

Effects of ease of comprehension and individual differences on the pleasure experienced while reading novelized verb-based metaphors

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Abstract

People generally seek to minimize effort, including cognitive effort, but poetic language can be pleasurable while requiring effort to understand. The ‘optimal innovation hypothesis’ holds that this paradoxical relationship arises when a non-default interpretation is required and the default interpretation is easily available for comparison. A recent study of ease and pleasure during reading novel variations of familiar verb-based metaphors was partially consistent with this prediction. The present study replicated that pattern of partial support and examined how it is correlated with individual differences in verbal ability, personality (emotionality and openness to experience), and lifestyle/experience (engagement with creative hobbies). Correlations with individual differences tended to be very small and not statistically significant, with two exceptions. First, participants with better verbal ability tended to rate metaphors easier to understand, particularly for familiar metaphors, and a similar pattern was observed for the ‘openness to experience’ personality trait. Second, there was a positive association between engagement with creative hobbies and pleasure ratings specifically for the critical ‘optimal’ extension metaphors. These results provide a robust basis for future research on the aesthetic experience of metaphors and literary language in general.

Keywords: metaphor comprehension; aesthetic experience; individual differences;

Introduction

There are few things more subject to individual taste than poetry. Why, when some are struck, moved to tears even, by one phrase, are others perhaps frustrated or simply shrug?

Formalist literary theorist Shklovsky (1917) argued that poetic language is designed ‘to make objects “unfamiliar”, to make forms difficult, to increase the difficulty and length of perception’ (p. 3), and that this unfamiliarity accounts for the pleasure of poetry. Building upon this, Giora and colleagues (2004, 2015, 2017) formulated an ‘optimal innovation hypothesis’: when stimuli provoke non-default interpretations or responses, processing costs increase, yet aesthetic pleasure is increased when a non-default is elicited while the default is still relatively easily available for comparison.

As common wisdom would have it, simply making something novel or difficult is no guarantee of making it

pleasurable; in general, people seek to minimize effort, including cognitive effort (Kool et al., 2010; Kurzban et al., 2013; Westbrook & Braver, 2015; Shenhav et al., 2017; cf. Cacioppo & Petty, 1982). In this respect, Giora and colleagues’ ‘optimal innovation’ aligns with Berlyne’s (1971) hypothesized inverted U-shaped relationship between stimulus complexity (difficulty) and aesthetic experience (pleasure) in visual art. Empirical testing of Berlyne’s hypothesis across multiple art forms, however, has yielded conflicting results (see e.g., Chmiel & Schubert, 2017; Friedenber & Liby, 2016; Adkins, et al., 2016).

A recent behavioral study (Errington, et al., 2022) based on Giora et al’s hypothesis tested whether slightly altering a lexicalized, verb-based metaphor phrase would make that phrase more pleasing to readers than either the original familiar phrase or one that had been altered excessively. A set of 62 familiar, verb-based metaphors written in the first-person (e.g., ‘I grasp the meaning’) were novelized to two increasing degrees in two different ways: (1) by varying the verb (‘I brush the meaning’ [optimal] or ‘I tickle the meaning’ [excessive]); or (2) by extending the metaphor at the end of the sentence (‘I grasp the meaning and shake it vigorously’ [optimal] or ‘I grasp the meaning and swing on it’ [excessive]). The familiar phrases were defined as metaphors following Lakoff & Johnson (1980), as variations that rely on active conceptual mapping between vehicle and tenor (e.g., ‘I grasp the meaning and shake it’) remain comprehensible as metaphors, suggesting that some conceptual mapping must exist despite the current lack of evidence (see Holyoak & Stamenković, 2018).

Applying Giora et al’s hypothesis, for familiar metaphor phrases like ‘I grasp the meaning’, the default interpretation is metaphorical (‘I understand’, rather than the literal ‘I am physically grasping meaning’). Because the variations were unfamiliar, their default interpretations should be literal, but the ‘optimal’ variations were designed so that the non-default metaphor interpretation derived from the familiar metaphor was also easily available (‘I brush the meaning’ interpreted as something like ‘I came close to understanding’). These were predicted to be more pleasurable than the ‘excessive’ metaphors, which were equally unfamiliar but without an easily available non-default interpretation based on the familiar metaphor.

