GESTALT THEORY, DOI 10.2478/gth-2024-0012
© 2024 (ISSN 2519-5808); Vol. 46, No. 2-3, 157–168

Original Contributions - Originalbeiträge

Marta Maisto & Rossana Actis-Grosso

The impact of spatial placement on valence judgments of images: a comparative analysis between right-handed and left-handed individuals

Introduction

Across cultures, concepts of 'good' and 'bad' are frequently mapped onto spatial dimensions, where the right side is associated with positive qualities and the left side with negative ones (McManus, 2002). This pattern appears in language and common phrases, with 'right' often associated to positive meanings and 'left' to negative ones (McManus, 2002). In English, for instance, 'right' conveys both a spatial direction and correctness, while the phrase 'left to rot' suggests neglect or abandonment.

However, in addition to language and cultural frameworks, individuals tend to associate spatial areas with positive or negative meanings based on their own handedness and motor proficiency (e.g., Casasanto, 2009; Milhau et al., 2015).

According to embodied cognition theories (Barsalou, 1999, 2008), the Body Specificity Hypothesis (BSH) introduced by Daniel Casasanto (2009) posits that right-handed individuals are more likely to associate 'good' with their dominant-hand side and 'bad' with the opposite side. This tendency likely stems from greater comfort and fluency in actions performed with the dominant hand, which fosters positive emotions (Beilock & Holt, 2007; Cannon et al., 2010). The BSH suggests that these fluency-based preferences influence spatial associations with affect, leading to space-valence associations.

Research backing this hypothesis spans numerous cultures and age groups, including studies with children as young as five (de la Fuente et al., 2015). It has been examined across varied contexts, such as response time experiments (de la Vega et al., 2012; Kong, 2013), simulated job interviews (Casasanto 2009, exp. 5), group membership (Dalmaso et al., 2022; Kühne et al., 2022), and even analyses of politicians' hand gestures during speeches (Casasanto & Jasmin, 2010).

As aforementioned, while prior research employed response time paradigms within the BSH framework (de la Vega et al., 2012, 2013; Kong, 2013; Milhau et al., 2015), limited attention has been given to the influence of the spatial placement of stimuli on valence evaluation without motor feedback (e.g., without hands or feet movements). In this vein, a few studies (Everhart et al., 1996; Natale et al., 1983) have examined the effect of the spatial placement of stimuli on valence judgments, exclusively focusing on facial expressions as stimuli. Specifically, in a valence judgment task (Natale et al., 1983), individuals with right-handed dominance judged all expressions except happiness as more negative when presented in the left visual field (LVF). However, in a study by Everhart et al. (1996), a different pattern was observed: while right-handed participants consistently perceived neutral faces regardless of the visual field, left-handed individuals evaluated neutral faces as more positive (happy) when presented in the LVF and more negative (angry) when presented in the right visual field (RVF).

Furthermore, Casasanto's (2009) investigations primarily focused on the spatial positioning of stimuli, either through drawing or vocal responses, such as in the "Bob goes to the zoo" task (see below) or through binary choices tasks: for example, participants were instructed to attribute positive or negative qualities to items (alien creatures) positioned on the right or left side.

Considering the limited evidence concerning the impact of spatial stimuli on explicit valence evaluation, we assert that it is crucial to deeply investigate this aspect in absence of motor responses. Specifically, we think it is worth investigating whether body-specific associations might be evident in a valence judgment task involving neutral images placed alternately at the center, right, and left of a screen. Images should be presented to both right-handed and left-handed participants as, consistent with the BSH, their space-valence associations are expected to be opposite: for right-handers, right is positive and left is negative, whereas for left-handers, left is positive and right is negative. It is important to underscore that when we refer to body-specific associations, we refer to the valence reinforcement effect that has been found over time in studies involving lateralized hands movements (for example, see Cervera Torres et al., 2020). The valence reinforcement effect is a reinforcing effect on the valence appraisals of stimuli (i.e., stimuli being more positively/negatively evaluated) when there is a match between the valence category of the stimuli, the hand used for interaction, and the starting side of the movement.

