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The Role of Stimuli Complexity and Handedness on Visual Symmetry and Asymmetry Preference

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ABSTRACT

Previous research results indicate visual information processing asymmetry in case of visual verbal stimuli. However, other studies that investigate nonverbal stimuli processing show inconsistent effect of laterality. Although differences between left- and right-handers can be found in tasks that involve letters, spatial attention stimuli and visuomotor control performance, the differences between the two groups almost disappear in several directional preference tasks, suggesting that direction preference is influenced mainly by writing and reading habits. Perceiving visual art involves visual attention, that is driven by the bottom-up aspects of the visual stimuli, therefore perception of nonverbal images, that contain geometrical forms might be influenced by handedness. To assess the possible differences in visual symmetry-asymmetry preference, university students (N = 65) were divided into two groups based on handedness, and as a measurement we used simple-complex- symmetrical and asymmetrical geometrical forms. Our main result shows a significant effect of stimuli complexity on symmetry-asymmetry preference. The interaction effect between handedness and symmetry-asymmetry type was not significant. After conducting a pairwise comparison our results show that right-handers evaluate simple and complex symmetrical forms as more preferable than simple and complex asymmetrical forms. We also found that there is a preference for symmetry over asymmetry in both groups, however these differences are significant only in the right-handed group. We conclude that preference for symmetrical geometrical forms is not influenced by handedness, however preference for complexity is affected by right-handedness. To extend these results, further investigations are needed.

1. Introduction

Aesthetical judging is the process where one evaluates a certain visual stimulus considering several aesthetic standards, while aesthetic preference is a result of the liking of the certain visual stimulus (van Hounten et al., 1981). The former process is considered as more objective, while the latter is influenced by more subjective factors. Considering the differences between the two processes, in this study we are focusing on the aesthetical preference aspect of geometrical forms.

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Aesthetical preference is influenced by several physical and psychological factors of the to-be-preferred stimulus and by the person that is making the decision. Therefore, physical characteristics of the stimulus, colour, composition, symmetry, visual complexity and contrast play a major role in the process, while personal attributes like age, education, knowledge and context have an impact on aesthetical preference (Braun et al. 2019; Kahler et al., 2020). However, there is some inconsistency in the literature regarding the personal factors of the aesthetical sensitivity, as results indicate that intelligence, personal traits or domain specific knowledge, such as experience in art do not influence aesthetical sensitivity (Corradi et al., 2019).

Studies that investigate biological factors that influence aesthetical preferences of symmetrical and asymmetrical visual stimuli are reporting that hemispheric asymmetry (Nachson et al., 1999), age (de Agostini et al., 2010) and sex (De Agostini, et al., 2010; Bode et al., 2017) affect visual symmetry and asymmetry preference. The link between left- or right-handedness and aesthetical preference has also been investigated previously, study results indicating that the relationship between them is not direct (Nachson et al., 1999). However, results also show that performance of left-handers in visual symmetry tasks were less consistent regarding asymmetry (Bryden, 1973).

Visual perception is influenced by different cerebral processes. It has been proven that the two hemispheric functions differ during visual perception in the majority of people (Petit et al., 2015; Nachson, 1985; Bryden, 1973). Left-handers tend to have a right hemispheric dominance, the right hemisphere being responsible for the processing of verbal stimuli, while the left hemisphere is considered to process the visuo-spatial aspect of the visual field by visual attention (Petit et al., 2015).

Hemispheric asymmetry studies report that stimulus processing is influenced by the aspect of the stimulus. Verbal stimulus processing shows a left hemispheric dominance, while visual stimuli processing is right hemisphere-dependent (Nachson, 1985). Interestingly, results of one particular study show no differences between left- and right-handers regarding non-verbal stimulus processing (Bryden, 1973). However, left-handers tend to use their non-dominant hands during object manipulation more often, compared to right-handers (Gonzalez et al., 2007). Left-handers also tend to react slower to haptic stimuli (Stoycheva & Tiippana, 2018). This can explain the specific spatial attention processing of the right hemispheric dominance, which is merely a manipulation aspect, rather than perceptual or motoric processing difference (Bryden, 1973).

On an individual level (Corradi et al., 2019), visual aesthetic preference is influenced by psychological factors such as culture (Bode et al., 2017), and domain specific knowledge such as visual art expertise (Koide et al., 2015). However, since aesthetic judgement is influenced by hemispheric dominance (van Hounten et al., 1981), the purpose of the current study is to investigate aesthetical preference mediated by handedness.

