

How Does One Become an Artist? A Copying Task Provides No Support for the "Upside-Down Drawing" Technique

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Abstract

According to a technique widely used in art schools, everyone can make more realistic drawings by copying upside-down originals. We tested if this is true by asking 40 artistically untrained participants to copy either upright or upside-down drawings of a face or a car. Our results indicate that participants were faster when copying the car in comparison to the face, but not when copying upside-down in comparison to upright images. In addition, they were more accurate in capturing the global proportions of the image in comparison to the local proportions of its parts. However, neither the face nor the car were copied more accurately when presented upside-down. Overall, we observed no significant difference in accuracy between the upright and upside-down conditions, with most measures showing a pattern consistent with greater accuracy in the upright orientation especially for the face. These results provide no evidence that copying upside-down images promotes greater resemblance to the original stimulus image. Implications for the cognitive psychology of drawing and for the pedagogy of the visual arts are discussed.

Keywords: drawing; inverted drawing; learning; innocent eye

Introduction and Rationale

Drawing is a fascinating form of visual art. Historically, humans drew pictures even before they started to write -- and some did that better than others. How can we explain differences in drawing skills? Traditionally, two theories have tried to explain why and how some of us can draw artistically. According to the "innocent eye" theory, the ability to draw derives from a special way to see the world. According to this idea, artists see without any perceptual distortion because they have access to the proximal stimulus projected on their retina. This is due to an innate ability as artists possess an 'innocent eye' (Ruskin, 1912) that allows them to see the world without external influences. In line with this hypothesis, many studies show an advantage of artists over non-artists in perceptual tasks, suggesting that they are somehow better at obtaining visual information (Cohen & Bennett, 1997; Kozbelt, 2001; Cohen, 2005; Mitchell, Ropar, Ackroyd, & Rajendran, 2005; Calabrese & Marucci, 2006; Cohen & Jones, 2008). The second hypothesis, proposed by Perdreau and Cavanagh (2011) and based on Tchalenko's work (2009), argues that artists create an internal representation of image structure through segmentation. Experts are trained to focus on the single elements and organize them meaningfully to keep them in memory until they reproduce them on paper. They suggest

that this specific ability depends on experience and is improved by training (Perdreau & Cavanagh, 2014).

In between the formulation of these two theories, an artist published a book that is now considered a classic in the pedagogy of the visual arts. Betty Edwards' *Drawing on the Right Side of the Brain*, first published in 1989 but now in its fourth edition, emphasizes the popular view that the right hemisphere is responsible for creativity. The key to drawing artistically is "to see through artist's eyes". Edward's techniques are created to favor switching to 'R-mode', which means engage the right brain and his ability to reproduce elementary information. The basic idea is learning a set of techniques for seeing in R-mode, the first and most important being upside-down drawing. According to Edwards, even if you were always incapable of drawing, with the sample rotation of the subject by 180°, your skill suddenly improves. Without any training, everyone can draw respectable portraits just looking at a subject image upside-down. Reportedly, by looking at an upside-down subject, student more easily focus on structural information, on single lines and shapes. This allows you to gain a more innocent eye, or, as Perdreau and Cavanagh argue, to better segment the object you need to draw.

Although widely acclaimed, Edwards' theory has not been tested systematically after an early qualitative study reported in Edward's dissertation (Edwards, 1976). Do individuals with no training in drawing actually draw better from upside-down subjects?

General Methods

Participants

Forty members (15 males, 4 left-handed, mean age 22 years) of the Parma student community volunteered. None had received formal training in drawing, and all were unaware of the purpose of the study.

Stimuli, Apparatus, and Procedure

The stimulus images (Figure 1) were presented on the upper half of a A4 white sheet. The lower half of the sheet was left blank for the participant's copy. Four different sheets were used depending on the figure to be copied (face or car) and on its orientation (upright or upside-down). Participants were given a B-grade pencil and an eraser. The time to completion of the drawing was recorded using a digital chronometer. Copy accuracy was measured by comparing distances between selected points of the original and copied images, as measured by a suitable set of rulers.

