Drawing human faces is a behavior that children and adults engage in all around the world. Perhaps due to the popularity of this activity, researchers have investigated the psychological and developmental processes that are associated with individual variability in the appearance of such drawings (Brodie, Wyatt, & Waller, 2004; Cohen, 2005; Cohen & Bennett, 1997; Cohen & Earls, 2010; Cohen & Jones, 2008; Costa & Corazza, 2006; Freeman & Loschky, 2011; Hayes & Milne, 2011; Kozbelt, Seidel, ElBassiouny, Mark, & Owen, 2010; Kozbelt, Snodgrass, & Ostrofsky, 2014; McManus et al., 2012; Ostrofsky,

Geographically, drawings produced by children living in Europe, Africa, South/Central America, and Asia were analyzed in order to determine (a) which geographic groups exhibit systematic directional biases in their drawings of the spatial relationships between features and (b) if there are any di erences between children living in the di erent continents with respect to the magnitude of such spatial drawing biases.

Methods

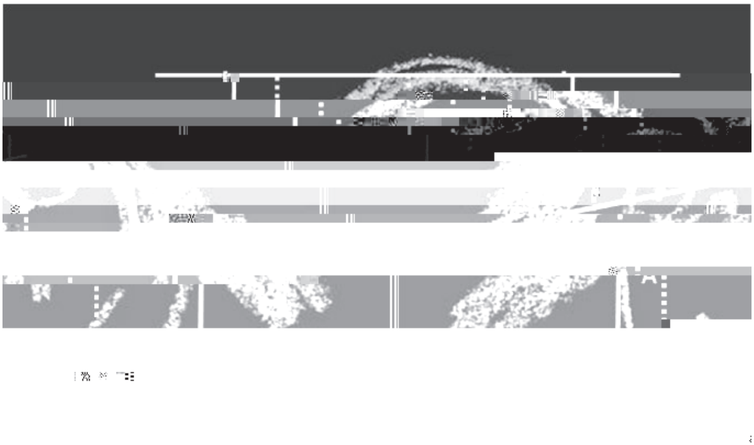
Materials

The drawings analyzed in this study were taken from Gilles Porte's Early Pictures: Portrait - Self-Portrait online archive of children's self-portraits (Porte, Maurer, & Gujer, 2012). In total, this collection currently contains 958 self-portraits produced by children ranging in age from 2 to 15 years old from 36 countries distributed throughout six continents. After being provided a black sheet of paper and a sharpened white crayon, each child was simply asked to draw themselves. No further instruction was provided, and no time limit was imposed on this task. After each drawing was created, the name, age, and country that the child was living in at the time the drawing was produced was recorded.

Procedure

The drawings included in this analysis were selected based on the criterion that the drawing must include a face that depicts at least both eyes and a mouth embedded in a drawing of a human figure. Out of the 958 drawings in the archive, 506 drawings met this criterion and were included in the analysis to be reported below.

Four spatial measurements, A to D, were made for each drawing and are illustrated in Figure 1. "A" measured the length of the head, with the landmark points being defined as the two points on the top and bottom ences



Spatial Relation Ratio	Interpretation	Normative Value
B/A	- -	0.71
C/A	E D	0.53
D/A	D	0.86

Figure 1. Illustration of how the drawings were measured and definition of the three spatial relation ratios.
Note. Normative values approximating the values of the three spatial relation ratios for the average 6-year-old face are presented. Normative values were generated by Farkas and Munroe (1987) and the A to D measurements were made from an illustration of these normative values present in McManus et al. (2012). The sample drawing depicted here was produced by a 5-year-old girl living in Israel. Permission to reproduce this image was provided by Gilles Porte.

greater than the length of the head. The C/A ratio quantified the vertical positioning of the eyes on the length of the head. The D/A ratio quantified the vertical positioning of the mouth on the length of the head. For the C/A and D/A ratios, greater values indicate that the feature was positioned lower down the head relative to lesser values.

Once these spatial relation ratios were calculated, three bias ratios (one for each of the spatial relation ratios) were computed that quantified the degree to which each drawing deviated from normative values of the spatial relation ratios of the average 6-year-old face. Normative values were acquired from the anthropometric measurements of Farkas and Munroe (1987) (measured from an illustration of these values in McManus et al., 2012). The normative values of the three spatial relation ratios for the average 6-year-old face were B/A = 0.71; C/A = 0.53; D/A = 0.86. Bias ratios were computed as:

$$\text{Bias Ratio} = \text{Drawing Ratio Value}/\text{Normative Ratio Value}$$

For the B/A ratio, a bias ratio value greater than 1 indicateu the mean bias ratio values against a test value of 1 (indicative of zero deviation of the drawing from the normative value of the spatial relation ratio). For each position of the eyes, F

Table 3. Mean (Standard Error) of Spatial Relation and Bias Ratio Values Across the Geographic Groups of Children Aged 4 to 6 Years Old.