It is worth noting that even in the ‘excessive’ conditions, a coherent interpretation remains available, though the amount of effort involved is greater and the resulting interpretation is more susceptible to variation between individuals. ‘I tickle the meaning’ might, with effort, resolve along lines of ‘I understand a meaning in a tentative, playful manner’ or ‘in such a way as to cause the meaning to move away’; ‘I grasp the meaning and swing on it’ might be interpreted as ‘I understand the meaning and use that to enable further creative thinking’. Regardless of the exact interpretation arrived at by participants (something that was not tested), coherent interpretations were *possible* for all conditions, despite the variable amount of effort required and participants’ willingness to make that effort.

The Errington et al. study yielded mixed results. Metaphor extension variations produced the hypothesized relationship between pleasure and difficulty: while ease of comprehension (reported on a 7-point scale) decreased linearly across conditions from familiar to ‘optimally’ to ‘excessively’ extended metaphors, readers’ self-assessed enjoyment (also reported on a 7-point scale on a separate set of trials) rose for the optimal condition before falling for the excessive condition. In the case of verb changes, however, ease and pleasure both decreased steadily, from familiar to optimal and excessive condition.

Several factors could account for the differences between verb and extension manipulations, including testing and stimulus context, timing of variation (for verb variations, the variation occurs mid-metaphor whereas extensions occur after the full familiar metaphor is presented), and participants’ willingness to make the effort required to create a coherent interpretation (this may relate to participants’ reading ‘goals’ or perceived rewards for cognitive effort; see e.g., Sandra & Otto, 2018). Before testing those, we sought to (1) replicate the results of the prior study in a new sample of participants, and (2) evaluate the sensitivity of these patterns to individual differences.

One of the most persistent criticisms of the U-shaped pleasure/difficulty curve hypotheses for art is the lack of attention to the role that individual differences might play (see Van Geert & Wagemans, 2021), specifically aptitude, personality, and experience. If one has an aptitude for comprehending metaphors, for instance, they may find ‘optimal’ what for others is an ‘excessive’ variation. If another is more open to new experiences, or more inclined to feel things strongly, they could enjoy the challenge of novel metaphors more. If another is an avid reader of poetry, or frequently engages in other creative hobbies, they too might find novel metaphors more enjoyable even if those metaphors are no easier for them to comprehend. These attributes, individually and collectively, could have substantial effects on the pleasure/difficulty curve.

Previous research on the effects of individual differences suggests that differences in aptitude, personality, and experience would play a key role in the aesthetic experience of figurative language. However, both personality and experience are under-examined when it comes to metaphor

comprehension and the experience of figurative language. One study (Duffy & Feist, 2014) examined the links between lifestyle (comparing students and administrators) and the comprehension of ambiguous time metaphors, as well as the associations with personality factors like tendencies to procrastinate, conscientiousness, and extroversion. While the results revealed little about the subjective experience of metaphors, the clear associations between personality and lifestyle and the interpretation of these metaphors suggest that they can play a role, bolstered by research in other art forms (see e.g., Kazmerski, et al., 2003) and attesting to the role of Openness to Experience and of creative hobbies in a wide range of aesthetic experiences.

Openness to Experience was also found to be associated with metaphor processing in one experiment (Altaras-Dimitrijevic & Tadić, 2007) that used the NEO personality inventory (NEO-PI-R). Kuiken, Douglas and Kuijpers (2021) found different types of Openness to Experience (measured with either the Tellegen Absorption Scale [TAS] or the Big Five Aspects Scale [BFAS]) differentially associated with experiences they called ‘expressive enactment’ (TAS) and ‘integrative comprehension’ (BFAS), further underscoring the importance of openness in metaphor experience.

