



Conceptual metaphors, processing fluency, and aesthetic preference[☆]

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ABSTRACT

In everyday language, abstract concepts are described in terms of concrete physical experiences (e.g., good things are “up”; the past is “behind” us). Stimuli congruent with such conceptual metaphors are processed faster than stimuli that are not. Since ease of processing enhances aesthetic pleasure, stimuli should be perceived as more pleasing when their presentation matches (rather than mismatches) the metaphorical mapping. In six experiments, speakers of English (Experiment 1-3a) and Farsi (Experiment 3b and 4) viewed valence- and time-related photos in arrangements congruent and incongruent with their metaphorical mapping. Consistent with the valence-verticality metaphor in both languages, English and Farsi speakers preferred visual arrangements that placed the happy photo above the sad photo. In contrast, participants' preferences for time-related photos were moderated by the direction of writing. English speakers, who write from left to right, preferred arrangements that placed past-themed photos to the left of modern-themed photos; this was not observed for Farsi speakers, who write from right to left as well as left to right. In sum, identical stimuli enjoy an aesthetic advantage when their spatial arrangement matches the spatial ordering implied by applicable conceptual metaphors.

1. Conceptual metaphor, processing fluency, and aesthetic preference

Is beauty in the eye of the beholder or in features of the beholder? Experimental research indicates that attributes of the beholder (e.g., symmetry, contrast, and clarity) as well as attributes of the beholder (e.g., prior exposure and implicit learning) influence perceptions of beauty through facilitating or impairing ease of processing (for reviews, see Reber, Schwarz, & Winkielman, 2004; Schwarz, 2018). From this perspective, beauty is a function of the perceiver's processing experience, which depends on the interplay of object, perceiver, and context characteristics. Supporting this view, research has shown that object attributes that enhance aesthetic pleasure – such as high figure-ground contrast (e.g., Checkosky & Whitlock, 1973), clarity (Whittlesea, Jacoby, & Girard, 1990), symmetry (Cárdenas & Harris, 2006; Enquist & Arak, 1994; Garner, 1974), and prototypicality (Winkielman, Halberstadt, Fazendeiro, & Catty, 2006) – also facilitate efficient processing and fast recognition (for a review, see Reber et al., 2004). So do perceiver variables, such as prior exposure to the object (Haber & Hershenson, 1965; Jacoby & Dallas, 1981), to some of its attributes (Reber,

Winkielman, & Schwarz, 1998), or to related semantic concepts (Winkielman, Schwarz, Fazendeiro, & Reber, 2003). Similarly, context variables, from ambient lighting to noise and the presence of materials that can serve as semantic primes, can influence processing fluency and pleasure (for a review, see Reber et al., 2004). Independent of which variable facilitates ease of processing, easy processing elicits a sense of familiarity (Kinder, Shanks, Cock, & Tunney, 2003; Whittlesea, 1993) and positive affect (Winkielman et al., 2003; Winkielman et al., 2006). When asked to evaluate how much they like an object, how beautiful they find it, or which of several objects they prefer, people draw on their concurrent subjective experiences and provide more favorable evaluations of fluently processed objects (for reviews, see Reber et al., 2004; Schwarz, 2018; Schwarz, Jalbert, Noah, & Zhang, 2021). The underlying process is consistent with feelings-as-information theory (Schwarz, 1990, 2012; Schwarz & Clore, 1983), which conceptualizes the use of subjective experiences (including moods, emotions, metacognitive, and bodily experiences) as a source of information in human judgment.

Building on this work, we examine the influence of conceptual metaphors (Lakoff & Johnson, 1980). In everyday language, abstract concepts are often described in terms of concrete physical experiences.

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For example, good things are “up”; the past comes “before” the present; important things are “heavy”; and nice people are “warm”. Numerous studies demonstrated that such metaphors are not just figures of speech, but cognitive tools people use to conceptualize abstract concepts (Lakoff & Johnson, 1980, 1999; for a review see Landau, 2017). Hence, processing of information should be easier when the information is consistent with the implications of conceptual metaphors than when it is not. Empirically, this is the case, as reviewed in the next section. Accordingly, we predict that metaphor-congruent materials are also more aesthetically pleasing. We test this hypothesis with two different metaphors. One pertains to the relationship between valence and vertical location in space and places the good “above” the bad; the other pertains to the relationship between time and horizontal location in space and places the past “before” the present and future. Below, we elaborate on these metaphors and cultural and linguistic variations in their expression before we report experimental tests conducted with native speakers of English (in the United States) and Farsi (in Iran).

1.1. Valence and verticality

Numerous expressions entail that good things are “up” and bad things are “down” – feeling “on top of the world” is preferred over feeling “down”, a “thumbs up” signal is more favorable than a “thumbs down” signal, and good people go “up” to heaven, whereas bad people go “down” to hell. This metaphorical link between valence and verticality can be observed in many languages, (Kovecses, 2000; Lakoff & Johnson, 1980; Li, 2010; Niksiyar, 2018; Sutton-Spence, 2010), including English and Farsi, and may be universal. Research examining the impact of vertical placement on evaluative judgment has shown that things that are positioned “up” are perceived more positively than things that are positioned “down”. For example, fictional cities that are positioned in the top vs. bottom section of a map are perceived as being more desirable to live in (Meier, Moller, Chen, & Riemer-Peltz, 2011) and survey items are evaluated more positively when presented near the top of the screen than when presented further down (Tourangeau, Couper, & Conrad, 2013).