	Africa	Asia	Europe	South/Central America
Spatial relation ratio values				
B/A	1.024 (.021)	0.986 (.021)	0.966 (.022)	0.940 (.036)
C/A	0.384 (.008)	0.411 (.008)	0.351 (.009)	0.348 (.014)
D/A	0.825 (.008)	0.809 (.008)	0.804 (.008)	0.774 (.014)
Bias ratio values				
B/A	1.436 (.028)	1.382 (.029)	1.354 (.034)	1.318 (.053)
C/A	0.725 (.014)	0.774 (.016)	0.663 (.017)	0.656 (.027)
D/A	0.961 (.008)	0.942 (.011)	0.935 (.009)	0.901 (.019)

Note

Table 4. Analysis of Drawing Biases for Each Continent Group.

	Continent group			
	Africa ($n = 116$)	Asia ($n = 119$)	Europe ($n = 107$)	South/Central America ($n = 41$)
B/A				
t	15.83***	13.36***	10.34***	5.95***
Cohen's d	1.47	1.22	1.00	0.93
C/A				
t	−19.13***	−13.84***	−20.33***	−12.52***
Cohen's d	1.78	1.27	1.96	1.96
D/A				
t	−5.13***	−5.52***	−7.03***	−5.32***
Cohen's d	0.48	0.51	0.68	0.83

Note. For all t-test analyses, $df = n-1$.
Effect si es and single-sample t tests comparing mean bias ratio values against a test value of 1 (indicative of no bias relative to the average 6-year-old face).
***$p < .001$

The results of these analyses are presented in Table 4. Children living in all four continents were systematically biased to draw the head too round (i.e., the mean B/A bias ratio values were significantly greater than 1) and the eyes and mouth too up the length of the head (i.e., the mean C/A and D/A bias ratio values were significantly less than 1). Thus, children living in Africa, Asia, Europe, and South/Central America do not di er from one another in terms of the presence and direction of systematic biases in the drawing of the width-to-length ratio of the head and the vertical position of the eyes and mouth. However, they might di er from one another with respect to the magnitude of such drawing biases. In order to determine this, three analyses of variance (ANOVAs) were conducted comparing each bias ratio between the four geographic groups.

With respect to the drawings of the width-to-length ratio of the head, the B/A bias ratio values did not significantly di er between the four geographic groups, $F(3, 379) = 1.88$, $p = .132$, partial $Z^2 = .015$.

With respect to the drawings of the vertical position of the eyes, the C/A bias ratio values significantly di ered between the four geographic groups, $F(3, 379) = 10.08$, $p < .001$, partial $Z^2 = .074$. Follow-up Sche e tests indicated that the bias in Asian children's drawing of the vertical position of the eyes was significantly smaller than the drawings of European children ($p < .001$) and South/Central American children ($p < .01$). In other words, Asian children's drawing placed the vertical position of the eyes lower down the length of the face than European and South/Central American children. No other comparisons indicated significant di erences at the .05 a-level.

With respect to the drawings of the vertical position of the mouth, the D/A bias ratio values di ered significantly between the four geographic groups, $F(3, 379) = 3.72$, $p < .05$, partial $Z^2 = .029$. Follow-up Sche e tests indicated that the bias in African children's drawings of the vertical position of the mouth was significantly smaller than those of South/Central American children ($p < .05$). In other words, the African children drew the vertical position of the mouth lower down the length of the face than did South/Central American children. No other comparisons indicated significant di erences at the .05 a-level.

Discussion

The current study extends our understanding of the spatial biases that are present in children's imagination-based drawing of faces. Here, McManus et al.'s (2012) observations that children living in London, England systematically draw the head too round and the eyes too high up the face were replicated in a geographically broader sample of children. An additional observation made here was that the drawings produced by children aged from 3 to 8 years were also biased to draw the mouth too high up the head. These drawing biases were present in the drawings of 4- to 6-year-old children living in Africa, Asia, Europe, and South/Central America, indicating a universal similarity in the style in which children draw these spatial relationships. Although some di erences were noted in the drawing biases between children living in di erent continents, these di erences pertained to the magnitude of the biases, and not their direction or presence.

