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# Face Inversion Impairs the Ability to Draw Long-Range, but Not Short-Range, Spatial Relationships Between Features

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**Abstract**

**Keywords**

Observational drawing is the behavior where individuals attempt to draw a recognizable depiction of a directly perceived model. Many individuals without a lot experience or training in drawing experience di culty in producing high-quality drawings of this type. Therefore, one goal of art education has been to develop instructional strategies that aim to increase the accuracy of students' observational drawings. One such strategy, famously promoted by Edwards (2012), is the practice of drawing models upside-down to increase novices' drawing accuracy. The theoretical foundation of the practice is based on the idea that

> [novices] do not perceive in the special way required for drawing. They take note of what's there, and quickly translate the perception into words and symbols mainly based on the symbol system developed throughout childhood and on what they know about the perceived object. (Edwards, 2012, p. 82)

In other words, most novices' drawings are theorized to partially be reproductions of graphic symbols stored in memory that *stand for* the elements of an object (e.g., a smile as a U-shaped line; the eyes as isolated circles or ovals; the shape of the head as a circle) rather than the apparent visual information contained in the model stimulus. Further, Edwards theorized that perceiving objects in noncanonical orientations (e.g., upside-down) inhibits the activation of such symbolic representations and therefore facilitates the ability of individuals to accurately perceive, and therefore draw, the visual information inherent in the model. This theoretical foundation and the resulting practice became very well known in the art-instruction field, as evident by the widespread advocating of this technique on many online drawing tutorials (perform a Google search using the term *upside-down drawing*), in many print-based drawing manuals (e.g., Garcia, 2003; Parks, 2003), and in drawing classes.

Even though there is much anecdotal and testimonial evidence that suggests this technique is e ective, this claim did not receive any formal scientific test of its e ectiveness for over 30 years until the study reported by Cohen and Earls (2010). They assessed how performance was a ected by drawing from an upside model of a face because the misperception theory of drawing accuracy (Cohen & Bennett, 1997) predicted that certain elements of drawing performance should be impaired, rather than improved, when drawing an upside-down face. It has long been known that upside-down faces are more di cult to recognize than upright faces (Yin, 1969). This impairment is not related to the visual processing of all information contained in a face. Rather, while there is some evidence to suggest that the recognition of individual facial features are not a ected by face

This prediction was not tested by Cohen and Earls (2010) because, by using a single subjective rating to quantify the perceived spatial accuracy of the drawings, the accuracy of reproducing long-range versus short-range spatial relationships was not able to be distinguished. To test this prediction, the current study

A repeated measures experimental design was used, where participants drew the face one time each in both orientation conditions. The order in which the upright and upside-down drawings were produced was counterbalanced across participants.

For each of the model photographs and drawings, six measurements (A to F) were made (see Figure 2).

- "A" was measured as the height of the head (the vertical distance between the

Based on these measurements, one long-range and three short-range *spatial relation ratios* were calculated to quantify the relative positioning of target facial features.

- Ratio “C/A” quantified the vertical distance between the eyes and the mouth relative to the height of the head. This ratio quantified the one long-range spatial relationship of interest to this study.
- Ratio “D/A” quantified the vertical distance between the eyes and the eyebrows relative to the height of the head. This ratio quantified one of the short-range spatial relationships of interest to this study.
- Ratio “E/A” quantified the vertical distance between the nose and mouth relative to the height of the head. This ratio quantified one of the short-range spatial relationships of interest to this study.
- Ratio “F/B” quantified the horizontal distance between the eyes relative to the width of the head. This ratio quantified one of the short-range spatial relationships of interest to this study.

See Table 1 for the C/A, D/A, E/A, and D/B values of each of the four model photographs and the mean and standard deviation values of their associated upright and upside-down drawings.

Absolute drawing errors for each of the four spatial relation ratios were calculated for each of the two ratios as follows:

Absolute Drawing Error = | Drawing Ratio Value – Model Ratio Value |

## Results

Because we quantified drawing errors as absolute values, their distributions were positively skewed and thus violated the assumptions of normality that are associated with parametric inferential tests. Therefore, we used nonparametric tests for our analyses.

First, we aimed to determine if the magnitude of drawings errors di ered between the four photographic models. We performed eight Kruskal–Wallis tests (

**Table 1.** S R R F M (SD) T A D.

| | | M 1 (*n* = 36) | M 2 (*n* = 28) | M 3 (*n* = 32) | M 4 (*n* = 30) |
|---|---|---|---|---|---|
| C/A | M | 0.3471 | 0.3558 | 0.3180 | 0.3421 |
| D | | 0.3995 (0.0311) | 0.3904 (0.0547) | 0.3829 (0.0446) | 0.3935 (0.0424) |
| | | 0.4132 (0.0538) | 0.4122 (0.0556) | 0.3859 (0.0601) | 0.4070 (0.0603) |
| D/A | M | 0.1059 | 0.0833 | 0.1016 | 0.0822 |
| D | | 0.0976 (0.0191) | 0.1037 (0.0130) | 0.1113 (0.0171) | 0.0861 (0.0154) |
| | | 0.0977 (0.0255) | 0.0973 (0.0128) | 0.1180 (0.0231) | 0.0905 (0.0211) |
| E/A | M | 0.1412 | 0.1474 | 0.1443 | 0.1370 |
| D | | 0.1704 (0.0301) | 0.1534 (0.0274) | 0.1726 (0.0236) | 0.1678 (0.0251) |
| | | 0.1706 (0.0259) | 0.1610 (0.0285) | 0.1665 (0.0402) | 0.1657 (0.0344) |
| F/B | M | 0.2522 | 0.2216 | 0.1795 | 0.2368 |
| D | | 0.2361 (0.0554) | 0.2110 (0.0625) | 0.2095 (0.0515) | 0.2537 (0.0465) |
| | | 0.2222 (0.0639) | 0.2065 (0.0599) | 0.2129 (0.0639) | 0.2270 (0.0581) |