Since people use verticality as a way to process valence-related concepts, material that is congruent with the metaphor should be easier to process than material that is incongruent with it. Empirically, this is the case. Meier and Robinson (2004, Experiment 1; see also Meier, Sellbom, & Wygant, 2007) found that positive words were evaluated faster when presented at the top of the computer screen, above a fixation point, whereas negative words were evaluated faster when presented at the bottom of the screen, below the fixation point. Moreover, exposure to a positive word in the middle of the screen facilitated the subsequent identification of a neutral visual stimulus shown in the upper region of the screen, whereas exposure to a negative word did so for stimuli shown in the lower region of the screen (Meier & Robinson, 2004, Experiment 2). Facilitative effects of metaphor congruence can also be observed across modalities, with exposure to positive words facilitating the identification of high-pitched tones and exposure to negative words facilitating the classification of low-pitched tones (Weger, Meier, Robinson, & Inhoff, 2007).

Such findings indicate that stimuli that are congruent with the metaphorical valence-verticality link are processed more easily than stimuli that are not. Given that ease of processing is a key determinant of aesthetic pleasure (Reber et al., 2004; Schwarz, 2018), we predict that visual arrangements of valenced photographs that are congruent with the up-is-good/down-is-bad metaphor will be preferred over arrangements that are not. We further predict that this preference will be observed for speakers of English as well as Farsi, given that their cultures share the same valence-verticality metaphor.

1.2. Time and space

The progression of time is often described in terms of locomotion

through space (Boroditsky, 2000; Tenbrink, 2011; for a review, see Boroditsky, 2011). Metaphorically, the past is “behind” us and the future is “ahead” of us; we move “forward” towards the future, leaving our past “behind”. The grounding of time in space has been observed in many of the world’s languages (Haspelmath, 1997; Radden, 2004). Supporting the assumption that metaphor congruence facilitates fluent processing, Torralbo, Santiago, and Lupianez (2006, Experiment 1) found that the spatial placement of a word influences how fast its temporal meaning can be identified. In an ingenious arrangement, they showed past- or future-oriented words next to a side-looking head silhouette and asked participants whether the word refers to the past or the future. The temporal reference of future-oriented words was identified faster when the words were presented in front of the silhouette (as if the person were looking at them), whereas the temporal orientation of past-oriented words was identified faster when the words were presented in the back of the silhouette.

Although a general grounding of time in space may be universal (Boroditsky, 2011), its specific implementation shows cultural variation when the relationship is mapped onto a two-dimensional space. Not surprisingly, whether the letter X comes “before” or “after” the letter Y in the sequence “X-Y” depends on whether the perceiver reads from left to right (as you will just have done, reading an English language article) or from right to left. Empirically, the forward-backward spatial representation of time follows the direction of writing and reading (Boroditsky, 2011; Tversky, Kugelmass, & Winter, 1991). Hence, speakers of languages that are written from left to right (e.g., English) project the past to the left and the future to the right (Ouellet, Santiago, Funes, & Lupianez, 2010; Santiago, Lupianez, Pérez, & Funes, 2007), whereas the reverse has been observed for speakers of languages that are written from right to left, such as Hebrew (Fuhrman & Boroditsky, 2010) and Arabic (Maass & Russo, 2003). Further supporting the hypothesis that metaphor congruence facilitates processing, Ouellet et al. (2010, Experiment 1) found that the mere activation of temporal concepts is sufficient to shift the focus of spatial attention. Holding past-related concepts in mind directed the attention of native Spanish speakers to the left, whereas holding future-related concepts in mind directed their attention to the right, resulting in enhanced performance on a spatial orientation task when the target location was congruent with the spatial implication of the activated time concept. Related work suggests that these facilitation effects are not limited to visual stimulus presentations but also observed under auditory conditions (Ouellet, Santiago, Israeli, & Gabay, 2010). Native speakers of Spanish (who read and write from left to right) were faster responding to orally presented past-words with their left hand and to orally presented future-words with their right hand; this pattern reversed for native speakers of Hebrew (who read and write from right to left).

Given that ease of processing influences aesthetic preference (Reber et al., 2004; Schwarz, 2018), we hypothesize that visual arrangements of time-related photographs that are consistent with the writing direction of the perceiver’s language will be preferred to arrangements that are not. This predicts that speakers of languages that are written from left to right (e.g., English, Dutch, Spanish) prefer arrangements that place past-themed photos to the left. This preference should not be observed for speakers of languages that are written from right to left (e.g., Hebrew, Arabic, Farsi), who should instead prefer arrangements that place past-themed photos to the right. We further conjecture that the observed effects may be more pronounced for speakers of left-to-right languages than for speakers of right-to-left languages. Most notably, left-to-right languages do not include elements that are written right-to-left, whereas right-to-left languages write all numerical expressions from left-to-right, thus reversing the direction of writing between verbal and numerical expressions. Moreover, the cultural dominance of Western media and smartphones makes it more likely that speakers of Farsi are exposed to some material that flows left-to-right than that English speakers are exposed to material that flows right-to-left.

1.3. The present research

To test the prediction that metaphor congruence enhances aesthetic experience, we draw on the two metaphors discussed above, which relate valence to vertical position in space and time to horizontal position in space. Metaphor congruence and incongruence is implemented through the spatial arrangement of photographs, as illustrated in Fig. 1. Displays that place a positively valenced photo above a negatively valenced photo are congruent with the valence-verticality metaphor, whereas the reverse arrangement is incongruent with this metaphor. Displays that place a past-themed photo “before” a modern-themed photo are congruent with the time-space metaphor, whereas the reverse arrangement is incongruent with this metaphor. As discussed, what counts as “before” or “after” in a horizontal display depends on the perceiver’s direction of reading, giving rise to cultural variation.