The rationale for investigating this phenomenon considering exclusively the different (center vs right vs left) visual field is diverse. Firstly, it is necessary to consider that in the "Bob goes to the zoo" task (Casasanto, 2009), positive animals were associated with the right side by right-handed individuals and with the left side by left-handed individuals, then hypothetically, presenting images on the right, left, and center visual field could also potentially modify valence judgments within right-handers and left-handers respectively, as well as between right-handers and left-handers. Secondly, excluding those few studies (Everhart et al., 1996; Natale et al., 1983) that used exclusively facial expressions as stimuli, as mentioned earlier, the valence reinforcement effect has been investigated mainly when associated with hand movements, typically lateralized (Cervera Torres et al., 2020; Milhau et al., 2013). For example, in the study conducted by Milhau et al. (2013), in a valence judgment task, right-handed participants who performed smooth rightward arm movements using an evaluative scale aligned with their space-valence association (where positivity was associated to the right and negativity to the left) tended to offer more positive assessments for neutral words. Conversely, when executing non-fluent leftward movements with an incongruent scale, participants displayed a tendency toward negative evaluations. Therefore, it can be assumed that studies exclusively examining the exposure of stimuli to the right and left are indeed scarce (Everhart et al., 1996; Natale et al., 1983) and those few have focused on a single type of stimuli, namely, facial expressions. Therefore, considering these factors, the research questions are as follows: (1) do neutral stimuli placed at the center, right, and left of a screen affect participants' valence evaluations based on their space-valence associations? (2) If so, do valence evaluations differ between right-handed and left-handed individuals in accordance with their space-valence associations?

According to the BSH, we expected participants to provide more positive evaluations for images positioned in the space aligned with their dominant hand, typically associated with positive concepts. Conversely, we anticipated more negative evaluations for images placed on the side aligned with their non-dominant hand, generally associated to negative concepts. Additionally, we hypothesized that left-handed participants would rate images in the LVF more positively than right-handed participants, while right-handers would evaluate images in the RVF more positively than left-handers. To test these hypotheses, we conducted a valence judgment task in which participants evaluated stimuli positioned in the center, right, and left visual fields across two experimental sessions.

Method

Participants

Based on existing literature using a similar procedure (Everhart et al., 1996) and on an a priori power analysis performed using the G*Power software (Faul et al., 2007), a sample size of 30 participants was estimated to have 80% probability to detect a significant interaction (α=.05) with a medium effect size (r=.25) in a mixed model, following Cohen's guidelines (Cohen, 1977). Therefore, 30 participants (20 females; M_{age} = 27.72, SD_{age} = 3.62) from the University of Milan-Bicocca, of which 15 right-handers and 15 left-handers, were enrolled as volunteers. Handedness was assessed with the Edinburgh Inventory (Oldfield, 1971), short version, in Italian translation. This 10-item inventory includes a series of tasks to be performed by the person being evaluated. The responses can be recorded either through direct observation of the individual's actions or via self-reported descriptions of their daily activities. Descriptive statistics of the Edinburgh Handedness Inventory scores, including mean, standard deviation, mode, and range for right-handers and left-handers, are reported in Table 1.

Table 1. Descriptive statistics of handedness scores.

Handedness	Mean	Std. Dev	Mode	Range
Right-Handers (N = 15)	+67.5	28.27	+100.0	+25.0, +100.0
Left-Handers (N = 15)	-70.0	25.79	-100.0	-25.0, -100.0

All participants had normal or corrected to normal vision and were naive to the purpose of the experiment. All participants read and signed a consent form prior to data collection in accordance with the Declaration of Helsinki (World Medical Association, 2013). Ethical approval for the study was received by the Committee for Research Evaluation of the University of Milan-Bicocca (Protocol number: RM.2022-544).

Design

The study utilized a 3 × 2 mixed-design, incorporating both within-subjects and between-subjects factors. The factors included image Location (center vs right vs left visual field) as a within-subject factor and Handedness (right-handed vs left-handed) as a between-subject factor, with Valence Evaluation (VE) as the dependent variable.

