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The Write Bias: The Influence of Native Writing Direction on Aesthetic Preference Biases

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Leftward asymmetries and preference biases are commonly observed among various aspects of spatial composition in artwork. This leftward asymmetry is particularly prominent when examining populations whose native language reads from left to right. However, examination of non-Western populations whose native language is read from right to left often demonstrates a weakening or elimination of the commonly observed leftward biases. The current study examined aesthetic preferences in native Hindi (left-to-right) and Urdu (right-to-left) readers. These groups share extralinguistic and linguistic similarities, as well as a common geographical location and cultural foundation, reducing the potential influence of confounding cultural differences on aesthetic preference biases. Participants viewed mirror-imaged pairs of mobile objects and landscapes in both static and dynamic form and subsequently judged which stimulus was more aesthetically pleasing. Despite the cultural similarities between the sample groups, native left-to-right readers demonstrated a strong preference for stimuli with left-to-right directionality (η^2 = .220), whereas right-to-left readers failed to demonstrate a preference bias. Furthermore, the magnitude of the preference biases observed by both groups was larger for the dynamic stimuli compared to the static stimuli. This pattern of results provides evidence that the strength of aesthetic bias is influenced by both behavioral biases, such as scanning habits developed from reading direction, and neural and anatomical asymmetries in spatial attention mechanisms.

Keywords: aesthetic preference, reading direction, dynamic stimuli, right hemisphere, laterality

The spatial composition of artwork is characteristically organized in an asymmetrical manner, with the most noted asymmetries present in posing direction, location of lighting source, and the directionality of the image content. In particular, researchers examining posing direction have found that the left cheek is displayed in a larger portion of single-subject portraits than the right cheek, producing a leftward posing bias (Conesa, Brunold-Conesa, & Miron, 1995; Gordon, 1974; Grüsser, Selke, & Zynda, 1988; McManus & Humphrey, 1973). This leftward posing bias is evident in painted portraits from several time periods (Humphrey & McManus, 1973) and when participants are asked to pose for a family portrait (Nicholls, Clode, Wood, & Wood, 1999). Similarly, light sources illuminating portraits and advertisements, from the perceiver's point of view, are often located in the top left corner, producing a leftward lighting bias. Portraits, photographs, and advertisements are more commonly lit from the left than from the right (LaBar, 1973; McManus, Buckman, & Woolley, 2004; Thomas, Burkitt, Patrick, & Elias, 2008), and artists prefer locating the light at an angle left of the vertical when illuminating paintings (McDine, Livingston, Thomas, & Elias, 2011; Sun & Perona, 1998), which in turn have been found to create a more favorable purchase intention (Hutchison, Thomas, & Elias, 2011). From the point of view of the perceiver, a leftward directionality bias is also evident in the asymmetrical organization of content within an image with aesthetic preference being given to images whose content directionality flows from left to right and whose mass is located on the right side of the image (Beaumont, 1985; Christman & Pinger, 1997; Freimuth & Wapner, 1979; Levy, 1976; Mead & McLaughlin, 1992; Palmer, Gardner, & Wickens, 2008).

These aesthetic preference asymmetries found in artwork have been largely explained by perceptual and attentional biases that are generated by underlying neurobiological mechanisms. It has been proposed that perceptual biases toward the left hemifield are associated with a phenomenon in neurologically healthy participants known as pseudonelgect (Bowers & Heilman, 1980; Jewell & McCourt, 2000). Pseudonelgect has been found to involve the right posterior parietal cortex (PPC), the dorsolateral prefrontal cortex (PFC), and the superior longitudinal fasciculus, which connects the PFC and PPC (Bartolomea, De Schotten, & Chica, 2012; Bowers & Heilman, 1980; Corbetta, Kincade, Ollinger, McAvoy, & Shulman, 2000; Foxe, McCourt, & Javitt, 2003; Thiebaut de Schotten et al., 2011; Vallar, 1998). Converging evidence from a large body of literature has suggested that preferential activation of the right hemisphere distributes attention to the left visual field and increases the salience of features located in the left hemispace

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during visuospatial tasks, such as viewing artistic stimuli (Bultitude & Aimola Davies, 2006; Kinsbourne, 1970; Loftus & Nicholls, 2012; Ossandón, Onat, & König, 2014; Nuthmann & Matthias, 2013; Reuter-Lorenz, Kinsbourne, & Moscovitch, 1990).