Because a choice between two simultaneously presented stimuli imposes no memory load and forced-choice tasks show minimal response bias effects (Palmer, Schloss, & Sammartino, 2013), we assess aesthetic preference by using a two-alternative forced-choice paradigm, asking participants to select their preferred arrangement. Previous research found that judgments of preference, liking, and beauty show similar patterns (Bornstein, 1989; Reber et al., 2004) and we vary the wording of the choice task across experiments. Throughout, our interest is in the perceiver’s aesthetic preference, not in the perceiver’s evaluation of the object’s artistic value. Many aesthetically pleasing objects lack high artistic value (e.g., a photo of a sunset); conversely, many objects of high artistic value are not aesthetically pleasing (e.g., Marcel Duchamp’s *Fountain*, a urinal altered to resemble a drinking fountain).

In all experiments, we present valenced photographs in arrangements that are congruent or incongruent with the good-is-up/bad-is-down metaphor and past- vs. present-themed photographs in arrangements that are congruent or incongruent with the past-before-present metaphor. Consistent with the theoretical rationale of fluency research and robust findings across classic fluency tasks, all manipulations are within-participants. People are more sensitive to changes in their processing experience than to stable states, which makes within-participant manipulations more powerful than between-participant manipulations, where some participants are only exposed to easy-to-process and others only to difficult-to-process material (Wänke & Hansen, 2015). Hence, classic fluency effects, including Zajonc’s (1968) mere exposure effect and Hasher, Goldstein, and Toppino’ (1977) illusory truth effect, are reliably observed in within- but not in between-participant designs (Dechêne, Stahl, Hansen, & Wänke, 2010; Hansen, Dechêne, & Wänke, 2008). This makes within-participant manipulations more appropriate for testing fluency predictions than between-participant manipulations.

Experiment 1 examines aesthetic preference by asking native speakers of English to select the arrangement they think is better.

Experiments 2a-b replicate Experiment 1 by asking native speakers of English to select the arrangement they like more. Experiments 3a-b investigate cultural differences of preference between English and Farsi speakers. Experiment 4 examined the effect of familiarity with English on Farsi speakers’ preference. Finally, a single paper meta-analysis (Borenstein, Hedges, Higgins, & Rothstein, 2013) examined the consistency of results across experiments and is presented in Appendix A of the supplementary materials. All materials and data are available at https://osf.io/xystg/?view_only=bf82a309fa3e4c7abdc5a06a626e5a33.

2. Experiment 1

2.1. Method

2.1.1. Participants

Based on the effect size of Reber et al.’ (1998) experiment 1 (Cohen’s $d = 0.24$), a sample of 139 participants is required to achieve a power of 0.80 at $\alpha = 0.05$. To ensure sufficient power after excluding non-native speakers of English, we recruited 190 undergraduate students from the University of Southern California, who completed the experiment online. The exclusion of 28 non-native speakers of English left a total of 162 participants for analysis.

2.1.2. Design and materials

Eight pairs of time-related photos (past vs. modern) and eight pairs of valence-related photos (happy vs. sad) were presented to each participant, along with eight pairs of filler photos (e.g., animals and landscape). For the time-related and valence-related photos, half of the pairs were arranged horizontally and half vertically (Fig. 1). This results in four within-subject combinations of photos \times spatial arrangement. Two of these combinations (time-horizontal, valence-vertical) bear on the theoretical predictions and two (time-vertical, and valence-horizontal) are exploratory. Next, we describe these combinations.

2.1.2.1. Metaphor conditions. The combinations of interest pertain to the horizontal placement of time-related photos and the vertical placement of valence-related photos. For speakers of English and other languages that write from left to right, the past-before-future metaphor implies that the past is on the left and the future on the right when presented in two-dimensional space. Hence, a horizontal visual arrangement that presents past-themed photos to the left of modern-themed photos is metaphor congruent, whereas the reverse arrangement is metaphor incongruent. For the good-is-up/bad-is-down metaphor, a vertical visual arrangement that presents positively valenced photos above negatively valenced photos is metaphor congruent, whereas the reverse arrangement is metaphor incongruent.

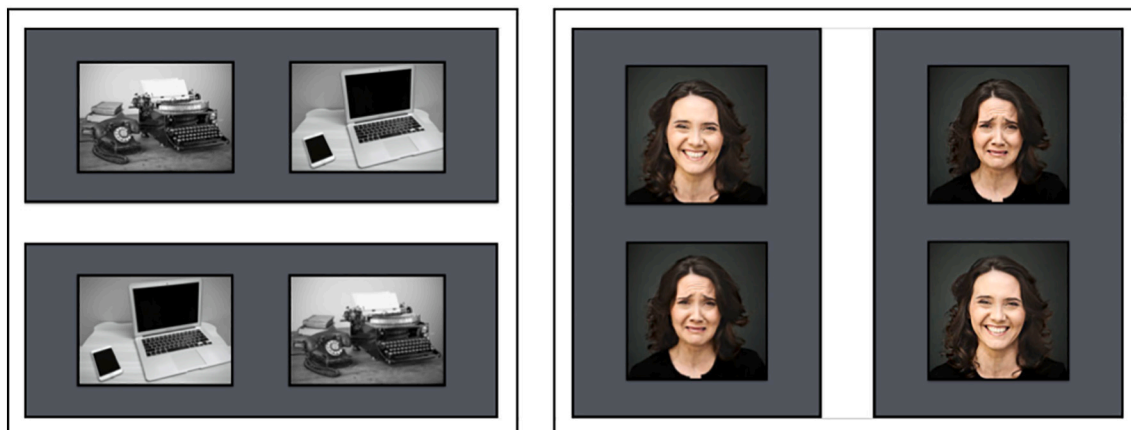


Fig. 1. An example of horizontal arrangements of time-related photos (left) and vertical arrangements of valence-related photos (right).

