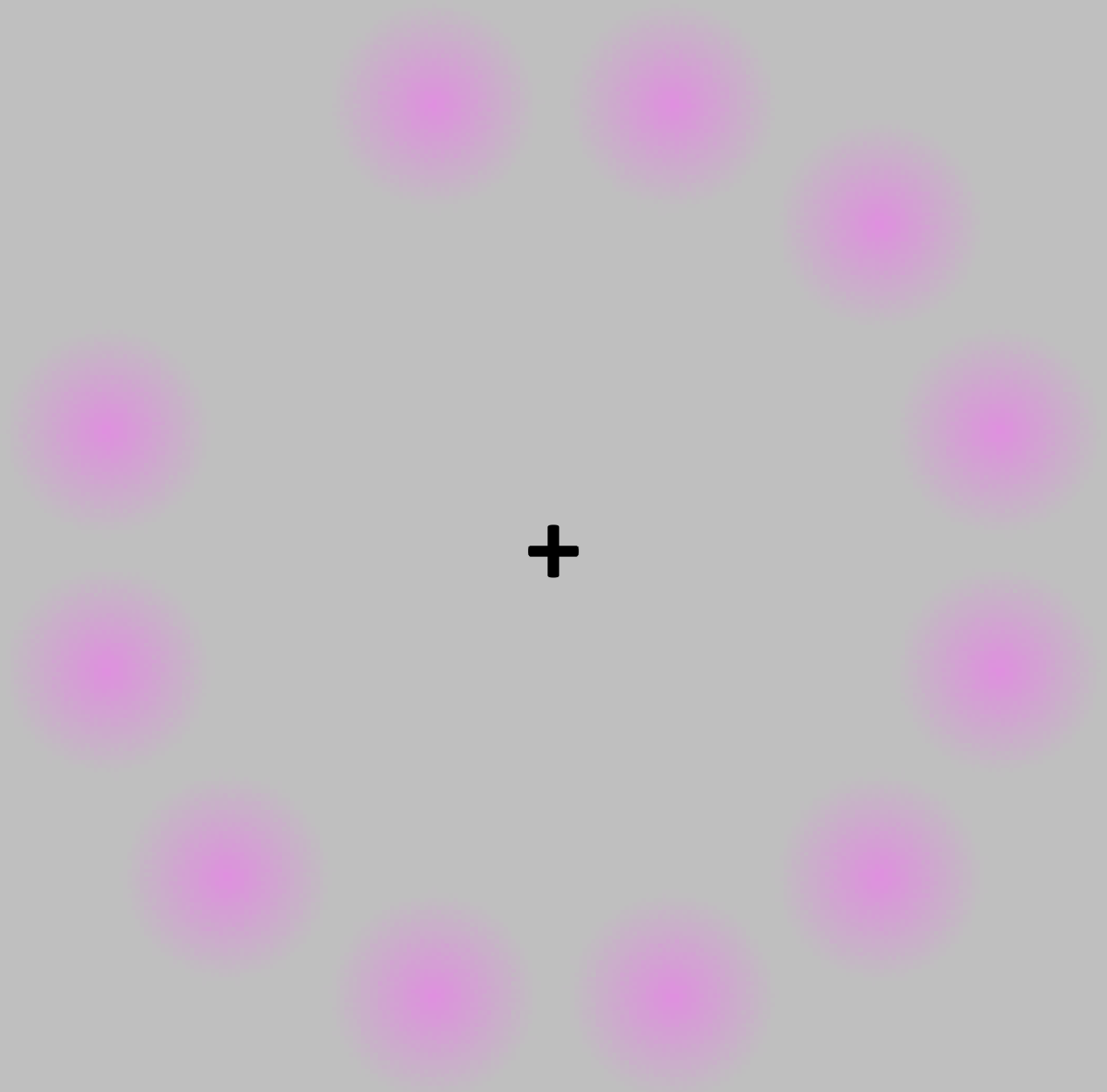
unconscious inference

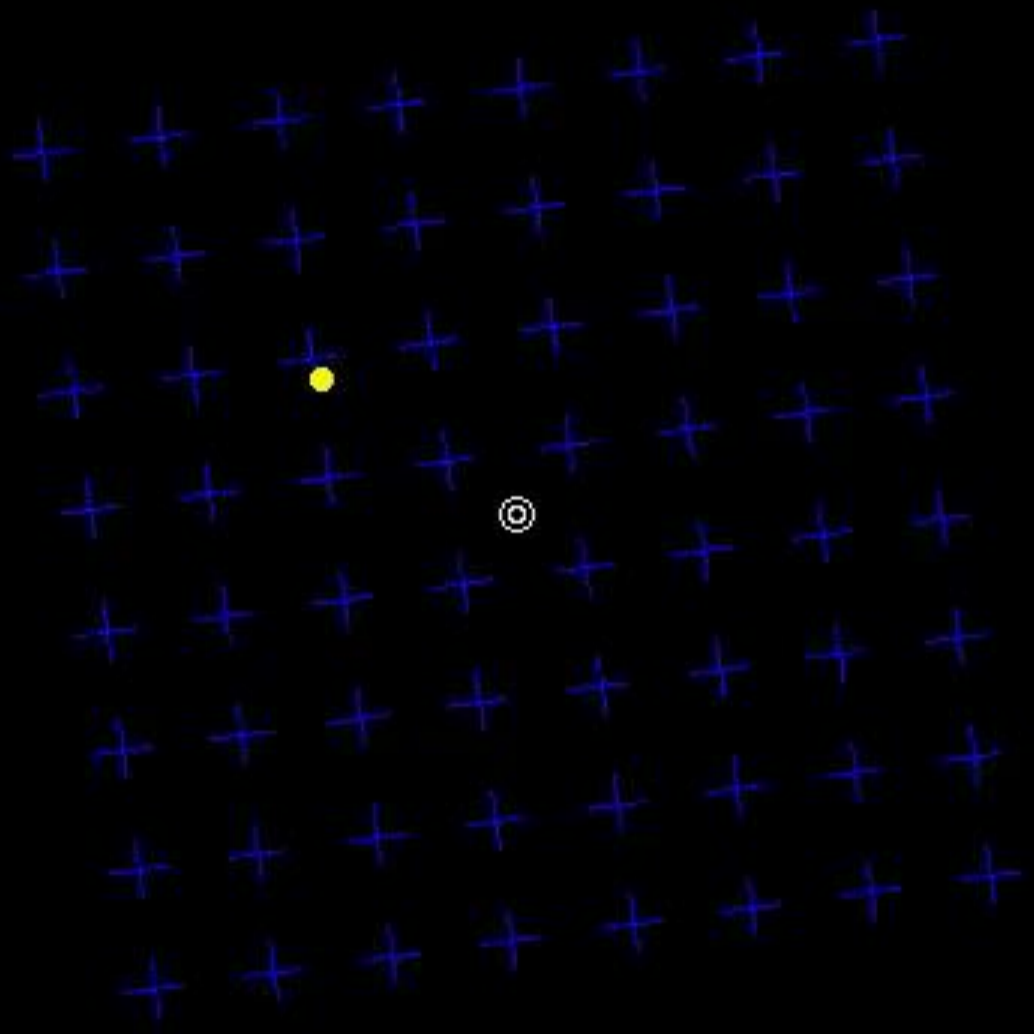
But motion illusions are so much more than this!