Apparatus and Stimuli

A Galaxy Chromebook Go laptop with a 14.0-inch display and a resolution of 1366 × 768 pixels was used to present the stimuli. The experiment was run on a native Android mobile app developed by the BiCApP (Bicocca Center for Applied Psychology) and built according to the "React Native" framework (Zammetti, 2018). This app, integrated with Qualtrics (https://www.qualtrics.com/) automatically recorded all user-sessions data in a non-interactive Qualtrics survey, with information represented through embedded fields.

The stimuli were 36 images (500 × 400 pixels) from the Open Affective Standardized Image Set (OASIS, Kurdi et al., 2017), an open-access online stimulus set consisting of 900 color images depicting a broad spectrum of themes. The OASIS database contains images of humans, animals, objects, and scenes, along with normative ratings on two affective dimensions—*valence* (i.e., the degree of positive or negative affective response that the image evokes) and *arousal* (i.e., the intensity of the affective response that the image evokes) both measured on 7-point

Likert scale (1=very negative, 2=moderately negative, 3=somewhat negative, 4=neutral, 5=somewhat positive, 6=moderately positive, and 7=very positive).

We selected images covering four main themes: scenes (N=12), objects (N=11), and animals (N=13), by choosing images with neutral valence (i.e., corresponding approximately to a rating of 4, indicating "neutral") and low arousal (ranging from a minimum of 1 to a maximum of 2, indicating "very low" or "moderately low"). Descriptive statistics for the selected images, divided by theme, are reported in Table 2. This choice mirrors Milhau et al. (2013), who used neutral words for their experiment.

Table 2. Descriptive statistics (mean and standard deviation) of selected images divided by themes.

	Theme		
	Scenes	**Objects**	**Animals**
Valence	4.03 (0.23)	4.13 (0.21)	4.23 (0.18)
Arousal	2.05 (0.04)	2.12 (0.03)	2.17 (0.05)

Procedure

The experiment comprised two experimental sessions separated by a 3-week washout period. During the first session, participants undertook a valence evaluation task featuring a set of 36 neutral images presented in a randomized order. This first session served to obtain a baseline measure of valence evaluation (VE) for the images. The images were exclusively shown at the CVF, while, in the second session, each image was randomly presented once on the right side of the screen and once on the left side.

Before starting the experiment, participants were informed that a second session would be administered after three weeks. Participants were comfortably seated at a desk in front of a laptop positioned approximately 70 centimeters away, at the center of the desk, and aligned with the body's midline. Before the start of the experiment, participants were briefly introduced to the study and completed the informed consent procedures, including the provision of personal information such as age, gender, and educational level.

A brief training session, featuring two images, preceded each main session. In the first session, a single image was presented in the CVF for a duration of 4 seconds. Subsequently, participants were instructed to judge whether the previously seen image was positive or negative by clicking on a vertically oriented 9-point Likert scale consisting of small squares numbered from 1 to 9, with 1=very negative and 9=very positive. After their response, a countdown timer from 3 to 1, lasting 750 milliseconds, preceded the presentation of the next image.

The second session was identical to the first session, with the primary difference being the location of the images on the screen: images appeared alternately on the right and left sides of the screen. To ensure variety and prevent order effects, images were not shown consecutively on the same side, with at least ten different images interspersed between repetitions. Each experimental session lasted approximately 10 minutes. Overall, each participant viewed and evaluated 108 images: 36 images in the first session and 72 in the second session, with 36 images in each of the three positions.

Statistical analysis

Data were analyzed with a linear mixed effects model (LMM) using the software Jamovi (version 2.3; *The Jamovi Project*, 2023). All statistical tests were conducted on a two-tailed .05 level of significance. To select an appropriate random component, we started setting all plausible effects as random. The model that converged included only the intercept as random coefficient. Therefore, the final model featured a random intercept across participants as random factors, with handedness (right-handed vs left-handed), locations (center vs right vs left), and their interaction as fixed factors. To calculate p values estimates for the fixed effects, it was used a Type III Satterthwaite approximation (e.g., Carr et al., 2016).