Visuospatial research using vertebrate animal models has provided further support for an underlying neurobiological mechanism that may be influencing an attentional bias to the left visual field, as a consequence of the right hemisphere's dominance over spatial attention processing (Diekamp, Manns, Güntürkün, Vallortigara, & Regolin, 2005; Diekamp, Regolin, Güntürkün, & Vallortigara, 2005; Regolin, 2006; Rugani, Kelly, Szelest, Regolin, & Vallortigara, 2010). A pecking bias to the left hemispace during free foraging (Diekamp et al., 2005) and during line bisection tasks has been displayed by avian species, including domestic chicks and pigeons (Diekamp et al., 2005). Similarly, domestic chicks and nutcrackers have demonstrated greater accuracy in correctly identifying the ordinal sequence of containers when pecking the sequence from left-to-right compared to pecking the sequence from right to left (Rugani et al., 2010). The asymmetric leftward biases and left-to-right ordinal preferences exhibited in nonhuman vertebrates further support the role of underlying neurobiological mechanisms in generating aesthetic preference asymmetries.

However, the reliability of leftward perceptual and attentional biases is inconsistent when non-Western populations whose native language reads from right to left are examined (Chokron & Imbert, 1993; Friedrich, Harms, & Elias, 2014; Ishii, Okubo, Nicholls, & Imai, 2011; Nachson, Argaman, & Luria, 1999; Nicholls & Roberts, 2002; Perez Gonzalez, 2012). In these populations, the typical leftward bias consistently observed in left-to-right readers is notably weakened or eliminated entirely. Thus, the orientation of visuospatial attention appears to be flexible (Foulsham, Gray, Nasiopoulos, & Kingstone, 2013) and susceptible to environmental and cultural influences such as scanning habits, resulting in divergent biases on visual spatial tasks for native left-to-right and right-to-left readers. The reading direction of an individual's first language has been found to influence perception of space (Chokron & Imbert, 1993), perception of motion (Morikawa & McBeath, 1992), and eye movement exploration (Abed, 1991), leading to unequal distribution of attention (Pollatsek, Bolozky, Well, & Rayner, 1981). Consequently, in addition to hemispheric specialization, scanning habits operating during visuospatial tasks may also influence orientation of attention and aesthetic preference biases (Chokron, Kazandjian, & De Agostini, 2009).

Research investigating aesthetic preference in left-to-right and right-to-left reading groups has found a preference for images that portray objects in the direction congruent with the participants' reading direction. Chokron and De Agostini (2000) and Ishii et al. (2011) used similar methods to examine samples whose reading directions were opposite and recognized that left-to-right readers prefer images of mobile and static objects that display a left-to-right directionality from the perceiver's point of view, whereas right-to-left readers prefer a right-to-left directionality. In addition to examining static stimuli, Friedrich and colleagues (2014) examined the influence of scanning habits on aesthetic preference of dynamic stimuli (videos) consisting of realistic mobile objects and landscapes. Like Chokron and De Agostini (2000) and Ishii et al. (2011), Friedrich et al. (2014) found a significant leftward bias for left-to-right readers, which was strongest for dynamic stimuli, but failed to identify a directional preference bias for static or dynamic images in right-to-left readers.

Contrary to Chokron and De Agostini's (2000), Ishii and colleagues' (2011), and Friedrich and colleagues' (2014) comparable results, Treiman and Allaith (2013) failed to find a significant difference between native left-to-right and right-to-left readers' aesthetic preference for images of static and mobile objects. A preference for rightward-facing objects was found in both reading direction groups. However, unlike prior research examining aesthetic preference and writing system directionality, Treiman and Allaith (2013) used filler stimuli that were not mirror-imaged pairs to prevent participants from developing strategies when selecting images and to disguise the researchers' interest in compositional asymmetries. As well, the researchers used a sample that was significantly larger than prior research, and the sample comprised children rather than adults (735 Bahraini students from Grades 2–12).