Aptitude has clear connections with metaphor comprehension, but links to enjoyment are still unclear. Several studies focus on working memory (see e.g., Chiappe & Chiappe, 2007; Iskandar & Baird, 2014; Olkonemi et al., 2016; Prat et al., 2012). Dimitrijevic and Tadić’s tests focused on verbal intelligence, with personality as something of a sidenote, finding their ‘Test of Literary Metaphor Comprehension’ more effective than standard verbal intelligence tests. Across a series of studies, Stamenković and colleagues (Stamenkovic et al., 2019, 2020, 2022, 2023; Morsanyi et al., 2022) have found higher verbal ability (measured using their Semantic Similarities Test [SST]) and vocabulary consistently associated with better comprehension.

We sought to replicate the previous findings of Errington et al. (2022) and to assess the links between personality (Openness to Experience and Emotionality assessed with the HEXACO), aptitude (crystalized verbal intelligence as assessed with the SST), and lifestyle/experience (engagement with creative hobbies) and the inconsistent inverted U-shaped relationship found between ease of comprehension and pleasure.

Methods

Participants & Procedure

The sample consisted of 211 participants recruited via the University of Edinburgh’s SONA student participant recruitment program (SONA). The combined sample also included the publicly shared data reported by Errington et al (2022), which consisted of 63 participants recruited via Prolific. Participants were excluded from analysis if English was not their first language (n=74), they had a history of language-related disorders (n=9), cognitive impairment

(n=2), incomplete data (n=3), or failed more than 1 attention check (n=37). These exclusions resulted in a final combined sample of 149 participants: 89 from SONA and 60 from Prolific. See Table 1 for participant demographic information for the SONA and Prolific samples.

Table 1. Participant Demographic Information

	SONA (n=89) M (SD)	Prolific* (n=60) M (SD)
Age	19.30 (5.96)	31.32 (9.76)
F:M:NA	68:16:5	38:22:0
SST Score	24.30 (5.58)	22.12 (6.88)
Creative Hobbies	11.28 (9.70)	9.68 (6.48)
HEXACO		
<i>Honesty-Humility</i>	32.18 (5.93)	33.08 (6.14)
<i>Emotionality</i>	36.19 (5.89)	33.98 (6.79)
<i>Extraversion</i>	30.67 (7.13)	30.58 (6.77)
<i>Agreeableness</i>	31.26 (6.68)	30.68 (6.85)
<i>Conscientiousness</i>	34.94 (7.44)	35.42 (5.87)
<i>Openness</i>	35.71 (6.25)	36.73 (6.67)

* Reported by Errington et al. (2022).

The study procedures were the same as in Errington et al. (2022), which also describes them in more detail. The study was administered via Qualtrics. Participants were randomly assigned to 1 of 3 experimental groups. The groups differed in the set of sentences shown to participants, but each group of stimuli contained the same overall number of items (n=75) as well as an equal number of items from each variation category (e.g., Optimal Verb, Excessive Extension). Multiple variations of familiar metaphor may be included in each group, but none of the groups included all variations. Participants provided the following subjective ratings for all sentences within their group, ensuring that sentence-level ratings were within subject: Ease (how easy the sentence was to interpret), Imageability (how quickly and easily each sentence aroused a sensory experience), Emotion (how strongly each sentence evoked an emotional response), and Pleasurability (how much the participant liked the way the message was expressed focusing on how effective, satisfying, or powerful the sentence was). All ratings were given on a 7-point scale with higher values indicating an increase in Ease, Imageability, Emotion or Pleasure. Sentence variations were assigned to one of five lists. An attention check question with the same structure as the critical sentence rating items was added to each list. For a given rating (i.e., Ease), the set order and the presentation of the sentences within each list were randomized, but each rating block began with a description of the property and at least 3 example sentences. The presentation order of the subjective rating blocks was counterbalanced such that participants were randomly assigned to one of four presentation orders.