As mentioned earlier, besides several psychological factors, symmetry also defines aesthetical preference. Together with the symmetrical aspects, results indicate that curved shapes are preferred over sharp forms, balanced over unbalanced, and complex over simple forms (Corradi et al., 2019).

Considering the above-mentioned research results, the aim of the current study is to investigate specific aspects of handedness on symmetry- asymmetry preference of simple and complex geometrical forms.

2. Materials and Methods

2.1. Participants

65 participants have been gathered from Babes-Bolyai University, Cluj-Napoca, Romania. Participants have been divided into two groups based on their hand dominance: right-handed (N = 35) and left-handed (N = 30). Status for handedness was reported by each participant. The mean age of students was 21.02 years, ranging from 18 to 30 years.

Table 1.
Sociodemographic Data of the Participants

		N	Min.	Max.	M.	SD	%
Age		65	18	30	21.02	2.36	
Gender	Male	15					23.1
	Female	50					76.9
Handedness	Right handers	35					53.8
	Left handers	30					46.2

2.2. Material

In the present study we investigated participants' symmetry- asymmetry preference of simple and complex geometrical forms. We used the stimuli created by Jacobsen & Höfel (2001). Two hundred fifty-two stimuli have been constructed, half of which (126) were symmetrical, while the other half were asymmetrical. Stimulus complexity has been manipulated by changing the number of elements of the pattern.

2.3. Procedure

Participants were presented with the stimuli, and they were requested to evaluate the presented patterns aesthetically. They were instructed to evaluate the patterns as beautiful, not beautiful, or indifferent, however at least 75 of the shown stimuli have to be categorized as beautiful and 75 of the patterns have to be categorized as not beautiful (Jacobsen & Höfel, 2002).

2.4. Data Analysis

A statistical power analysis, G*Power (Faul, Erdfelder, Lang, Buchner, 2007; Faul, Buchner, Lang, 2009) has been used to compute sample size. In order to detect an effect of $\boldsymbol{\eta}^2_p = .04$ with 80% power in two- way analysis of variance ANOVA (two groups, alpha = .05), G*Power suggests we would need 32 participants in each group (N = 64).

3. Results

A Shapiro- Wilk test of normality did not show a significant departure from normality for the mean scores: of Simple symmetrical forms W(65) = .963, p = .52; Complex symmetrical forms W(65) = .972, p = .151; Simple asymmetrical forms W(65) = .984, p = .58; Complex asymmetrical forms W(65) = .982, p = .482.

Two- way between- groups analysis of variance was conducted to explore the impact of artistic experience on the dependent variable, measured by visual stimuli originally produced by Jacobsen and Höfel (2001). Participants were divided into two groups based on their hand dominance.

Table 1.
Means and Standard Deviations for Hand dominance and Symmetry- asymmetry preference for simple and complex geometrical forms

	Simple symmetrical		Complex symmetrical		Simple asymmetrical		Complex asymmetrical	
Group	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Right handers	1.57	0.34	1.67	0.34	1.76	0.27	1.87	0.23
Left handers	1.62	0.62	1.63	0.37	1.76	0.33	1.76	0.26

The interaction effect between handedness and symmetry-asymmetry type was not significant F (3, 252) = 0.75, p = 0.53. The main effect for handedness F (1, 252) = 0.28, p = 0.59, was statistically not significant. There was a statistically significant main effect for symmetry-asymmetry type F (3, 252) = 6.3, p = 0.00, the effect size was medium (partial eta squared = .07).

Table 2.
Summary of the Two- way Analysis of Variance for Groups and Symmetry- asymmetry preference

Source	**df**	**SS**	**MS**	**F**
Group	1	.029	.029	.28
Symmetry- asymmetry	3	1.92	.64	6.34*
Group x Symmetry- asymmetry	3	.224	.075	.737
Within cells	252	25.52		
Total	260	788.78		

*$p < .01$.

To entirely understand group differences, we conducted Pair- wise tests of the differences between the right- and left-handed groups over simple symmetrical, complex symmetrical, simple asymmetrical and complex asymmetrical preference.