The contradictory results regarding the influence of cultural factors on leftward spatial biases warrant further investigation of scanning habits with homogeneous sample groups to determine the contribution of scanning habits on aesthetic preference. Furthermore, previous research has consistently compared non-Western right-to-left reading groups to a Western sample of left-to-right readers, which may confound reading direction with extralinguistic (e.g., context of usage, direction of arithmetic and music) and linguistic differences (e.g., phonology and grammar; Vaid & Singh, 1989). Ideally, research examining left-to-right and right-to-left reading groups should examine groups that have extralinguistic and linguistic similarities, as well as a common geographical location and cultural foundation. Thus, the aim of the research was to uniquely examine participants whose native language is Hindi (left-to-right readers) and Urdu (right-to-left readers), as both languages originate from the same geographical location, India, and both share common a lexicon, phonology, and grammar but differ in the direction that single letters and words are written and read (Vaid & Singh, 1989). Using methods similar to those employed by Friedrich and colleagues (2014), it is predicted that participants who read from left to right will reliably demonstrate a leftward aesthetic preference bias, consistent with previous literature examining Western populations (Chokron & De Agostini, 1995, 2000; Chokron et al., 2009; Friedrich et al., 2014; Ishii et al., 2011; Morikawa & McBeath, 1992; Nachson et al., 1999; Perez Gonzalez, 2012). However, if visual scanning direction influences orientation of attention, participants who read from right to left are expected to demonstrate a weaker leftward, or central, bias as right-to-left scanning habits are expected to balance the results from hemispheric specialization of the right hemisphere for visual attention (Abed, 1991; Chokron & Imbert, 1993). As predicted by Friedrich et al. (2014), dynamic stimuli are expected to accentuate preference biases observed from the static stimuli and magnify the effect of scanning habits on aesthetic preference biases.

Method

Participants

A total of 31 participants recruited from the University of Saskatchewan consented to participate and were naïve to the expected outcome of the study. Fourteen of the participants' native language was Hindi (M = 24.29 years, SD = 5.21 years), of whom 9 were male, and 17 participants' native language was Urdu (M = 24.76 years, SD = 5.89 years), of whom 9 were male. All of the participants were bilingual and fluent in English. The procedures received ethical approval from the University of Saskatchewan Behavioral Research Ethics Board.

Stimuli and Procedure

Participants viewed a total of 160 realistic stimuli, which were composed of four categories with 20 mirror-imaged pairs in each category. The categories consisted of static images of mobile objects, static images of landscapes, dynamic videos of mobile objects, and dynamic videos of landscapes. Landscapes included moving water, wind, aurora borealis, clouds, and lava, whereas mobile objects consisted of animals (e.g., penguins, horses, polar bear, giraffe, dolphins, geese, deer, and moose) and a variety of motorized vehicles (e.g., boat, helicopter, and planes). The dynamic stimuli were selected from YouTube video clips that portrayed direct horizontal movement of landscapes and mobile objects. The videos were shortened to 2 s in length, and a second mirror image of the original video was created using QuickTime Player 10.2. To ensure that the movement maintained a horizontal direction and the participants' attention on the direction of the movement, the videos were 2 s in length (Maass, Pagani, & Berta, 2007). The static stimuli were created from the dynamic stimuli and consisted of a single screenshot of the video, which was subsequently copied and horizontally flipped to mirror the original image. The images and videos were displayed to the participants on a 1680 × 1050 resolution 22-inch Acer monitor using Microsoft PowerPoint 2011. The 1267 (33.24 degrees) × 710 (19.19 degrees) to 640 (17.15 degrees) × 329 (8.96 degrees) resolution images and 1280 (33.57 degrees) × 720 (19.46 degrees) to 320 (8.62 degrees) × 240 (6.54 degrees) resolution videos were presented subsequently in the middle of the individual slides following presentation of a fixation cross. The 2 s of video played automatically and was looped until stopped by the participant.

Participants were presented 80 pairs of stimuli (original orientation and its mirror image) in two separate blocks. Forty static stimuli were presented in the first block, followed by 40 dynamic stimuli in the second block. Half of the pairs within each block displayed the stimulus with a left-to-right directionality, from the participants' point of view, prior to the right-to-left directionality, which was reversed for the remaining pairs. The order in which the participant viewed the stimulus in each pair and the order that the pairs of stimuli were presented to the participants were randomized. Participants were required to make a forced-choice decision between the paired stimuli and asked to indicate which stimulus was more aesthetically pleasing. The participants' responses were recorded on a response sheet.

Scoring

A preference score was calculated for each stimulus pair and then totaled for each condition. Stimuli with left-to-right horizontal directionality, from the participants' point of view, was designated a score of −1, whereas stimuli with right-to-left horizontal directionality was designated a score of +1, allowing scores in each of the four categories to range from −20 to +20. Thus, a negative score indicated a left-to-right directionality preference.