Color
adaptation







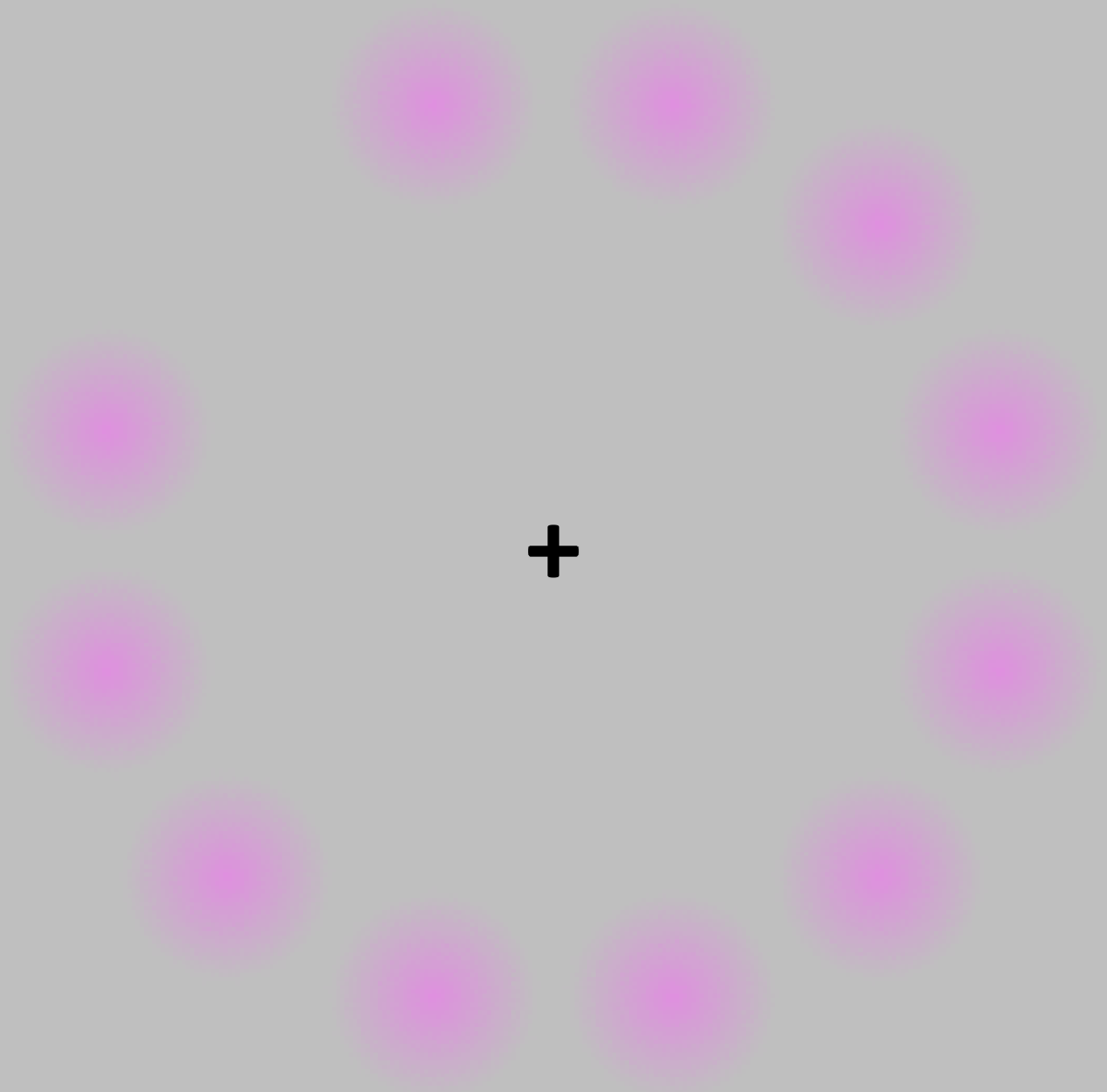