The experiment began by recording the participant's age as well as his or her preferred hand for writing as an indicator of handedness (for a justification of this method of determining handedness, see Rigal, 1992). Next, they were presented with one A4 sheet (turned to show the back of the page which had no drawing) and asked to read the following instructions: "You will be presented with two sheets containing two images, one at a time. Your task is to reproduce the figures as best as you can. Use the space in the lower part of the sheet to reproduce the figure. Take as much time as you need and feel free to use the eraser. However, please keep the sheet always in the orientation that was originally presented and avoid rotating the sheet. After a go signal, turn the sheet and begin." If participants require additional explanations, the experimenter provided further clarification. Once the task was clear, the experimenter provided the first go signal, started the chronometer, and the participant started to copy the first stimulus image. At the end of the experiment participants that so requested were debriefed.

The dependent variables were the time to completion of the copy and two measures of accuracy in reproducing the original proportions (see below). The independent variables were the orientation of the stimulus original (upright or upside-down) and type of stimulus (face or car). To control the effect of order, a Latin square was used to randomly assign 10 participants to each of four conditions: upright car, upside-down face; upright face, upside-down car; upside-down car, upright face; upside-down face, upright car. In each condition, participants copied each drawing in the specified order and orientations.



Figure 1. Drawings used in our copying task.

Analysis and Results

We inspected histograms of the distributions of the times to completion of the drawings (see below) separately for the four conditions. Given the differences in the shape, dispersion, and symmetry of the four distributions, we measured the central tendency of these distributions using their medians and tested differences using Mann-Whitney's nonparametric two-sample test. To assess the participant's accuracy in copying the stimulus images, we computed aspect ratios (ratios of horizontal to vertical extents, AR) for distances between selected points in the original images and compared these to AR's for corresponding points in the copied images. We computed the following AR's for the face and car, respectively: Global face AR - horizontal distance between each ear-cheek junction and vertical

distance between the highest point on the hair contour and the lowest point on the chin contour; Local face AR - horizontal distance between pupil centers and vertical distance between the eye level and the lowest point of the nose contour; Global car AR - horizontal distance between the left- and rightmost points on the car front and back bumpers and vertical distance between the highest and lowest points of the car frame; Local car AR1 - horizontal distance between the left- and rightmost points and vertical distance between the highest and lowest points, for the front door; Local car AR2 - horizontal distance between the left- and rightmost points and vertical distance between the highest and lowest points, for the back door. Having measured these AR's, we computed a percent measure of deviation from the original image as follows

$$\% \text{ deviation} = (\text{ARc} - \text{ARo}) / \text{ARo} \times 100$$

where ARc is the relevant aspect ratio in the copied image, and ARo is the corresponding aspect ratio in the original stimulus, a negative sign signifies a copy more elongated vertically than the original, and a positive sign a copy more elongated horizontally.

In addition, we also computed an accuracy metric based on the formula proposed by Perdreau and Cavanagh (2013). We chose 16 junctions that could be readily located on both the original drawings and on the participants's copies. Next, we centred both the original picture and the drawings on their leftmost selected junction. Finally, we normalised the coordinates to the maximum horizontal and vertical coordinates. The result was the mean of the percentage root-mean-square error calculated for each axis, x and y. This method allowed us to obtain a unique score of how much the participants' drawings deviated from the originals, disregarding the information about local and global proportions. Moreover, this formula represents a second check of the results.

Distributions of the times to completion of the drawings are presented in Figure 2. Times tended to be lower in the upright car condition (median = 278 s) in comparison to the other three conditions (medians = 362 s, 351 s, and 371 s, for the upright face and upside-down face and car, respectively). However, the difference between faces and cars proved statistically reliable, Mann-Whitney U = 3282, $p < 0.005$, whereas the difference between upright and upside-down did not, Mann-Whitney U = 4208, $p > 0.75$. Distributions of percent deviations from original image are presented in Figure 3, separately for each measure and orientation.

Overall, participants tended to produce copies of the face that were more elongated horizontally than the original (positive % measures), and copies of the car that were more elongated vertically (negative). Additionally, they tended to be more accurate with the car (average deviation -3.3%) than with the face (7.7%) and, to a lesser extent, in the local (0.5%) in comparison to the global measures (2.0%).