Results

Direction preference was analyzed with a 2 Stimulus Form (Image, Video) × 2 Content (Mobile Object, Landscape) × 2 Reading Direction (Left-to-Right, Right-to-Left) mixed-measures analysis of variance (ANOVA). A Bonferroni adjusted alpha level of 0.0167 (.05/3) was used to test the three a priori hypotheses. There was a significant effect for stimulus form, $F(1, 29) = 9.548$, $p = .004$, $\eta^2 = .248$, where a greater left-to-right preference was found for videos, $M = -6.39$, $SD = 10.01$, compared to images, $M = -1.89$, $SD = 4.87$. A significant effect was also found for reading direction, $F(1, 29) = 8.188$, $p = .008$, $\eta^2 = .220$, where left-to-right readers demonstrated a stronger preference bias, $M = -7.61$, $SD = 6.71$, compared to right-to-left readers, $M = -.68$, $SD = 6.71$. However, there was no significant main effect of content, $F(1, 29) = .505$, $p = .483$, $\eta^2 = .017$. As well, no significant interactions were found (see Table 1).

To determine if a left-to-right directionality preference was present, one-sample t tests were conducted for each stimulus type to compare the mean to a test value of zero. Following Bonferroni adjustment of alpha levels to 0.0125 (0.05/4), left-to-right readers showed a left-to-right preference for images of mobile objects, $t(13) = -3.426$, $p = .005$, 95% CI [−7.74, −1.98], $d = -1.900$; images of landscapes, $t(13) = -3.259$, $p = .006$, 95% CI [−7.65, −1.77], $d = -1.807$; videos of mobile objects, $t(13) = -4.021$, $p = .001$, 95% CI [−16.57, −5.71], $d = -2.230$; and videos of landscapes, $t(13) = -3.191$, $p = .007$, 95% CI

Table 1
Analysis of Variance Results

Interaction	F	df	Significance	η_p^2	SS
Stimulus Form	9.548	1, 29	.004	.248	621.290
Content	.505	1, 29	.483	.017	8.952
Reading Direction	8.188	1, 29	.008	.220	1475.115
Stimulus Form × Reading Direction	.619	1, 29	.438	.021	40.258
Content × Reading Direction	.105	1, 29	.749	.004	1.855
Stimulus Form × Content	.009	1, 29	.755	.003	.934
Stimulus Form × Content × Reading Direction	.717	1, 29	.404	.024	6.740

Note. The main effects and interactions resulting from the 2 (Stimulus Form [Image, Video]) × 2 (Content [Mobile, Landscape]) × 2 (Reading Direction [Left-to-Right, Right-to-Left]) mixed-measures analysis of variance. SS = sum of squares.

[−15.68, −3.74], $d = -1.770$. However, right-to-left readers failed to show a preference bias for images of mobile objects, $t(16) = .511$, $p = .616$, 95% CI [−2.00, 3.42], $d = 0.256$; images of landscapes, $t(16) = .951$, $p = .356$, 95% CI [−1.38, 3.96], $d = .476$; videos of mobile objects, $t(16) = -1.05$, $p = .309$, 95% CI [−6.74, 2.04], $d = -.525$; and videos of landscapes, $t(16) = -.946$, $p = .358$, 95% CI [−7.22, 2.52], $d = -.473$ (see Table 2).

Discussion

Consistent with previous literature examining visuospatial biases of left-to-right and right-to-left readers, the two reading groups in the current experiment demonstrated different preference biases. Similar to previous research examining Western populations, participants whose native language reads from left to right (Hindi) demonstrated a strong preference for stimuli with a left-to-right directionality from the perceivers' point of view. However, participants whose native language reads from right to left (Urdu) failed to demonstrate a lateral preference bias for all stimuli. Consistent with Friedrich and colleagues (2014) and inconsistent with Chokron and De Agostini (2000) and Ishii and colleagues (2011), the directionality preference observed by both reading groups was independent of the type of object portrayed in the stimuli (i.e., mobile object or landscape) and dependent on the directionality depicted in the image or video. As well, the magnitude of the bias demonstrated by both reading direction groups was larger for the dynamic stimuli compared to static stimuli, suggesting that dynamic stimuli should be used as a tool to magnify the occurrence of lateral biases.