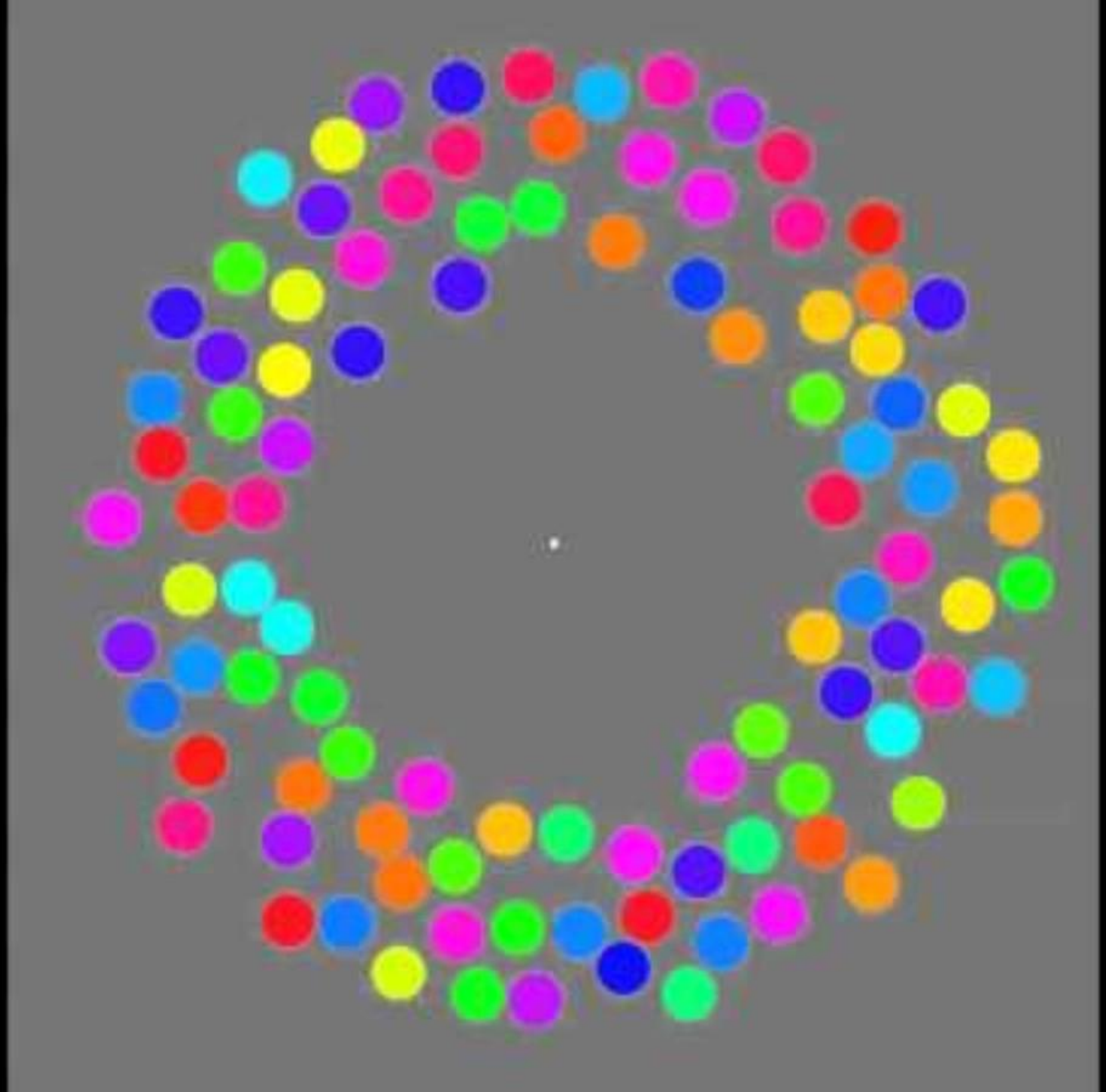
Motion-induced blindness!