2.1.2.2. Exploratory conditions. The remaining combinations are silent on the role of metaphor congruence in aesthetic preference because the metaphors do not bear on the vertical location of time or the horizontal location of valence. We included these combinations for exploratory purposes (Appendix B of the supplementary materials).

2.1.3. Procedure

All participants saw all 16 pairs of photos along with 8 pairs of filler photos. Half of the participants saw all horizontal arrangements first and half saw all vertical arrangements first. The order of presentation was randomized within the horizontal and vertical conditions. For each pair of photos, participants were asked to choose the arrangement that they think is better. At the end of the experiment, demographic information was collected.

2.2. Results and discussion

Trials where the participant chose the congruent arrangement were coded "1" and trials where the participant chose the incongruent arrangement were coded "0". For each metaphor condition, the proportion of times participants chose the metaphor congruent over the metaphor incongruent arrangement was obtained by averaging responses from each trial, which was then compared against chance (0.5) with a two-tailed one-sample *t*-test. A sensitivity power analysis using G*Power indicates 80% power to detect a minimum effect size of Cohen's *d* = 0.196.

As predicted, participants preferred the metaphor-congruent arrangement over the metaphor-incongruent arrangement for both time and valence metaphors (see Fig. 2 and Table 1). The proportion of trials participants chose happy-above-sad arrangements over sad-above-happy arrangements was 0.613, 95% CI [0.563, 0.662], $t(161) = 4.445$, $p < 0.001$. The preference for the happy-above-sad arrangements was observed in seven out of eight pairs of valence-themed photos, with five of them being significant. The proportion of times participants chose past-on-the-left arrangements was 0.664, 95% CI [0.617, 0.710], $t(161) = 6.928$, $p < 0.001$. The preference for past-on-the-left arrangements was observed for all of the eight time-themed photo pairs, with six of them being significant. These results provide first evidence that metaphor-congruent arrangements are perceived as "better" than metaphor-incongruent arrangements. Experiments 2a-b replicate this effect by asking participants to select the arrangement they "like more".

3. Experiment 2a-b: Liking

3.1. Method

3.1.1. Participants

Based on the smallest effect size observed in Study 1 (valence-

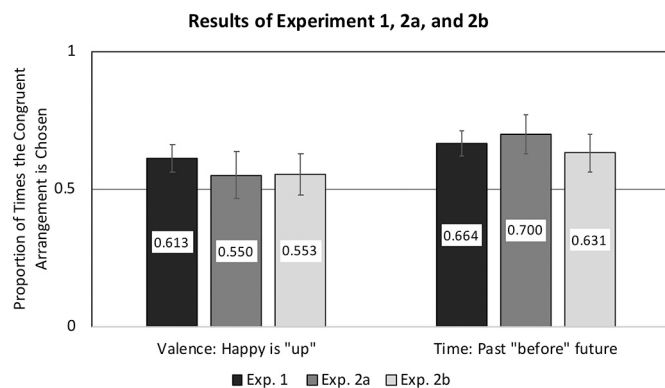


Fig. 2. Results of Experiment 1, 2a, and 2b. The error bars represent 95% confidence intervals.

Table 1
Results of Experiment 1–4.

	Experiment	Mean	95% CI	t
Valence: Happy is "up"	1: US	0.613***	[0.563, 0.662]	4.445
	2a: US	0.550	[0.464, 0.636]	1.139
	2b: US	0.553	[0.479, 0.627]	1.411
	3a: US	0.584*	[0.517, 0.652]	2.455
	3b: Iran	0.629**	[0.559, 0.700]	3.605
	4: Iran	0.622***	[0.581, 0.664]	5.773
	1: US	0.664***	[0.617, 0.710]	6.928
	2a: US	0.700***	[0.629, 0.771]	5.519
	2b: US	0.631***	[0.563, 0.700]	3.749
Time: Past "before" future	3a: US	0.690***	[0.622, 0.758]	5.467
	3b: Iran	0.524	[0.456, 0.591]	0.679
	4: Iran	0.504	[0.467, 0.540]	0.200

1. The mean represents the mean proportion of congruent arrangements being chosen.
 2. The congruent arrangement for Valence is happy-above-sad for both US and Iranian samples.
 3. The congruent arrangement for Time is past-on-the-left for US samples and past-on-the-right for Iranian samples.
- (Note that the text of the paper reports the mean proportion of past-on-the-left arrangements being chosen for both US and Iranian samples instead).
4. * represents $p < 0.05$, ** represents $p < 0.01$, *** represents $p < 0.001$.

verticality, Cohen's *d* = 0.349), G-power software (Faul, Erdfelder, Lang, & Buchner, 2007) indicates that a total sample size of 67 is needed for a two-tailed one-sample *t*-test at an alpha level of 0.05 and power of 0.80. We recruited 80 participants to allow for the exclusion of non-native speakers of English (see <https://aspredicted.org/pp59i.pdf> for the pre-registration).

Experiment 2a was conducted on Amazon Mechanical Turk and Experiment 2b in the subject pool of the University of Southern California; eighty time slots were posted for each experiment. For Experiment 2a, participation was limited to those with United States IP addresses and approval ratings of 95% or higher for previous HITS. Participants were compensated with \$0.50; $N = 80$ participants completed the study. For Experiment 2b, undergraduates who are native speakers of English were recruited. All participants in Experiment 2a and 2b reported being native speakers of English and none were excluded from data analysis.