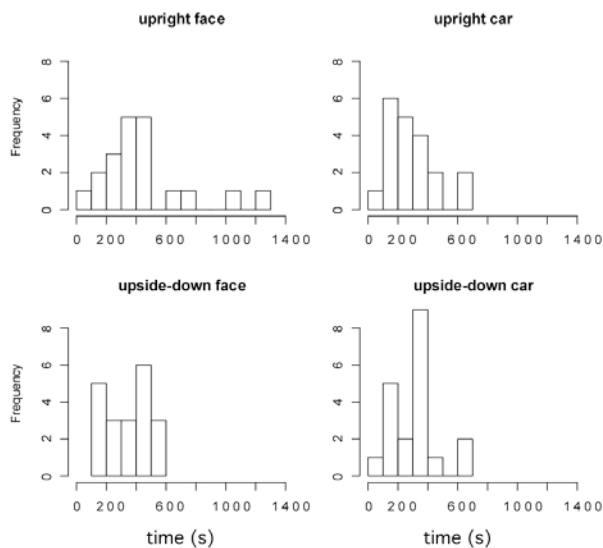


Figure 2. Times to completion of the copies in the four conditions of our study.

However, results did not show sizable differences as a function of the orientation of the stimulus image, except for the global measure with the car stimulus, where the average percent distortion was 2.2% in the upright orientation but 10%, a fivefold increase, in the upside-down orientation. To subject the above-described pattern to inferential analysis, we entered the % deviation data into a 5 (type of measure) \times 2 (orientation) ANOVA. This revealed a significant effect of type of measure, $F_{4,190} = 7.96$, $p < 0.0001$, but not of orientation $F_{1,190} < 1$ or of the interaction $F_{4,190} < 1$. Consistent with our qualitative assessment of the results, Scheffé post-hoc tests indicated that all car - face paired comparisons were statistically significant, $p < 0.05$ or lower, except for the comparison between the face global AR and the car local AR2, whereas only two (out of five possible) local vs global comparisons were significant, $p < 0.01$ or lower. Most importantly, no pairwise comparison between the upright and upside-down orientations within any of the five measure proved significant, $p > 0.11$ or larger.

Accuracies based on Perdreau and Cavanagh's %RMSE metric were analyzed using a 2 (Group: Car vs Face) \times 2 (Condition: Original vs Upside-down) ANOVA. A significant effect of group, $F_{1,79} = 45.4$, $p < 0.0001$ was observed, indicating that participants produced smaller errors when they copied the car than the face. However, these data also did not show an effect of condition, $F_{1,79} = 0.05$, $p > 0.05$, or of the two-way interaction, $F_{1,79} = 0.053$, $p > 0.05$, indicating that there were no differences between the original and upside-down orientations of the models.

Discussion and Conclusion

In a nutshell, our results indicate that participants were able to copy the car more quickly and accurately than the face, and that there were differences of detail in the ability to reproduce the proportions of the original image. These

differences are to be expected given the simpler geometry of the car image, and are not particularly surprising. Importantly, however, we failed to observe any systematic difference between copies from the upright and the upside-down orientations of the original image. If anything, we observed a (nonsignificant) tendency towards greater accuracy in the upright condition with the face stimulus. Thus our results are not consistent with expectations based on the "upside-down drawing" technique promoted by Edwards (1989).

It may be argued that our results are inconclusive in that we obtained nonsignificant effects. However, our study did reveal several significant differences, although not between the orientations of the original stimulus image. In addition, it seems unlikely that we failed to observe an advantage of upside-down drawing due to insufficient statistical power. Our sample size, 20 participants in each orientation condition, was comparable to that of the original study reported by Edwards (1976) which had 21 participants in each orientation. In addition, each of our participants produced two drawings, effectively doubling the number of observations we had. Finally, we stress that overall if any hint of a difference is to be detected in our data, it was in fact in the direction of an upright advantage, not the other way around. We also stress that similar results were obtained with our accuracy metric, which emphasizes key features encompassing local and global properties, and with the more global metric proposed by Perdreau and Cavanagh (2013). Thus, the results are unlikely to depend on the choice of a given method for assessing accuracy.