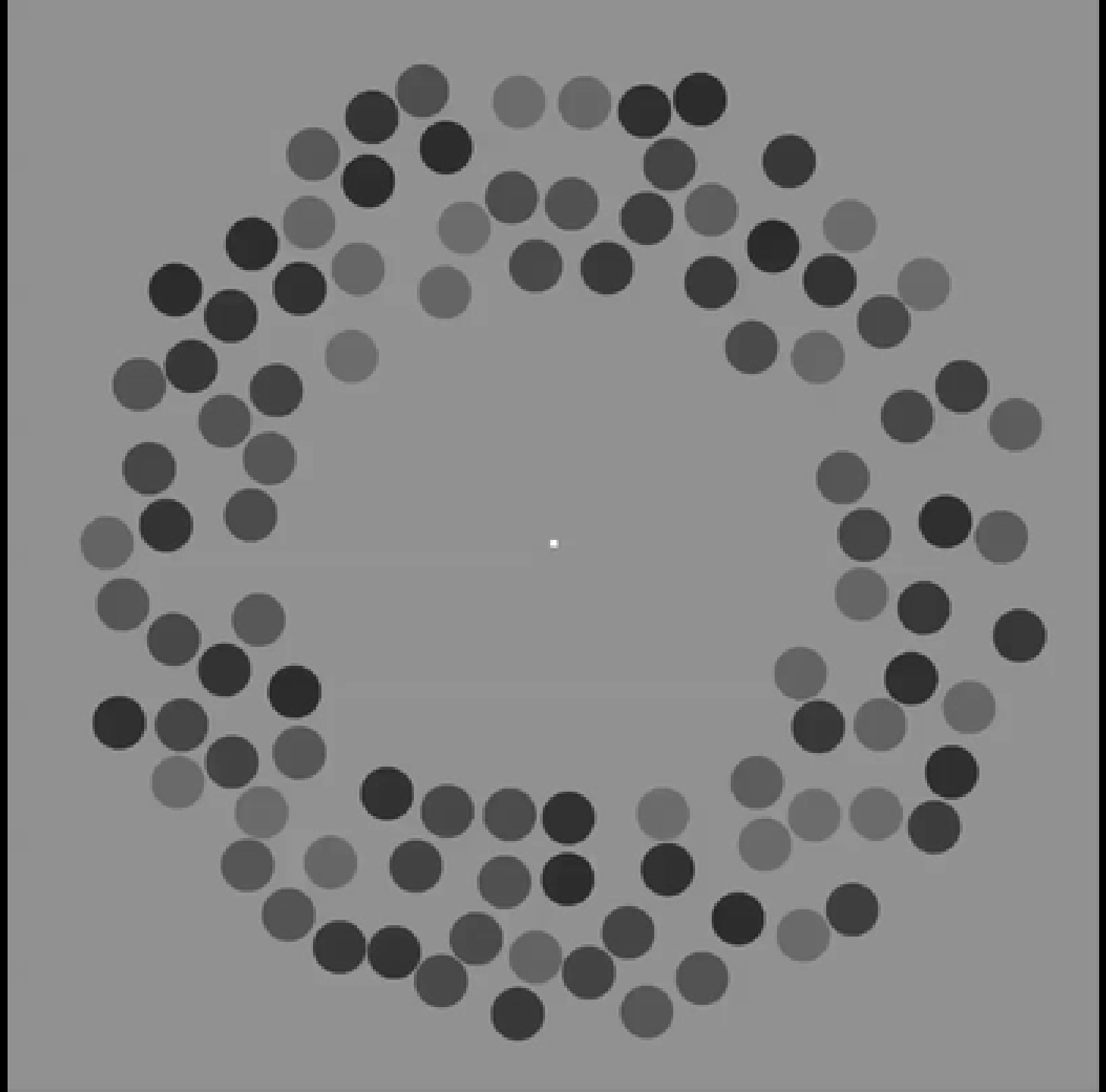
Motion-induced blindness!