3.1.2. Design and material

The design of Experiment 2a and 2b was identical to Experiment 1, except that half of the photographs used in Experiment 1 were replaced with new stimuli, in order to 1) make the photos in each pair resemble each other more in terms of lighting and orientation, and 2) to use more culturally appropriate photos for an Iranian sample that we planned to recruit in Experiment 3.

3.1.3. Procedure

Experiments 2a and 2b followed the same procedures as Experiment 1, except that the wording of the selection task now read, "Which arrangement do you like more?"

3.2. Results and discussion

The proportion of times participants chose the metaphor congruent arrangement over the incongruent one was again compared to chance (0.5) with a two-tailed one-sample *t*-test. A sensitivity power analysis using G*Power indicates each experiment has 80% power to detect a minimum effect size of Cohen's *d* = 0.280.

3.2.1. Valence: happy is "up"

As shown in Fig. 2 and Table 1, participants selected the metaphor-congruent happy-above-sad arrangements more frequently than the metaphor-incongruent sad-above-happy arrangements. However, the

observed differences were small and not significant; $M = 0.550$, 95% CI [0.464, 0.636], $t(79) = 1.139$, $p = 0.258$ for Experiment 2a, and $M = 0.553$, 95% CI [0.479, 0.627], $t(79) = 1.411$, $p = 0.162$ for Experiment 2b. The preference for happy-above-sad arrangements was observed in six of the eight pairs in Experiment 2a, and seven out of the eight pairs in Experiment 2b. However, none reached significance. A single-paper meta-analysis (Borenstein et al., 2013) including these nonsignificant effects confirmed the overall reliability of the consistent patterns across studies (see Appendix A of supplementary materials).

3.2.2. Time: past "before" future

Replicating Experiment 1, participants preferred the metaphor congruent past-on-the-left arrangements over the metaphor incongruent past-on-the-right arrangements in both studies; $M = 0.700$, 95% CI [0.629, 0.771], $t(79) = 5.519$, $p < 0.001$, for Experiment 2a, and $M = 0.631$, 95% CI [0.563, 0.700], $t(79) = 3.749$, $p < 0.001$, for Experiment 2b. This preference for past-on-the-left arrangements was observed in all of the eight time-themed photo pairs in Experiment 2a, and seven out of the eight pairs in Experiment 2b, with five pairs being significant in each experiment.

In sum, Experiments 1, 2a, and 2b show the predicted preference for metaphor congruent over metaphor incongruent displays of visual stimuli. Among native speakers of English, the observed differences are larger and more reliable for time-related stimuli than for valence-related stimuli. Next, we turn to the moderation of metaphor congruence effects by culturo-linguistic differences in the direction of writing.

4. Experiment 3a-b: Cultural differences

At the conceptual level, good things are "up" and the past comes "before" the present across many cultures and languages. However, whether X "precedes" or "follows" Y in an X-Y arrangement may depend on the direction of reading – X precedes Y when reading from left to right, but follows Y when reading from right to left. Hence, the direction in which perceivers read should moderate aesthetic preference for time-related materials but not for valence-related materials. Experiment 3a and b test this prediction with native speakers of English in the U.S., who read from left to right, and native speakers of Farsi in Iran, who write from right to left.

Because good things are metaphorically "up" in both English and Farsi, happy-above-sad arrangements should be preferred over sad-above-happy arrangements for both U.S. and Iranian participants. In Farsi, there are numerous metaphoric expressions indicating that good, important, sacred, and valuable things or beings are "up", while deplorable, trivial, evil, and worthless things are "down". Much of this metaphoric language is reflected in ancient and contemporary Persian poetry (Niksiyar, 2018). However, English and Farsi speakers should differ in their preference for the horizontal arrangement of time-themed materials. Past-on-the-left arrangements should be preferred over past-on-the-right arrangements by U.S. participants, whereas Farsi speakers in Iran should show the reverse pattern because Farsi text reads from right to left, although numbers read from left to right in Farsi. Consistent with this difference in the direction of text and numbers, Iranians prefer the right-to-left arrangements when objects are labeled in Farsi, but prefer left-to-right arrangements when objects are labeled numerically (Matoori, Gorjian, Veysi, & Memari, 2020).

4.1. Method

4.1.1. Participants

We preregistered to recruit 80 participants in each country. Due to a discrepancy between the recruitment platforms and Qualtrics, 84 U.S. students at the University of Southern California (Experiment 3a) and 90 Iranian participants (Experiment 3b) from Tarbiat Modares University (Tehran, Iran) completed the experiments online. We pre-registered to exclude participants who do not speak English as their native language

for Experiment 3a (<https://aspredicted.org/pv2py.pdf>) and participants who indicate a native language that writes from left to right for Experiment 3b (<https://aspredicted.org/74qp3.pdf>). This resulted in the exclusion of one U.S. participant in Experiment 3a (leaving $N = 83$ for analysis) and five Iranian participants in Experiment 3b (leaving $N = 85$ for analysis).

4.1.2. Design, material, and procedure

The design and material of Experiment 3a and 3b were identical to Experiment 2a and 2b. The procedure was identical to Experiment 1, where participants were asked to select the arrangement that they think is "better". For Iranian participants (Experiment 3b), all instructions and questions were presented in Farsi.

4.2. Result and discussion

We again computed a two-tailed one-sample t -test for each metaphor to compare the proportion of times participants choose the metaphor-congruent arrangement to chance (0.5). Fig. 3 depicts the results. A sensitivity power analysis using G*Power indicates Experiment 3a and 3b have 80% power to detect a minimum effect size of Cohen's $d = 0.275$ and 0.272, respectively.