The causes of these geographic differences are presently unclear. They may be due to racial/ethnic- and culture-based differences in average facial structure that children are potentially sensitive to (Farkas et al., 2005; Zhuang, Landsittel, Benson, Roberge, & Shaffer, 2010). However, it is currently unclear as to whether the specific differences between geographic groups that were observed pertaining to the magnitude of vertical eye and mouth drawing biases mirror specific differences in the average facial structure of Asians, Africans, South/Central Americans, and Europeans. Therefore, future research that evaluates racial/ethnic differences in facial morphology may provide clues as to why children of different geographic locations differ from each other with respect to the magnitude of the drawing biases observed here. Nevertheless, despite the fact that some aspects of children's drawings differ across cultures (Cox, 1998; Toku, 2001; Wilson & Wilson, 1982, 1987), it appears that biases in the spatial configuration of facial features is not an aspect of drawing that is influenced by the geographic location the child develops in.

Developmentally, children ranging in age from 3 to 11 years old were observed to express these drawing biases in a qualitatively similar fashion. However, with respect to the vertical positioning of the eyes and mouth, signifiuniversal, the directional congruence of spatial bias in the face drawings of Western children and adults leads to the prediction that adult nonartists from non-Western countries (e.g., those living in Africa or Asia) would also exhibit the same spatial drawing biases when asked to draw a face from imagination or observation. Future research aimed at testing this hypothesis would further clarify the universal or culturally specific nature of face drawing biases.

Following this, it is worth considering the nature of the graphic representations that are stored in long-term memory that guide imagination-based drawings related to observational drawing performance. On the one hand, it could be that the spatial positioning of facial features is represented metrically. According to this perspective, spatial memory biases would be conceptualized as the representations of the relative metric distances between features deviating from that of the average face. On the other hand, it could be that the configuration of facial features is represented in memory in a nonmetric, symbolic fashion. Here, spatial memory biases would take the form of individuals coding the positioning of features in a categorical fashion (e.g., the eyes are the highest feature, the nose is the middle feature, and the mouth is the lowest feature). McManus et al.'s (2012) finding that the eyes are positioned lower and the mouth higher in the face when a nose was neglected to be drawn compared with when a nose was drawn in the face may be consistent with this latter possibility. Here, features could be competing with each other for position in the space of the face. However, future research is needed to distinguish between these two possibilities as the methods employed in this study are not equipped to provide a test of these hypotheses.

Finally, it is important to note that there are two important limitations to this study that prevents one from making strong conclusions relating to the universal or culturally specific nature of these drawing biases. First, the geographic groups that the drawings were categorized into were very broad, each containing countries that are culturally diverse from one another (e.g., Middle-Eastern and Eastern Asian children were combined together in the Asian group). Thus, it is still possible that there are more specific cultural differences with respect to these drawing biases that have been masked by the relatively broad categorization of drawings into continent-based groups. Second, the geographic groups only contained drawings produced by children who were 4 to 6 years old. So, it is still possible that there might be geographic differences in the presence versus younger than 4 years old and older than 7 years old is too small to adequately analyze whether there are geographic di erences in these age groups.

Following this, another limitation exists with respect to the degree of representativeness of children included in the four age groups compared with each other for the developmental analyses. There was a substantial inequality in sample size with respect to the children in the two age groups ranging from 3 to 6 years old ($n = 423$) compared with the children in the two age groups ranging from 7 to 11 years old ($n = 83$). Thus, one may question whether the latter two age groups were as representative of their respective global population as the former two age groups. Thus, it is possible that the observations made here might not be replicated if more equally representative age groups were available to compare with one another.

The limitations highlighted above may be improved upon with future research. Gilles Porte has collected over 4,000 drawings in total from children living in 38 di erent countries (Porte et al., 2012). Although only 938 of them have been digitized and made publically available to date, an ongoing project is being conducted that aims to digitize and make available the entire collection in the near future. Once this has been accomplished, the analyses conducted in the current study could be made more powerful with samples of drawings that are more strongly representative of the age and geographic groups focused on here. Nevertheless, the current study has generated preliminary evidence that has furthered our understanding, albeit tentatively, of the developmental and geographic nature of drawing biases produced in early and late childhood.

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Notes

2. Asian Countries: Israel (n = 18), India (n = 16), Japan (n = 16), Cambodia (n = 3), Sri Lanka (n = 6), Myanmar (n = 17), Mongolia (n = 15), Malaysia (n = 6), Palestine (n = 12), and Thailand (n = 10).
3. European Countries: Belgium (n = 7), Germany (n = 13), France (n = 17), Italy (n = 13), Moldova (n = 17), Turkey (n = 17), and Ukraine (n = 23).
4. South/Central American Countries: Argentina (n = 19), Colombia (n = 11), and Cuba (n = 11).

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