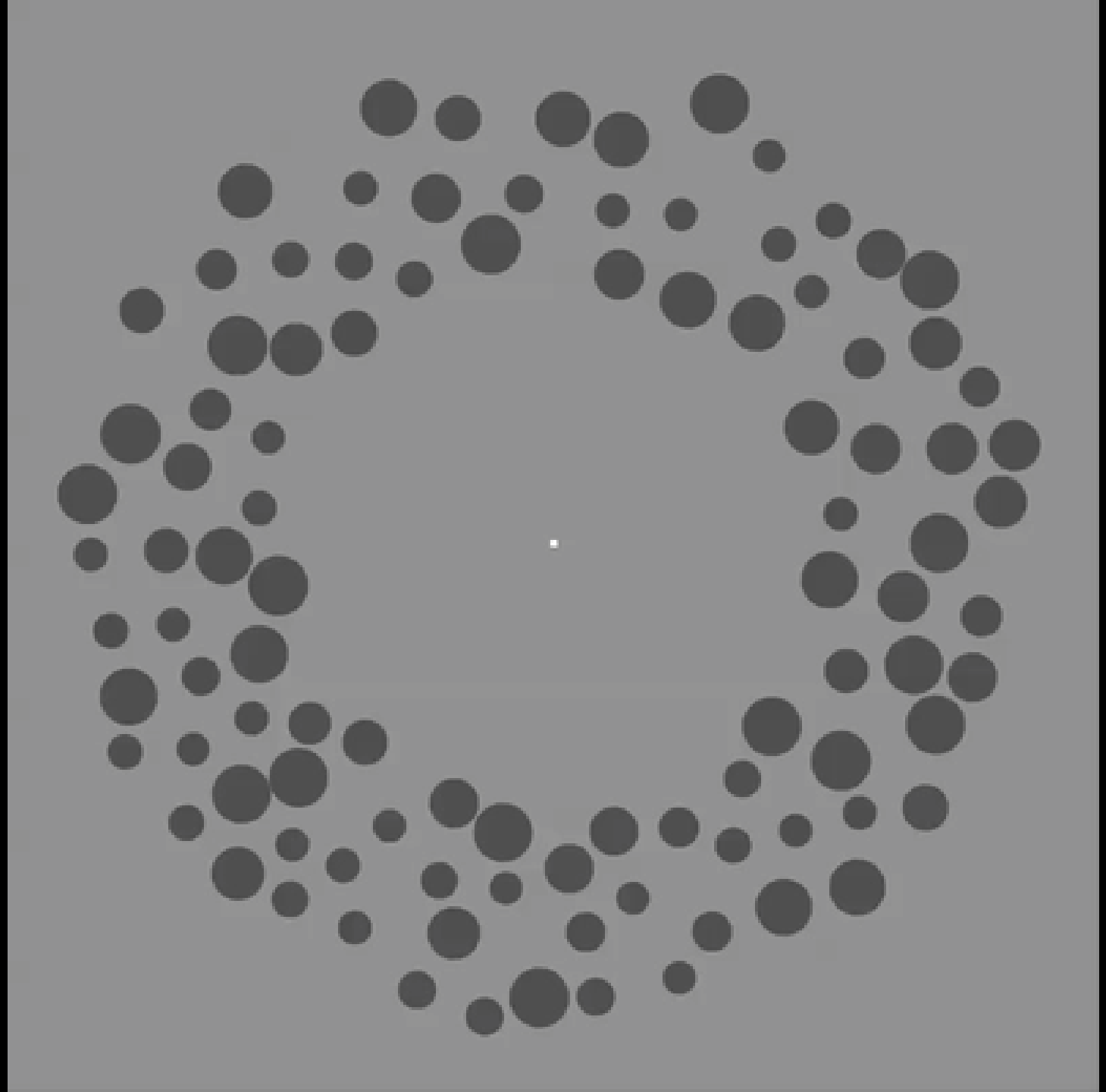
A perceptual scotoma?