4.2.1. Valence: happy is "up"

Consistent with the hypothesis, native speakers of English as well as Farsi preferred the happy-above-sad arrangements; $M = 0.584$, 95% CI [0.517, 0.652], $t(82) = 2.455$, $p = 0.016$ for the English speaking U.S. participants, and $M = 0.629$, 95% CI [0.559, 0.700], $t(84) = 3.605$, $p = 0.001$ for the Farsi-speaking Iranian participants. This preference for happy-above-sad arrangements was observed in all of the eight pairs for English speakers and in seven out of eight pairs for Farsi speakers, although only one and three pairs reached significance, respectively. A logistic regression ($P(\text{Preference}_{ij} = 1) = \text{logistic}(\gamma_{00} + \gamma_{01} \text{Country}_j + u_{0j})$) with country (0 = US, 1 = Iran) as a predictor yielded similar results, Mean Predicted Probability = 0.591, 95% CI [0.517, 0.664], $p = 0.017$ for the English speaking U.S. participants, and Mean Predicted Probability = 0.641, 95% CI [0.569, 0.712], $p < 0.001$, for Farsi speaking participants, with no significant difference in the mean predicted probabilities between the two countries, OR = 1.288, 95% CI [0.771, 2.175], $p = 0.331$.

4.2.2. Time: past "before" future

Consistent with our predictions, native speakers of English again preferred the past-on-the-left arrangements, $M = 0.690$, 95% CI [0.622, 0.758], $t(82) = 5.467$, $p < 0.001$. This preference was observed in all eight pairs of time-themed photos, with five of them being significant.

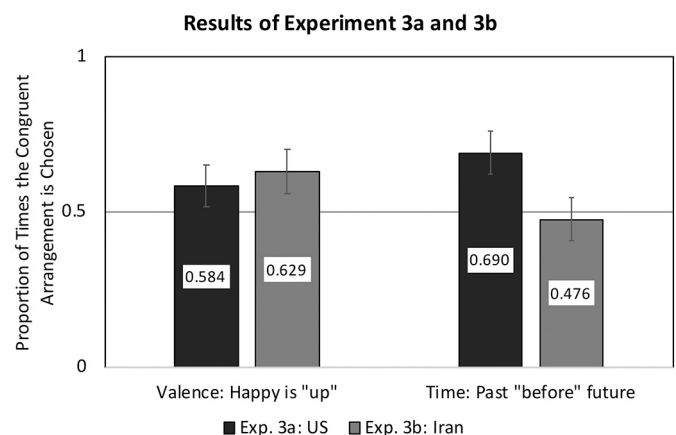


Fig. 3. Results of Experiment 3a and 3b. The error bars represent 95% confidence intervals.

Also consistent with predictions, this preference was not observed for speakers of Farsi; for Farsi speakers, the preference for past-on-the-left arrangements was only observed in two out of eight time-themed photos, and none was significant. However, contrary to predictions, the preference for past-on-the-left arrangements was only eliminated and not fully reversed, $M = 0.477$, 95% CI [0.409, 0.544], $t(84) = -0.679$, $p = 0.499$. A logistic regression ($P(\text{Preference}_{ij} = 1) = \text{logistic}(\gamma_{00} + \gamma_{01} \text{Country}_j + u_{0j})$) with country (0 = US, 1 = Iran) as a predictor yielded similar results, Mean Predicted Probability_{Past-Left} = 0.706, 95% CI [0.637, 0.773], $p < 0.001$ for the English speaking U.S. participants, and Mean Predicted Probability_{Past-Left} = 0.475, 95% CI [0.400, 0.549], $p = 0.504$ for the Farsi speaking participants. This is reflected in a significant difference between the two countries, with a 0.692 decrease in the odds of Iranian participants choosing the past-on-the-left arrangements compared to U.S. participants, $OR = 0.308$, 95% CI [0.176, 0.518], $p < 0.001$.

In sum, these findings replicate Experiments 1, 2a, and 2b for English speakers in the U.S. and allow comparisons with Farsi speakers in Iran. As predicted, both groups preferred the metaphor-congruent happy-above-sad arrangements over the metaphor-incongruent sad-above-happy arrangements. This is consistent with the use of the same metaphor in both cultures. Both cultures also share the past-before-future metaphor, but the representation of this metaphor in two-dimensional space differs as a function of the direction of writing. As predicted, English speakers preferred the metaphor congruent past-on-the-left arrangements over the metaphor-incongruent past-on-the-right arrangements, whereas Farsi speakers did not. In contrast to predictions, however, Farsi speakers did not show a reverse preference for past-on-the-right arrangements. Experiment 4 addresses possible reasons for this observation.

5. Experiment 4: Iranian replication

As noted, Farsi is written from right to left, whereas numbers are written from left to right, which makes Farsi speakers familiar with both directions of writing and reading. Moreover, modern technology has to some extent disrupted the traditional flow of writing: when texting on mobile phones, many Farsi speakers write Farsi with English letters in a left-to-right direction. Some Iranian scholars have referred to this manner of writing as “Finglish”, a portmanteau coined from the combination of the words “Farsi” and “English” (e.g., Alipour, Aghayosefi, & Abaszade, 2013). Finglish is particularly popular among young people in Iran. Moreover, the Farsi speakers of the university sample used in Experiment 3b were most likely familiar with English as a second language. To address these possibilities, we collected information on the frequency of texting in “Finglish” and familiarity with English as a second language in Experiment 4, which is a replication of Experiment 3b in all other respects.