Results

The main effect of Handedness was not statistically significant, $F(1, 28.1) = 0.41$, $p = .52$, indicating that Handedness alone did not significantly influence VE. Similarly, the main effect of Location was not significant $F(2, 3019.9) = 1.59$, $p = .20$.

The interaction between Handedness and Location approached significance $F(2, 3025.8) = 2.39$, $p = .09$ (Figure 1) but did not meet the threshold for

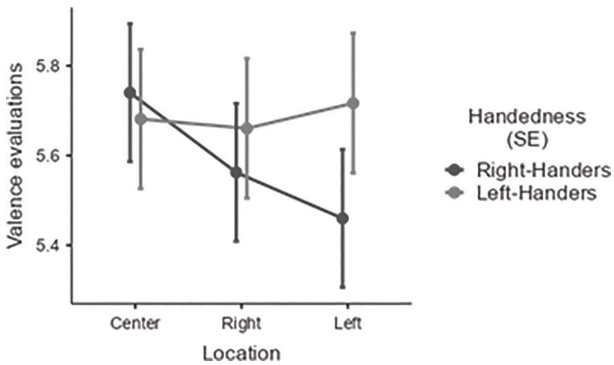

Fig. 1. Plot shows a significant interaction between handedness and location (left vs center) on valence evaluations ($p = .02$). The darker line represents right-handed participants, while the lighter line indicates left-handed participants. Error bars depict standard errors (SE).

statistical significance, indicating that the combined influence of Handedness and Location on VE may be worth further investigation.

Therefore, a singular test (Fixed effects parameter estimates) was performed on this interaction. The test (Table 1) revealed a statistically significant effect for the interaction between handedness and Location (b = 0.31, SE = 0.14, p = .02) at the Left vs Center images' location. Specifically, left-handers (M = 5.69, SE = 0.0836), compared to right-handed participants (M = 5.45, SD = 0.0739), tended to assign higher VE to images located on the Left side versus the Center side of the screen (Table 3, Figure 1).

Table 3. Fixed Effects Parameter Estimates.

				95% Confidence Interval				
Names	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**Df**	**t**	**p**
(Intercept)	(Intercept)	5.6370	0.1207	5.4004	5.8736	55.2	46.698	< .001
Handedness1	Left-Handers - Right-Handers	0.0988	0.1526	−0.2004	0.3979	28.1	0.647	0.523
Location1	Right - Center	−0.0993	0.0727	−0.2419	0.0432	3026.8	−1.366	0.172
Location2	Left - Center	−0.1224	0.0728	−0.2650	0.0202	3027.0	−1.682	0.093
Handedness1 * Location1	Left-Handers - Right-Handers * Right - Center	0.1570	0.1443	−0.1258	0.4399	3042.2	1.088	0.277
Handedness1 * Location2	Left-Handers - Right-Handers * Left - Center	0.3157	0.1444	0.0327	0.5988	3042.5	2.186	0.029

Simple effects analysis

For a more detailed examination of the effects of location on VE, we conducted a simple effects analysis of location with handedness (right-handers vs left-handers) as the moderator. The omnibus test revealed that only for right-handed participants there was a significant effect of location on VE, F(2.3037) = 3.72, p = .02, indicating that VE varied across different locations (Table 4). Specifically, in right-handed individuals, VE was lower in the LVF (M = 5.45, SE = 0.125) compared to the CVF (M = 5.74, SE = 0.125) (p = .007; Table 5). Notably, right-handed participants also tended to evaluate images slightly more positively when they were in the CVF (M = 5.74, SE = 0.125) compared to the RVF, (M = 5.55, SE = 0.125) but this difference did not reach significance (p = .08).

Conversely, in left-handed participants, there was no significant effect of location on VE, F(2,3037) = 0.16, p = .85, suggesting that the relationship between location and VE did not differ significantly among diverse locations (Table 4).

Table 4. Simple effects of Location: Omnibus Tests.

Moderator levels				
Handedness	**F**	**Num df**	**Den df**	**p**
Right-Handers	3.722	2.00	3037	0.024
Left-Handers	0.159	2.00	3037	0.853

Table 5. Simple effects of Location: Parameter estimates.