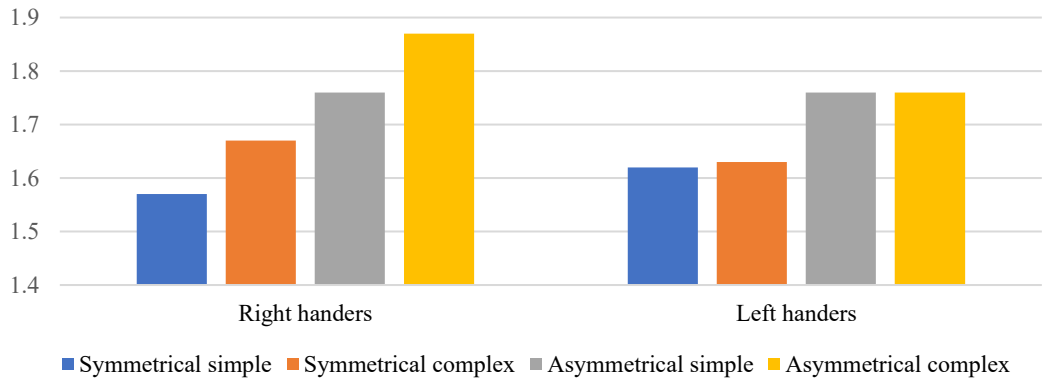

Figure 1. *Preference for Symmetrical- asymmetrical simple and complex geometrical forms of the two groups*

Note: *the higher the score the less preferable the stimuli have been judged.*

Pair-wise comparision indicated that the mean score for right-handed group of simple symmetrical forms (M = 1.57, SE = .054), was significantly different from simple (M = 1.76, SE = .054) and complex asymmetrical forms (M = 1.87, SE = .054), however the mean score of simple symmetrical forms was not significantly different from complex symmetrical forms (M = 1.67, SE = .054). The differences between simple (M = 1.76, SE = .054) and complex

asymmetrical forms (M = 1.87, SE = .054) were not statistically significant in the right-handed group.

The mean score for left-handed group of simple symmetrical forms (M = 1.63, SE = .058), was not significantly different from simple (M = 1.76, SE = .058) and complex asymmetrical forms (M = 1.76, SE = .058). The mean score of simple symmetrical forms was not significantly different from complex symmetrical forms (M = 1.63, SE = .058). The differences between simple (M = 1.76, SE = .058) and complex asymmetrical forms (M = 1.76, SE = .058) were not statistically significant in the left-handed group.

4. Discussion and Conclusion

In the present study a two- way analysis of variance was conducted to explore the impact of handedness on symmetry- asymmetry type, measured by the stimuli originally created by Jacobsen & Höfel (2001). Participants were divided into two groups based on their hand dominance. The interaction effect between handedness and symmetry-asymmetry type was not significant. There was a statistically significant main effect for symmetrical and asymmetrical geometrical form complexity, the effect size was medium. Our results also show that simple and complex symmetrical forms are preferred over simple and complex asymmetrical forms regardless of group. After conducting a pairwise comparison test, our result indicates a significant difference within groups, regarding the complexity of symmetrical- asymmetrical forms. Right-handers tend to prefer simple and complex symmetrical forms more than simple and complex asymmetrical forms, however these differences in preference for complexity of symmetrical and asymmetrical forms are not significant in the left-handed group. We found no significant differences between the two groups regarding preference of simple and complex symmetrical, and complex asymmetrical forms.

The results of the current paper show that symmetrical forms are preferred over asymmetrical ones. These results are in line with previous study results (Jacobsen & Höfel, 2001; Leder et al., 2004; Corradi et al., 2019). Our results also indicate that hemispheric dominance does not influence aesthetic preference, nor do directional habits (Nachson et al., 1999).

Interestingly, statistically significant differences in preference complexity have been present only in the group of right-handers, differences in preference between simple and complex forms did not differ statistically in the left-handed group. These results might suggest that hand dominance plays a role in visual field preference, and are also by some means in line with previous study results, where aesthetical preference of left-handed adult female participants did not show significant differences (De Agostini et al., 2010).

As another possible explanation for our result, the significant differences in complexity preference within right-handers and the lack of the same difference within left-handers, was originated by the nature of the study materials. Abstract geometrical forms were presented regardless of their non- verbal aspect, hence it is possible that their processing required some verbalizations, as previously claimed by Bryden et al. (1973), performing non-verbal tasks results in a specific activity that might inhibit the observation of the laterality effect.

As a further direction and a current limitation of this study, we suggest that testing for hand dominance is needed to extend our results. Participants have been divided into two groups based on their self-reported hand dominance, therefore participants with ambidexterity were miscategorized.

To summarize, we can conclude that preference for symmetrical geometrical forms is not influenced by handedness, however preference for complexity is affected by right-

handedness. Further examinations are needed to investigate other possible biological and psychological factors that determine preference for simple and complex symmetrical forms.

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