5.1. Method

5.1.1. Participants

We pre-registered to recruit 260 participants and to exclude those who indicate a native language that writes from left to right (see <https://aspredicted.org/3cy83.pdf> for the pre-registration). Due to a discrepancy between the recruitment platforms and Qualtrics, 269 participants at Tarbiat Modares University completed the experiment. One participant who reported English as their native language was excluded from data analysis.

5.1.2. Design, material, and procedure

Experiment 4 used the same material and design as Experiment 2a-b and 3a-b. Participants completed the experiment in Farsi, and were asked to select the arrangement that they think is better. Participants were asked to self-report their English proficiency on a 1–7 scale, where 1 indicates low and 7 indicates high English proficiency. Participants

were also asked to report the frequency with which they use “Finglish” (using English letters to type Farsi in the left-to-right direction).

5.2. Results and discussion

A two-tailed one-sample *t*-test was computed for each metaphor. A sensitivity power analysis using G*Power indicates the experiment has 80% power to detect a minimum effect size of Cohen's $d = 0.152$. In addition, English familiarity scores were obtained by averaging participants' self-reported English proficiency and Finglish usage. The effect of English familiarity on preference for past-on-the-left arrangements was then tested by performing a one-sample *t*-test separately for those with high vs. low English familiarity. The median of the composite English familiarity was 3 out of 6. A score smaller than 3 was categorized as having low familiarity ($n = 111$) and a score larger than 3 was categorized as high familiarity ($n = 166$).

Replicating Experiment 3b, Iranian participants preferred the metaphor-congruent happy-above-sad arrangements at above chance level, $M = 0.622$, 95% CI [0.581, 0.664], $t(267) = 5.773$, $p < 0.001$. This preference was observed in all of the eight pairs of valence-themed photos, with seven being significant. Also replicating Experiment 3b, Iranian participants did not show a preference for past-on-the-left arrangements, nor did they show a significantly reversed preference for past-on-the-right arrangements, $M = 0.496$, 95% CI [0.460, 0.533], $t(267) = -0.200$, $p = 0.842$. This is reflected in the item analysis. Iranian participants preferred past-on the right for 3 of 8 pairs and past-on-the-left for another 3 pairs, with none of the differences significant; they had no directional preference for the remaining 2 pairs. Similar results were obtained through logistic regressions ($P(\text{Preference}_{ij} = 1) = \text{logistic}(\gamma_{00} + u_{0j})$) with Mean Predicted Probability_{Happy-Up} = 0.636, 95% CI [0.591, 0.682], $p < 0.001$, for the valence metaphor, and Mean Predicted Probability_{Past-Left} = 0.496, 95% CI [0.458, 0.534], $p = 0.83$, for the time metaphor. Contrary to expectations, participants' preference for the time-themed materials was not moderated by self-reported familiarity with English. The proportion of time participants preferred the past-on-the-left arrangements was 0.473, 95% CI [0.416, 0.530], $t(110) = -0.931$, $p = 0.354$ for participants with low English and 0.517, 95% CI [0.461, 0.573], $t(115) = 0.605$, $p = 0.546$, for participants with high English familiarity.

An exploratory logistic regression ($P(\text{Preference}_{ij} = 1) = \text{logistic}(\gamma_{00} + \gamma_{10} \text{Eng_Fam}_{ij} + u_{0j})$) with English familiarity as a continuous variable yielded similar results. When English familiarity is at 0 (i.e., not familiar with English at all), the mean predicted probability of preferring past-on-the-right arrangements was 0.465, 95% CI [0.352, 0.582], $p = 0.559$, and with a one unit increase in English familiarity, the mean predicted probability increased to 0.475, 95% CI [0.392, 0.560]. However, similar to the pre-registered median split analysis, this was not significant, $OR = 1.042$, 95% CI [0.902, 1.204], $p = 0.574$.

In combination, Experiments 3b and 4 suggest that the horizontal ordering of time-related stimuli does not influence the aesthetic preferences of native speakers of Farsi. This may reflect that Farsi includes writing from right to left (for verbal material) as well as writing from left to right (for numbers). In related research, Matoori et al. (2020) found that Iranians prefer left-to-right arrangements when objects are labeled numerically. In addition, exposure to Western media and culture, such as its left-to-right presentation of chronology, may have contributed to a more flexible representation of the time-space relationship for Iranian participants.

6. General discussion

Our six experiments show that people prefer visual arrangements that are congruent with applicable conceptual metaphors over arrangements that are not. This observation connects theories of embodied cognition with theories about the metacognitive basis of aesthetic preference. According to conceptual metaphor theory (Lakoff &

Johnson, 1980, 1999; for a review see Landau, 2017), representations of abstract concepts (e.g., valence, time) are grounded in sensorimotor experiences with the physical world as reflected in the mappings of valence on vertical and time on horizontal space. Stimuli that are congruent with applicable metaphors are processed faster than stimuli that are metaphor incongruent as has been observed for valence (e.g., Meier, Hauser, Robinson, Friesen, & Schjeldahl, 2007; Meier & Robinson, 2004) and time (e.g., Ouellet, Santiago, Funes, & Lupiáñez, 2010; Ouellet, Santiago, Israeli, & Gabay, 2010).