Moderator levels				95% Confidence Interval				
Handedness	**Contrast**	**Estimate**	**SE**	**Lower**	**Upper**	**df**	**t**	**p**
Right-Handers	Right - Center	−0.1779	0.104	−0.382	0.0258	3037	−1.712	0.087
	Left - Center	−0.2802	0.104	−0.484	−0.0766	3037	−2.698	0.007
Left-Handers	Right - Center	−0.0208	0.101	−0.219	0.1772	3037	−0.206	0.837
	Left - Center	0.0355	0.101	−0.163	0.2338	3037	0.351	0.726

Discussion

The purpose of this study was to extend the investigation of the Body Specificity Hypothesis (Casasanto, 2009) by examining valence evaluations of neutral images across different spatial locations (center, right, and left visual fields) in both right- and left-handed individuals. Participants rated the valence of 36 images using a 9-point Likert scale. In the first session, images were presented centrally, while, in the second session, the same images appeared alternately in the right and left visual fields.

Based on the BSH, we expected both right- and left-handed participants to assign more positive evaluations to images located on the side aligned with their dominant hand, and more negative evaluations to those on the side of their non-dominant hand.

The results partially supported our predictions. While the omnibus test did not reveal significant differences for the image location factor, certain comparisons (e.g., center vs. left visual field) reached significance in the fixed effects analysis. Specifically, right-handed participants rated images in the LFV more negatively than those in the CVF, but this pattern did not hold for left-handed participants, whose evaluations did not significantly differ across different visual fields.

Consistent with our expectations, a significant interaction between handedness and image location was observed. Right-handers assigned lower valence ratings to images in the LVF compared to left-handers. Specifically, right-handers judged neutral images in the LVF as more negative, whereas left-handers evaluated the same images more positively. Overall, these findings offer partial support for the

BSH. While right-handers demonstrated the anticipated pattern of space-valence associations, left-handers did not exhibit the same effect.

Interestingly, right-handers exhibited a linear decrease in valence ratings from the center to the LVF, with the most pronounced effect observed between the center and left locations. However, we did not anticipate that centrally positioned images would be rated as the most positive overall. In line with the BSH, we expected images on the right to receive more positive evaluations. We believe this finding aligns well with certain universal aesthetic principles. Indeed, several studies have demonstrated that observers tend to prefer more symmetrical versions of stimuli, whether they are familiar objects or abstract patterns (Eisenman, 1967; Rhodes et al., 1998). Additional evidence supporting symmetry as a general aesthetic principle comes from cross-cultural research (for a recent review, see Che et al., 2018). Moreover, implicit measures have confirmed an association between symmetry and positive valence (Makin et al., 2012). This preference for symmetry could explain the preference for images shown at the center of the screen, which are displayed in a more balanced disposition.

Conversely to right handers, left-handers exhibited a flatter trajectory, as evidenced by their consistent ratings across visual fields. This may suggest that left-handers are more accustomed to conditions that do not align with their natural space-valence associations. This discrepancy could be attributed to the fact that the world is predominantly designed for right-handed individuals. Left-handers often encounter various inconveniences, ranging from simple tools like scissors and conference chairs with folding tables, to more complex digital devices such as keyboard shortcuts typically positioned on the right (e.g., Sonnino & Sonnino, 2024). Consequently, left-handed individuals face more challenges in their daily lives. In addition, technology and product design often favor right-handed users. For instance, computer mouse, number pads, and even smartphone interfaces are typically designed with right-handed individuals in mind. Nevertheless, left-handed users are accustomed to use devices as “right handers” (for example, see Thomas et al., 2019). Therefore, considering the adaptability that left-handers have developed in their daily lives, this may explain the divergence in our results, which show variability across different visual fields in our right-handed group and a relatively flat trajectory in our left-handed group.

Conclusion

In conclusion, our findings highlight the relationship between handedness and location in shaping participants’ valence perceptions. These results suggest that future research on valence assessments should take these factors into account, especially in contexts where spatial location is relevant. Understanding these dynamics may help clarify how individual characteristics influence subjective evaluations.

