

A Biological Perspective: The Effects of Line Style on Arc Curvature Perception

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Introduction

- Schmidtman et al. (2016) explains that curvature can be misperceived in many circumstances.
- Virsu (1971) found that perceived curvature was often underestimated. He varied the length and orientation of the arcs.
- Why does the misperception of the arcs occur? After examining contextual information, we believe there may be a biological cause – V4 neurons tuned to curvature may respond less to shorter arcs than to longer arcs.
- The ventral pathway, which is responsible for color and shape, includes both V1 and V4 cortical areas (Connor et al., 2007). The output of V4 depends on the amount of excitation from V1 (Yantis, 2013).
- By manipulating line style (dotted vs solid), arc radius, and arc length, we should better understand why the misperception occurs.

Hypothesis

- The dotted arc should be perceived as less curved than the solid arc with the same length and radius because dots should lead to less activation of V1 orientation detectors which send information to V4 curvature detectors.
- Perceived curvature of the arc should be more veridical when the arc is longer and has a larger radius.

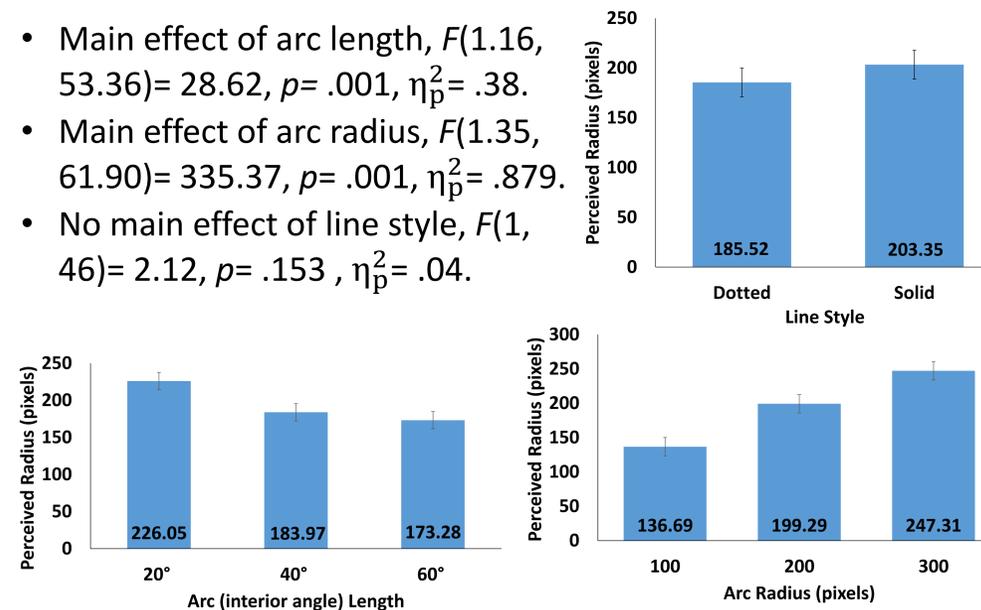
Method

- Participants:** 48 participants with a mean age of 20.00 years ($SD=1.89$) were used (24 male).
- IV 1 Line Style:** Arc style was dotted or solid.
- IV 2 Arc Radius:** Arc radius was small, med. or large.
- IV 3 Arc Length:** Arc length was short, med. or long.
- Procedure:** Participants were first randomly assigned to the dotted line or solid line group and then saw 9 conditions (factorial combination of the other IVs) repeated 5 times with 30 second breaks between each repetition.
- Task:** Adjust size of comparison circle so curvature of circle and arc perceptually matched.

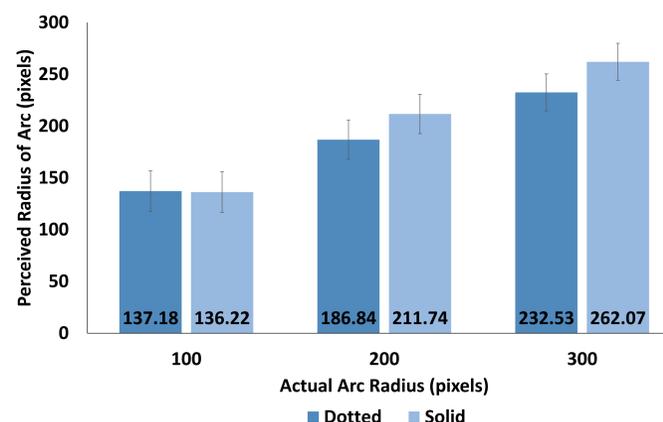
Results

- A univariate repeated measures analysis of variance (ANOVA) was used to compare the effect of the 2 (line style) x 3 (arc radius) x 3 (arc length) experiment on veridical curve judgements.

- Main effect of arc length, $F(1.16, 53.36)= 28.62, p= .001, \eta_p^2= .38$.
- Main effect of arc radius, $F(1.35, 61.90)= 335.37, p= .001, \eta_p^2= .879$.
- No main effect of line style, $F(1, 46)= 2.12, p= .153, \eta_p^2= .04$.



- Significant interaction of Length x Radius $F(3.06, 140.60)= 5.69, p= .001, \eta_p^2= .11$.
- Significant interaction of Radius x Line Style $F(1.34, 61.90)= 7.36, p= .004, \eta_p^2= .14$.



- Subsequent testing of the Radius x Line Style interaction revealed
 - At 300 Pixels: A simple main effect of Line Style, $F(1, 46)= 5.56, p= .023, \eta_p^2= .11$.
 - At 200 Pixels: A marginal simple main effect of Line Style, $F(1, 46)= 3.49, p= .068, \eta_p^2= .07$.
 - At 100 Pixels: No simple main effect of Line Style. $F(1, 46)= .005, p= .95, \eta_p^2= .00$.

Discussion

- When examining the effects of line style, all of the conditional means are in the expected direction except for the arc with the smallest radius and shortest length.
- Overall, the results do not support hypothesis 1, however they do support hypothesis 2.
- The interaction of the Radius and Line Style is an important finding. This interaction, paired with subsequent data analysis, suggests hypothesis 1 is supported at the 300 pixel arc radius level and it reveals a marginal significance at the 200 pixel level.
- After re-evaluating the design of the trials, we believe the spacing of the dots may be affecting the way the participant judges the dotted arcs. Spacing of the dots varies from 9 (smallest radius and shortest length) to 78 (largest radius and longest length) pixels apart depending on the trail.
- Future research will focus on dotted trials with equal spacing. We believe that by making the dots a uniform distance apart a main effect of line style will be observed.

References

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