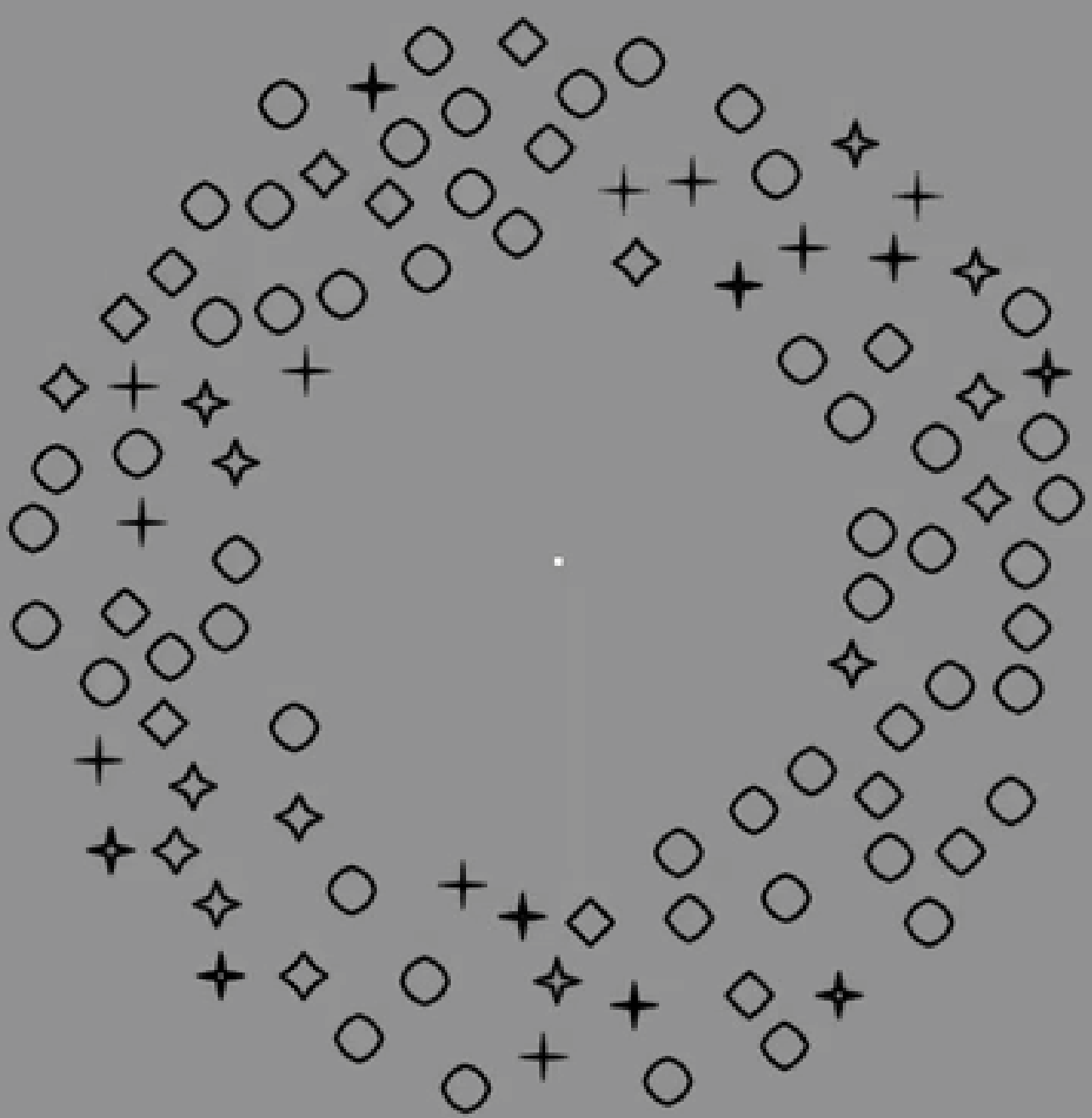
‼

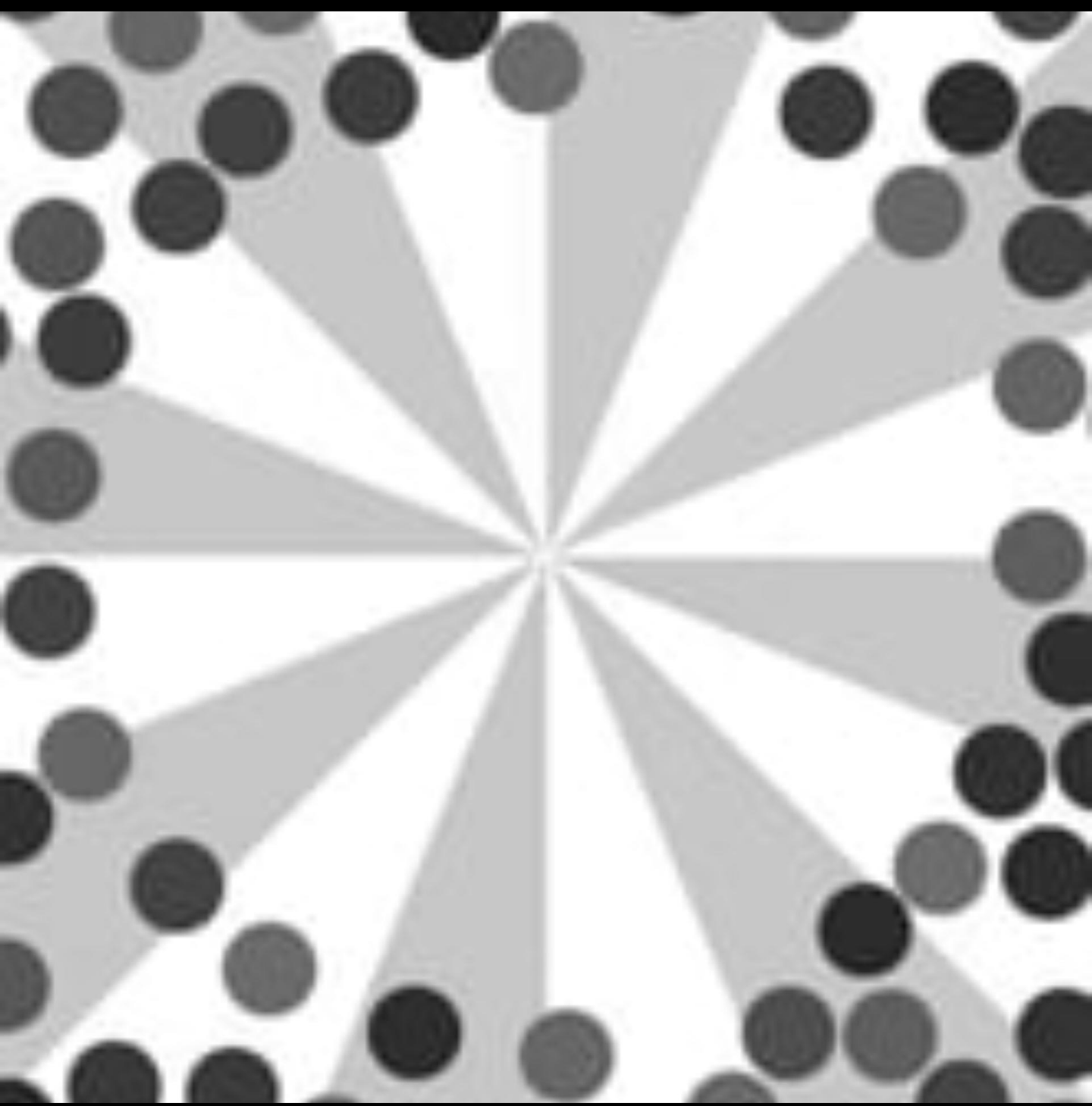












Why?

!!

Current Biology 21, 140–143, January 25, 2011 ©2011 Elsevier Ltd All rights reserved DOI 10.1016/j.cub.2010.12.019

Report

Motion Silences Awareness of Visual Change

Jordan W. Suchow[1,*] and George A. Alvarez[1]
[1]Department of Psychology, Harvard University, Cambridge, MA 02138, USA

Summary

Loud bangs, bright flashes, and intense shocks capture attention, but other changes—even those of similar magnitude—can go unnoticed. Demonstrations of change blindness have shown that observers fail to detect substantial alterations to a scene when distracted by an irrelevant flash, or when the alterations happen gradually [1–5]. Here, we show that objects changing in hue, luminance, size, or shape appear to stop changing when they move. This motion-induced failure to detect change, silencing, persists even though the observer attends to the objects, knows that they are changing, and can make veridical judgments about their current state. Silencing demonstrates the tight coupling of motion and object appearance.