Summary

The Body Specificity Hypothesis (BSH) suggests that individuals tend to associate positive evaluations with the space corresponding to their dominant hand and negative evaluations with the non-dominant hand. Valence reinforcement effects, related to BSH, have been demonstrated when stimuli are evaluated following lateral hand movements (e.g., dominant hand rightward—positive, non-dominant hand leftward—negative) on large touchscreens and keyboards. However, limited research has explored how spatial stimuli affect explicit valence judgments without motor responses. This study investigated the impact of spatial placement across different visual fields on valence judgments of neutral images, comparing right- and left-handed individuals. Thirty participants (15 right-handed, 15 left-handed) rated neutral images displayed in the center, right, or left visual field using a 9-point Likert scale. Two experimental sessions were conducted, separated by a 3-week washout period. The first session measured baseline valence evaluations (VE) with images presented centrally, while the second session randomized the images to the left and right visual fields. Results revealed that left-handers tended to assign higher VE to images located in the left visual field (LVF) compared to the center visual field (CVF; p = .02), while right-handers rated images in the LVF more negatively than those in the CVF (p = .007). Additionally, left-handed participants exhibited a flatter pattern across spatial placements. These findings may suggest that body-specific associations are stronger in right-handed individuals, while left-handers may show reduced sensitivity to body-specific associations, due to the predominance of right-handed design in digital technologies.

Keywords: Body Specificity, Affective valence, Embodied cognition.

Zusammenfassung

Die Body Specificity Hypothesis (BSH) legt nahe, dass Individuen positive Bewertungen mit dem Raum ihrer dominanten Hand und negative Bewertungen mit dem Raum ihrer nicht-dominanten Hand assoziieren. Valenzverstärkungseffekte, die mit der BSH in Verbindung stehen, wurden beobachtet, wenn Stimuli nach seitlichen Handbewegungen bewertet wurden (z. B. dominierte Hand nach rechts—positiv, nicht-dominierte Hand nach links—negativ) auf großen Touchscreens und Tastaturen. Allerdings gibt es nur begrenzte Forschung darüber, wie räumliche Stimuli explizite Valenzurteile ohne motorische Reaktionen beeinflussen. Diese Studie untersucht den Einfluss der räumlichen Platzierung in verschiedenen visuellen Feldern auf die Valenzurteile neutraler Bilder und vergleicht dabei rechtshändige und linkshändige Individuen. Dreißig Teilnehmer (15 rechtshändig, 15 linkshändig) bewerteten neutrale Bilder, die in der Mitte, rechts oder links im Sichtfeld angezeigt wurden, mithilfe einer 9-Punkte-Likert-Skala. Es wurden zwei experimentelle Sitzungen durchgeführt, die durch einen dreiwöchigen Washout-Zeitraum voneinander getrennt waren. In der ersten Sitzung wurden die Basis-Valenzbewertungen (VE) mit zentral angezeigten Bildern gemessen, während in der zweiten Sitzung die Bilder zufällig im linken und rechten Sichtfeld präsentiert wurden. Ein lineares gemischtes Modell zeigte eine signifikante Interaktion zwischen räumlicher Platzierung und Händigkeit. Linkshänder neigten dazu, höheren VEs für Bilder im linken Sichtfeld (LVF) im Vergleich zur Mitte (CVF) zuzuordnen (p = .02), während Rechtshänder Bilder im LVF negativer bewerteten als die in der Mitte (p = .007). Darüber hinaus zeigten linkshändige Teilnehmer eine konsistentere, flachere Reaktion über die räumlichen Platzierungen

hinweg. Diese Ergebnisse deuten darauf hin, dass körperliche spezifische Assoziationen bei rechtshändigen Individuen stärker ausgeprägt sind, während Linkshänder möglicherweise eine reduzierte Sensitivität gegenüber räumlichen Manipulationen aufweisen. Dies könnte mit der Dominanz des rechtsseitigen Designs in digitalen Technologien zusammenhängen, was die körperlich spezifischen Assoziationen bei linkshändigen Nutzern abschwächen könnte.
Schlagwörter: Körperspezifität, Affektive Valenz, Verkörperte Kognition.