Ease of processing, in turn, is a key input into judgments of aesthetic preference (Reber et al., 2004). It underlies the influence of object (e.g., symmetry, contrast, clarity, prototypicality) and perceiver variables (e.g., exposure history, expertise) that have long been the focus of empirical aesthetics and predicts systematic effects of variables that are outside the scope of traditional theories of aesthetics, including visual (e.g., Reber et al., 1998) and conceptual (e.g., Winkielman et al., 2003) primes. A processing fluency account of aesthetic pleasure thus provides a parsimonious mechanism that connects variables that would otherwise have been considered in isolation, with each requiring separate explanations. Going beyond previous observations, the present experiments identify the influence of a variable that qualifies as a joint characteristic of the object, the perceiver, and the cultural context, namely metaphor congruence: perceivers prefer stimuli whose characteristics are congruent with the form in which a conceptual metaphor is expressed in the perceiver's culture over objects that are not. This observation highlights that beauty is neither in the beholder nor in the eye of the beholder, but in the perceiver's processing experience, which is a joint function of object, perceiver, and context variables (Reber et al., 2004; Schwarz, 2018).

The current findings also suggest cross-cultural similarities in aesthetic preference to the extent that an applicable conceptual metaphor is shared across cultures. In the present experiments, both English and Farsi speakers share the valence-verticality metaphor, such that good things are “up” and bad things are “down”, which results in a consistent preference for metaphor congruent happy-above-sad arrangements. We expect similar effects for other widely shared conceptual metaphors. For example, the conceptualization of power is also grounded in verticality across many cultures, with high power represented higher in vertical space than low power (e.g., Schubert, 2005; Tang, Zhou, Zhang, & Zhu, 2018; Wu et al., 2016). Hence, stimuli associated with high power (e.g., photographs of influential world leaders) should have more aesthetic appeal when placed high in space, whereas artworks associated with low power (e.g., photographs depicting poverty) should have more aesthetic appeal when placed low in space. Similarly, as brightness is associated with valence (e.g., Meier, Robinson, & Clore, 2004; Meier, Robinson, Crawford, & Ahlvers, 2007), the appeal of positively (vs. negatively) valenced artworks should increase with their brightness.

Conversely, cultural differences in conceptual metaphors should result in cultural differences in aesthetic preference. Although both English and Farsi speakers share the time-space metaphor, they differ in their conceptualization of the direction in which time flows, which follows the direction of writing and reading. English speakers consistently preferred arrangements that placed a past-themed image before a modern-themed image. This preference was consistently eliminated with Farsi speakers, although not fully reversed. As already discussed, Farsi speakers' indifference to the spatial placement of time-oriented stimuli may reflect that Farsi speakers are familiar with both directions of reading and writing, due to verbal materials written from right to left and numbers from left to right.

Some caveats should be addressed. The present experiments used choice as a measure of preference, consistent with a long tradition in behavioral science and decision research. A choice format, in which both stimuli are presented simultaneously, also has the advantage of providing a sensitive test of the influence of subjective processing experiences. From sensory perception to judgment, people are more

sensitive to changes in subjective experience than to stable states; hence, fluency effects are more reliably obtained in within-participant than between-participant designs (Wänke & Hansen, 2015). However, such manipulations can also provide participants with increased insight into the hypotheses studied. We therefore included an open-ended debriefing question that asked participants to tell us their thoughts about the studies. Not a single participant mentioned “metaphor” or “valence”, and only a few mentioned concepts related to “chronology” (7.9%, 4.7%, 1.5%, 5.7% in Exp.1, Exp. 2a, Exp. 2b, and Exp. 3a respectively). This suggests that participants had very limited insight into the hypotheses tested and renders concerns about demand effects mute. Nevertheless, studies with more indirect indicators of preference – assessing, for example, participants' spontaneous affective response with electromyography (Winkielman & Cacioppo, 2001) – would be welcome.

More importantly, the observed influence of metaphor congruence on aesthetic preference should hold for any conceptual metaphor. Testing this prediction with a broad range of metaphors and diverse aesthetic stimuli provides a promising avenue for future research. Finally, experienced processing fluency serves as information for a wide range of judgments other than aesthetic preference (for reviews, see Alter & Oppenheimer, 2009; Schwarz, Jalbert, Noah, & Zhang, 2021), including truth (e.g., Reber & Schwarz, 1999), novelty (e.g., Jacoby, Woloshyn, & Kelley, 1989), and risk (e.g., Song & Schwarz, 2009), among others. Hence, the fluency enhancing effect of metaphor congruent presentations may influence a broad range of judgments in ways that are not predicted by the metaphor's specific content.

Open practice

We have made the stimuli and data of all experiments publicly available at the Open Science Framework: https://osf.io/xystg/?view_only=bf82a309fa3e4c7abdc5a06a626e5a33. We confirm that the information and files uploaded to the Open Science Framework are sufficient for an independent researcher to reproduce the reported methodology and results.

We have made the pre-registrations of Experiments 2a-b, 3a-b and 4 available at the following links: <https://aspredicted.org/pp59i.pdf>, <https://aspredicted.org/pv2py.pdf>, <https://aspredicted.org/74qp3.pdf>, <https://aspredicted.org/3cy83.pdf>. There were no additional pre-registrations other than the ones reported, but due to a record-keeping error, the pre-registered studies 2a-b, 3b, and 4 reference an erroneous pre-registration number #14284. The correct pre-registration that should be referenced is #14487 (Experiment 3a).

There were no changes to the pre-registered analysis plan for the primary confirmatory analysis in Experiments 2a-b and 3a-b. In Experiment 4, we pre-registered average reported 1) English proficiency, 2) frequency of English usage, and 3) frequency of Finglish as a composite indicator of English familiarity. However, due to a communication error, the frequency of English usage was omitted in the translation process. Hence, the pre-registered analysis was performed by averaging the responses of the other two variables. All analyses described in the pre-registered plans are reported.

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Appendices

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