Asymmetrical aesthetic preference biases influenced by perceptual and attentional biases toward the left hemifield are often explained by the preferential activation of the right hemisphere that distributes attention to the left visual field and increases the salience of features located in the left hemispace (Bowers & Heilman, 1980). The exact underlying neurological mechanisms responsible for the increased salience of features located in the left hemispace are currently debated (Thiebaut de Schotten et al., 2011; Ossandón et al., 2014; Reuter-Lorenz et al., 1990). However, according to the processing-efficiency model, the directionality of a stimulus, specifically left-to-right directionality, appears to draw the participants' gaze to the right portion of the picture, consequently allowing the majority of the stimulus to be positioned within the left visual field and primarily processed by the right hemisphere (Beaumont, 1985). However, the fluent gaze bias to the right portion of the image, resulting in efficient visual processing, appears to be moderated by one's native reading direction. Thus, the preference asymmetry resulting from the leftward attentional bias is strengthened by left-to-right script direction (congruent) or weakened by right-to-left script direction (incongruent). This pattern of results provides evidence that the strength of the preference asymmetry is influenced by behavioral biases, such as scanning habits developed from reading direction, and neural and anatomical asymmetries in spatial attention mechanisms localized in the right parietal and frontal cortices (Szczepanski & Kastner, 2013; Thiebaut de Schotten et al., 2011).

Left-to-right and right-to-left readers show different perceptual biases in line bisection tasks (Chokron, Bernard, & Imbert, 1997; Chokron & Imbert, 1993; Chokron & De Agostini, 1995), aesthetic preference tasks (Chokron & De Agostini, 2000; Friedrich et al., 2014; Ishii et al., 2011; Nachson et al., 1999; Perez Gonzalez, 2012), and lighting tasks (Smith & Elias, 2013). Additionally, manipulation of scanning direction has also been found to influence perceptual and attentional biases. During line bisection tasks (Brodie & Pettigrew, 1996) and face perception (Butler & Harvey, 2006), the direction and magnitude of perceptual biases have been found to be influenced by the manipulation of scan direction and eye movement, with biases deviating toward the direction from which the scan is initiated.

Researchers have previously demonstrated that it is not the final fixation point but rather saccades that are influenced by reading direction and cultural factors (Abed, 1991; Chokron et al., 2009). Research investigating right-to-left readers' visual gaze pathway during spatial attention tasks with eye tracking is limited. Recently, left-to-right readers were found to identify targets faster when they were located in the upper-left quadrant compared to the upper-right quadrant during a visual search task, whereas right-to-left readers showed no difference in search time for targets located in the upper-right and upper-left quadrants (Smith, 2013). This suggests that reading direction influences location of attention, as well as initial fixation, and that writing system directionality may interact with the right hemisphere dominance for visuospatial information.

Although both experimental groups were bilingual and highly trained in English, which restricts the generalization of the results to groups who have opposite native writing systems, the specific examination of native Hindi and Urdu readers allowed for a more controlled investigation of aesthetic preference. Furthermore, the examination of two non-Western reading groups limited the influence of potentially confounding variables stemming from differences between Western left-to-right readers and non-Western right-to-left readers. With efforts to limit the influence of additional cultural factors in the current experiment, the results were

Table 2
Response Bias in Left-to-Right and Right-to-Left Readers

	Left-to-right readers			Right-to-left readers		
Stimulus	*n*	*M* (*SD*)	95% CI	*n*	*M* (*SD*)	95% CI
Mobile object videos	14	−11.14 (10.37)	[−16.57, −5.71]	17	−2.35 (9.23)	[−6.74, 2.04]
Landscape videos	14	−9.71 (11.39)	[−15.68, −3.74]	17	−2.35 (10.25)	[−7.22, 2.52]
Mobile object images	14	−4.86 (5.30)	[−7.64, −2.08]	17	.71 (5.70)	[−2.00, 3.42]
Landscape images	14	−4.71 (5.41)	[−7.54, −1.88]	17	1.29 (5.61)	[−1.38, 3.96]

Note. CI = confidence interval.

consistent with previous literature identifying a difference in aesthetic preference when examining left-to-right and right-to-left readers. Comparing two reading groups that have extralinguistic and linguistic similarities and who originate from a common geographical location strengthened the results of the study. These similarities reduced the potential influence of cultural differences on aesthetic preference biases and improved isolation of the variable of interest, writing system directionality. The research sheds further light on the currently debated topic of moderating effects of script direction on underlying neurobiological mechanisms that influence aesthetic preference for asymmetrical stimuli (Suitner & McManus, 2011).

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