References

Barsalou, L. W. (1999). Perceptual symbol systems. *The Behavioral and Brain Sciences*, *22*(4), 577–609; discussion 610-660. https://doi.org/10.1017/s0140525x99002149

Barsalou, L. W. (2008). Grounded Cognition. *Annual Review of Psychology*, *59*(1), 617–645. https://doi.org/10.1146/annurev.psych.59.103006.093639

Beilock, S. L., & Holt, L. E. (2007). Embodied preference judgments: Can likeability be driven by the motor system? *Psychological Science*, *18*(1), 51–57. https://doi.org/10.1111/j.1467-9280.2007.01848.x

Cannon, P. R., Hayes, A. E., & Tipper, S. P. (2010). Sensorimotor fluency influences affect: Evidence from electromyography. *Cognition and Emotion*, *24*(4), 681–691. https://doi.org/10.1080/02699930902927698

Carr, E. W., Rotteveel, M., & Winkielman, P. (2016). Easy moves: Perceptual fluency facilitates approach-related action. *Emotion (Washington, D.C.)*, *16*(4), 540–552. https://doi.org/10.1037/emo0000146

Casasanto, D. (2009). Embodiment of abstract concepts: Good and bad in right- and left-handers. *Journal of Experimental Psychology. General*, *138*(3), 351–367. https://doi.org/10.1037/a0015854

Casasanto, D., & Jasmin, K. (2010). Good and bad in the hands of politicians: Spontaneous gestures during positive and negative speech. *PloS One*, *5*(7), e11805. https://doi.org/10.1371/journal.pone.0011805

Cervera Torres, S., Ruiz Fernández, S., Lachmair, M., & Gerjets, P. (2020). Coding valence in touchscreen interactions: Hand dominance and lateral movement influence valence appraisals of emotional pictures. *Psychological Research*, *84*(1), 23–31. https://doi.org/10.1007/s00426-018-0971-1

Che, J., Sun, X., Gallardo, V., & Nadal, M. (2018). Cross-cultural empirical aesthetics. *Progress in Brain Research*, *237*, 77–103. https://doi.org/10.1016/bs.pbr.2018.03.002

Cohen, J. (1977). *Statistical power analysis for the behavioral sciences, Rev. Ed* (pp. xv, 474). Lawrence Erlbaum Associates, Inc.

Dalmaso, M., Vicovaro, M., & Watanabe, K. (2022). Cross-cultural evidence of a space-ethnicity association in face categorisation. *Current Psychology*, *42*. https://doi.org/10.1007/s12144-022-02920-7

de la Fuente, J., Casasanto, D., Román, A., & Santiago, J. (2015). Can culture influence body-specific associations between space and valence? *Cognitive Science*, *39*(4), 821–832. https://doi.org/10.1111/cogs.12177

de la Vega, I., de Filippis, M., Lachmair, M., Dudschig, C., & Kaup, B. (2012). Emotional valence and physical space: Limits of interaction. *Journal of Experimental Psychology: Human Perception and Performance*, *38*(2), 375–385. https://doi.org/10.1037/a0024979

de la Vega, I., Dudschig, C., De Filippis, M., Lachmair, M., & Kaup, B. (2013). Keep your hands crossed: The valence-by-left/right interaction is related to hand, not side, in an incongruent hand–response key assignment. *Acta Psychologica*, *142*(2), 273–277. https://doi.org/10.1016/j.actpsy.2012.12.011

Eisenman, R. (1967). Complexity-simplicity: I. Preference for symmetry and rejection of complexity. *Psychonomic Science*, *8*(4), 169–170. https://doi.org/10.3758/BF03331603

Everhart, D. E., Harrison, D. W., & Crews, W. D. (1996). Hemispheric asymmetry as a function of handedness: Perception of facial affect stimuli. *Perceptual and Motor Skills*, *82*(1), 264–266. https://doi.org/10.2466/pms.1996.82.1.264

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146

Kong, F. (2013). Space-valence associations depend on handedness: Evidence from a bimanual output task. *Psychological Research*, *77*(6), 773–779. https://doi.org/10.1007/s00426-012-0471-7