Results

We created a series of movies in which 100 dots were arranged in a ring around a central fixation mark (Figure 1A). Each movie alternated between two phases, stationary and moving. During the stationary phase, the dots changed rapidly in hue, luminance, size, or shape. During the moving phase, the dots continued to change at the same rate while the entire ring rotated about its center. Observers were instructed to adjust the rate of change during the stationary phase to match the apparent rate of change in the moving phase. The results revealed a graded effect: the faster the ring rotated, the slower the dots seemed to change (Figure 1B). The fastest rotation (0.33 Hz) produced nearly complete silencing. Several visual demonstrations can be found at http://visionlab.harvard.edu/silencing/ and in the Supplemental Information available online (Movie S1, Movie S2, Movie S3, and Movie S4).

Determining the Perceived State

During silencing, rapidly changing objects appear nearly static, which raises an immediate question: What is the perceived state (e.g., red, bright, big, round) at any given moment? To illustrate, consider an observer who fails to notice an object change gradually from yellow to red. One possibility is that the observer always sees yellow, never updating his percept to incorporate the new hue—this is freezing, erroneously keeping hold of an outdated state [6]. Another possibility is that he always sees the current hue (e.g., yellow, orange, then red) but is unaware of the transition from one to the next—this is implicit updating [4].

Both accounts are plausible. Temporal freezing, filling-in, and illusory color-shape conjunction are three known phenomena in which the visual system paints a percept that differs from reality, either by retaining an outdated version of a changing stimulus or by inferring its current or future state [6–8]. Alternatively, in continuous change-blindness, part of a scene changes gradually, and though oblivious to the change, the observer perceives its current state veridically [3, 4].

To distinguish these two accounts of silencing—freezing and implicit updating—we created a change-detection task that generalizes Hollingworth and Henderson's reversion test [4]. In that study, observers viewed a picture of a room while, unbeknownst to them, the camera angle gradually shifted. After some time, the camera angle suddenly reverted to its original state. Observers pressed a button if they saw the picture change. The two accounts make different predictions as to whether the observers noticed the reversion: implicit updating predicts success, whereas freezing predicts failure. In fact, the reversion was obvious, ruling against freezing and in favor of implicit updating [4]. Here, instead of performing a single test in which the dots flip to their original state (i.e., their hue at the onset of motion), we performed a separate test for each state in the dots' history—past, present, and future. This generalized reversion test affords greater sensitivity in determining the perceived state. The two accounts both predict that observers will notice some reversions while failing to notice others but differ as to which reversions they predict will go unnoticed (Figure 2; red segments in "predictions" panel at top).

We found that observers noticed flips to the past and future, but not to the present (Figure 2; bottom panel); this occurred regardless of whether the objects stopped, continued to move, or were masked at the time of the reversion. The average magnitude of an unnoticed flip was $-14^\circ \pm 12^\circ$ (mean ± standard error of the mean [SEM]) when the objects stopped moving, $-8^\circ \pm 10^\circ$ when they continued, and $-14^\circ \pm 11^\circ$ when they were masked. Though each of these values is slightly negative, none are significantly different from 0° (one-sample test for mean angle of circular data, $p = 0.23$, $p = 0.43$, and $p = 0.20$, respectively), and all are reliably different from 180° ($p < 0.001$ for each). Importantly, each distribution is markedly nonuniform, which implies that observers were able to make a judgment that depended on the objects' state (Rayleigh test for uniformity of circular data, $p < 0.001$ for each). Silenced changes are updated implicitly—the observer sees the current state.

Incidentally, freezing of stationary color changes has been found to last for ≈200 ms [6], which corresponds to a -10° change in hue in our reversion test. Though the data rule out the possibility that temporal freezing explains silencing, they leave open the possibility that freezing persists within a local window, such that the perceived color consistently lags a bit behind the actual color; this would explain the observed, though not statistically significant, lag.

Motion in Space versus on the Retina

When an object moves but the observer's gaze does not—as in the movies presented here—two types of motion occur simultaneously: the object moves in space, and its image moves on the retina. Which causes silencing? We created four variants of the original movie that together dissociate the two types of motion. In the first variant, the object moves while the observer's gaze remains fixed, producing motion both in space and on the retina. In the second, the object moves

*Correspondence: suchow@fas.harvard.edu


Next week...
Illusions of number!


See you next time.