**Table 2.** A [illegible] D [illegible] E [illegible] : | D [illegible] R [illegible] M [illegible] R [illegible] |.

| | | dn | 25 P[illegible] | 75 P[illegible] | I[illegible] |
|---|---|---|---|---|---|
| C/A | [illegible] | 0.0478 | 0.0257 | 0.0727 | 0.0470 |
| D [illegible] | [illegible] | 0.0634 | 0.0238 | 0.1008 | 0.0770 |
| D/A | [illegible] | 0.0130 | 0.0046 | 0.0248 | 0.0202 |
| D [illegible] | [illegible] | 0.0179 | 0.0085 | 0.0270 | 0.0185 |
| E/A | [illegible] | 0.0285 | 0.0113 | 0.0439 | 0.0326 |
| D [illegible] | [illegible] | 0.0227 | 0.0122 | 0.0442 | 0.0320 |
| F/B | [illegible] | 0.0449 | 0.0228 | 0.0647 | 0.0419 |
| D [illegible] | [illegible] | 0.0440 | 0.0227 | 0.0795 | 0.0568 |

the upright and upside-down drawings, four Wilcoxon tests were performed, one for each of the four spatial relationships we measured (adopting a Bonferroni-corrected alpha level of .013).

## Long-Range Spa ial Rela ionship

With respect to errors in reproducing the vertical distance between the eyes and mouth (C/A ratio), participants produced reliably larger errors when drawing the face from the upside-down model than when drawing it from the upright model, $Z = 3.782$, $p < .013$.

## Shor -Range Spa ial Rela ionship

With respect to errors in reproducing the three short-range spatial relationships between features, participants did not reliably di er in the magnitude of errors they produced between their drawings of the upright and upside-down faces. This was evident with respect to (a) the vertical distance between the eyes and eyebrows (D/A ratio), $Z = 2.184$, $p > .013$; (b) the vertical distance between the nose and mouth (E/A ratio), $Z = 0.369$, $p > .013$; and (c) the horizontal distance between the two eyes, $Z = 0.768$, $p > .013$.

## Con rol Anal ses

Because the vertical distances between the eyes and mouth, eyes and eyebrows, and nose and mouth were measured as a proportion of the height of the head, it is important to establish that the average drawn height of the head was not confounded with the orientation conditions. In other words, it is important to establish that the average drawn height of the head did not significantly differ between the upright and upside-down drawings. As reflected by the "A" measurement, there was no significant difference in the reproduced head height between upright and upside-down drawings, $t(125) = 1.55$, $p > .05$. Further, because the horizontal distance between the eyes was measured as a proportion of the width of the head, it is also important to establish that the drawn width of the head was not confounded with the two orientation conditions. As reflected by the "B" measurement, there was no significant difference in how wide the head was reproduced between upright and upside-down drawings, $t(125) = 0.13$, $p > .05$.

## Discussion

Here, we extend on the research of Cohen and Earls (2010) by demonstrating that drawing upside-down models selectively impairs the accuracy of drawing long-range, but not short-range, spatial relationships between facial features. This observation adds to the body of research that provides empirical support of the misperception hypothesis of drawing accuracy (Cohen & Bennett, 1997) that proposes that drawing errors are, to some degree, caused by inaccurate perceptual encoding of the model being reproduced. To date, the strongest empirical support of this hypothesis have come from studies that evaluated patterns of perceptual and drawing errors on a standard set of stimuli that are known to produce systematic patterns of error in perceptual judgment. Such studies have demonstrated that patterns of error in perceiving the relative length of lines (Mitchell, Ropar, Ackroyd, & Rajendran, 2005) and the size of angles (Ostrofsky, Kozbelt, & Cohen, 2015) are congruent and positively correlated with the patterns of error produced when drawing when perceptual judgments and drawings are based on the same set of stimuli. The current study adds to the empirical support of the misperception hypothesis because the pattern of spatial drawing errors induced by face inversion is congruent with the pattern of errors previously observed when individuals perceive the spatial relationships between features in upside-down faces (Crookes & Hayward, 2012; Goffaux, 2008; Goffaux & Rossion, 2007; Goffaux et al., 2009; Sekunova & Barton, 2008).

The results of this study are also consistent with past research that has failed to provide any empirical support for the idea promoted by Edwards (2012) that drawing models of common objects upside-down facilitates drawing performance. When considering our results in conjunction with those of Cohen and Earls (2010), the evidence to date indicates that drawing from upside-down models has, at best, no effect (with respect to the perceived accuracy of the individual facial features and the objectively measured accuracy of drawing short-range spatial relationships between features) and, at worst, an impairing e ect on drawing accuracy (with respect to the objectively measured accuracy of drawing long-range spatial relationships between features).

However, it is worth noting that drawing from upside-down models may improve some aspects of accuracy not addressed in this study. For instance, Kozbelt, Seidel, ElBassiouny, Mark, and Owen (2010, Study 2) used a face-from upside-down models improves drawing accuracy and thus raises doubt concerning the effectiveness of this long-promoted practice in the realm of art instruction.

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