An alternative criticism to our study may be that our data are noisy due to insufficient control of skill level. Although we purposely chose to test only individuals with no formal training in the visual arts, some of them might still enjoy drawing as a hobby or pastime, providing them with a degree of informal training. These participants might be somewhat skilled, causing the accuracy data to reach ceiling and effectively washing out the difference between the conditions. We consider this unlikely, given the relatively large times that most participants required to complete these simple drawings and the substantial percentage deviations of the copies compared to originals. As an additional test of this possibility, after completing the drawings 25 of the 40 participants were asked to fill out a four-item questionnaire. The questionnaire items were the following: "I practice drawing often"; "I believe I can draw well"; "I found the upright image easier to copy than the upside-down image"; "I found the face easier to copy than the car". Participants reported their degree of agreement with each item on a 1 (completely disagree) to 7 (completely agree) scale. The median agreement scores to the first item was 2, with all participants choosing scores of 3 or less except for four participants that choose 7, 6, 5, and 4. The median agreement scores to the second item was also 2, with all participants choosing scores of 4 or less except for three participants that choose 5 (corresponding to three of the four reporting that they drew often). Thus, there was little

evidence that, overall, participants were informally trained or otherwise practiced drawing. Interestingly, the median agreement scores to the third and fourth items were 4 and 5, suggesting that participants did not perceive task difficulty to vary with image orientation, but perceived the face to be easier to draw than the car (the opposite of what we observed in our measures).

participants' drawings was evaluated qualitatively by a panel of experts. Although quantitatively they did not turn out to be more accurate in the upside-down condition, it is quite possible that the copies might have nonetheless been judged as artistically "better" by a panel of judges. We stress that the artistic quality of a drawings is however a different problem than its degree of consistency of a copy with the original. If there is a dissociation between the two, this would be interesting to learn.

These limitations notwithstanding, we conclude that at least in the current conditions there is little evidence in support of Edwards' upside-down drawing technique.

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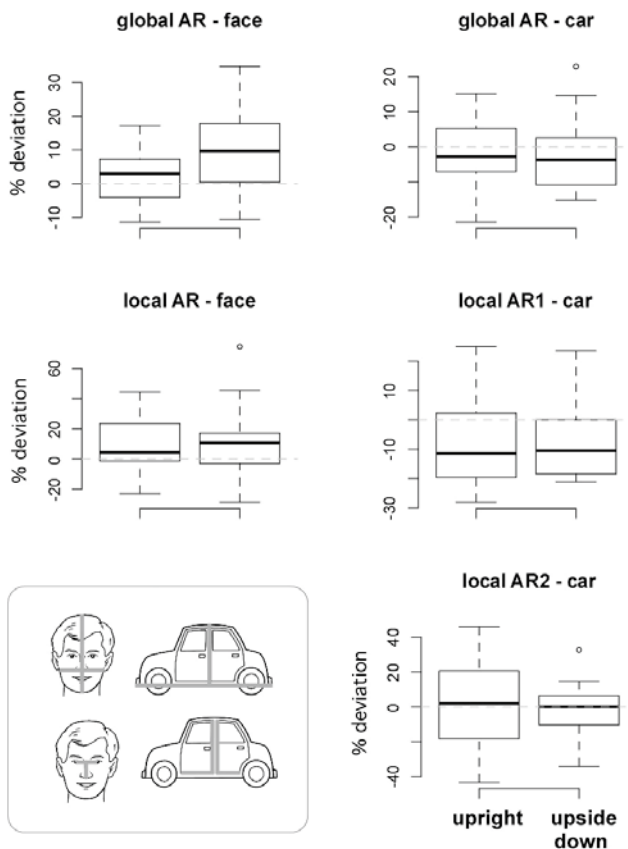


Figure 3. Accuracy data in the conditions of the study.

Although we do not believe that our results suffer from insufficient statistical power, our study has limitations. First of all, our conclusions are necessarily limited to the two kinds of figures that were tested. It may be that with different categories of figures the upside-down drawing technique proves more useful. We also stress that the drawings tested by Edwards were considerably different from ours. It may also be that unskilled participants require more training, perhaps over several days, before the effect of upside-down drawing begins to show. We stress however that in the original study reported by Edwards (1976) an advantage of upside-down drawing was observed after a single drawing session as in our study. But perhaps the most important consideration in comparing our study to Edwards' concerns the assessments of the quality of the participants' drawings. In our study, we sought quantitative indices of performance, based on drawing times and on comparing the aspect ratios of the original and of the copy for global and local features. In Edwards' study, instead, the quality of the