Kühne, K., Nenaschew, K., & Miklashevsky, A. (2022). Space-valence mapping of social concepts: Do we arrange negative and positive ethnic stereotypes from left to right? *Frontiers in Psychology*, *13*, 1070177. https://doi.org/10.3389/fpsyg.2022.1070177

Kurdi, B., Lozano, S., & Banaji, M. R. (2017). Introducing the Open Affective Standardized Image Set (OASIS). *Behavior Research Methods*, *49*(2), 457–470. https://doi.org/10.3758/s13428-016-0715-3

Makin, A. D. J., Pecchinenda, A., & Bertamini, M. (2012). Implicit affective evaluation of visual symmetry. *Emotion (Washington, D.C.)*, *12*(5), 1021–1030. https://doi.org/10.1037/a0026924

McManus, C. (2002). *Right hand, left hand: The origins of asymmetry in brains, bodies, atoms and cultures* (pp. xix, 412). Harvard University Press.

Milhau, A., Brouillet, T., & Brouillet, D. (2013). Biases in evaluation of neutral words due to motor compatibility effect. *Acta Psychologica*, *144*(2), 243–249. https://doi.org/10.1016/j.actpsy.2013.06.008

Milhau, A., Brouillet, T., & Brouillet, D. (2015). Valence–space compatibility effects depend on situated motor fluency in both right- and left-handers. *Quarterly Journal of Experimental Psychology*, *68*(5), 887–899. https://doi.org/10.1080/17470218.2014.967256

Natale, M., Gur, R. E., & Gur, R. C. (1983). Hemispheric asymmetries in processing emotional expressions. *Neuropsychologia*, *21*(5), 555–565. https://doi.org/10.1016/0028-3932(83)90011-8

Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia*, *9*(1), 97–113. https://doi.org/10.1016/0028-3932(71)90067-4

Rhodes, G., Proffitt, F., Grady, J. M., & Sumich, A. (1998). Facial symmetry and the perception of beauty. *Psychonomic Bulletin & Review*, *5*(4), 659–669. https://doi.org/10.3758/BF03208842

Sonnino, R. E., & Sonnino, V. G. (2024). Handedness and Its Impact on a Career in Medicine. *Academic Medicine: Journal of the Association of American Medical Colleges*, *99*(8), 821–823. https://doi.org/10.1097/ACM.0000000000005752

Thomas, N. A., Manning, R., & Saccone, E. J. (2019). Left-handers know what's left is right: Handedness and object affordance. *PLoS ONE*, *14*(7), e0218988. https://doi.org/10.1371/journal.pone.0218988

World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA*, *310*(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053

Zammetti, F. (2018). React Native: A Gentle Introduction. In F. Zammetti (Ed.), *Practical React Native: Build Two Full Projects and One Full Game using React Native* (pp. 1–32). Apress. https://doi.org/10.1007/978-1-4842-3939-1_1

Marta Maisto was born in 1991 and is a psychologist and research fellow at the University of Trieste. She holds a PhD in Psychology, Linguistic and Cognitive Neuroscience from the University of Milano-Bicocca. Her research, published in international journals, focuses on embodiment, implicit attitudes, and user experience, contributing to advancements in these fields.

Address: Department of Psychology, University of Milan-Bicocca, Piazza dell'Ateneo Nuovo 1, 20126 Milan, Italy; Department of Life Sciences, Psychology Unit "Gaetano Kanizsa", University of Trieste, Via E. Weiss 2, 34128 Trieste, Italy

Mail: m.maisto2@campus.unimib.it

ORCID: 0000-0003-2853-3901

Rossana Actis-Grosso was born in 1967 and is an Associate Professor at the University of Milan-Bicocca, where she has been teaching Cognitive Ergonomics since 2008. She is the author of several publications on basic research, mainly in visual perception, cognitive, and neuropsychology, as well as on applied psychology, with a special focus on human-computer interaction and user experience.

Address: Department of Psychology, University of Milan-Bicocca, Piazza dell'Ateneo Nuovo 1, 20126 Milan, Italy

Mail: rossana.actis@unimib.it

ORCID: 0000-0002-3190-5115