Between the subjective rating blocks, participants completed 4 blocks of individual differences measures which were presented in the following fixed order: the HEXACO

(presented across 2 blocks) (Ashton & Lee, 2009), an engagement in creative hobbies questionnaire (Asquith et al., 2022), and the Semantic Similarities Test (SST) (Stamenković et al., 2019). Participants either received course credit or £7.25 upon completion of the approximately 1-hour study. The study was carried out in accordance with an ethics protocol approved by the University of Edinburgh PPLS Research Ethics panel (Ref No. 277-2021/3). The sentence stimuli and Qualtrics survey file are provided on the OSF page for the study by Errington and his colleagues (<https://osf.io/hjcyd/>).

A composite score that captured the frequency of engagement in creative hobbies was generated according to the scoring guidelines outlined by Asquith et al. (2022). The SST was manually scored according to the criteria provided by Stamenković, Ichien, and Holyoak. Data were analyzed using linear mixed effects models implemented with the lme4 package (version 1.1.31) (Bates et al., 2015) in R (version 4.2.0) (R Core Team, 2019). Model parameter p-values were obtained using the Satterthwaite method for estimating degrees of freedom via the lmerTest package (version 3.1.3) (Kuznetsova et al., 2017). Continuous predictors were centered prior to analysis. Data and analysis code are shared on OSF (<https://osf.io/wy9bp/>).

Replication Analyses

The analyses from Errington et al. (2022) examining the impact of sentence type on subjective ease and pleasure ratings were conducted with the SONA sample as an independent replication of those results.

The first model assessed the impact of sentence type and ease on pleasure with fixed effects of sentence type (with familiar metaphor as the reference level) and ease and random by-participant intercepts and slopes of sentence type and random intercepts of item. The second model assessed the impact of sentence type and semantic knowledge on pleasure with fixed effects of sentence type and SST score and the same random effects structure as the prior model. The third model assessed the impact of sentence type and semantic knowledge on ease with the same fixed and random effect structure as the second model.

Individual Differences Analyses

The combined sample data were used to examine the connections between individual differences and the subjective experience of ease or pleasure in comprehending the metaphors used here. In investigating these associations, we focused on openness to experience, emotionality, and engagement in creative hobbies as we believed these individual differences would have the greatest impact on the subjective experience of metaphor comprehension.

The first set of analyses examined associations between openness to experience and ease or pleasure ratings with fixed effects of sentence type and openness (HEXACO subscale) and, as with the prior replication models, random by-participant intercepts and slopes of sentence type and random intercepts of item.

The second set of analyses examined how emotionality was associated with ease or pleasure ratings with fixed effects of sentence type and emotionality (HEXACO subscale). The random effects structure was the same as the prior model.

The third set of analyses examined how the engagement in creative hobbies was associated with ease or pleasure ratings with fixed effects of sentence type and creative hobbies composite score. The random effects structure was the same as the prior models.

Results

Replication of Prior Results

We first tested whether the key findings from Errington et al. (2022) were replicated in this new (and somewhat larger) sample of participants recruited locally through a university participant pool (SONA) rather than online through Prolific. Figure 1 shows the results from the new sample, which very closely match the results reported by Errington et al. A detailed comparison of the coefficients from the statistical models found that, for each model term, the estimates from the two samples are within one another's confidence interval (see Figure 2).

First, the metaphor conditions differed in both ease and pleasure ratings. For ease of comprehension (top panel of Figure 1), this was a monotonic effect with “optimal” metaphors rated less easy to comprehend than familiar metaphors, and “excessive” metaphors rated even more difficult to comprehend. For pleasure ratings (bottom panel of Figure 1), the pattern was different for verb and extension manipulations. Pleasure ratings for verb manipulations paralleled the ease ratings: “optimal” verb metaphors were rated slightly less pleasurable than familiar metaphors and “excessive” verb metaphors rated even less pleasurable. Pleasure ratings for extension manipulations exhibited the critical U-shaped pattern reported for the Prolific sample and predicted by the optimal innovation hypothesis: highest pleasure ratings for “optimal” extensions, with somewhat lower pleasure ratings for “excessive” extensions.

Second, there was an overall positive association between ease and pleasure (model 1, top panel in Figure 2), consistent with the general pattern that people tend to prefer stimuli that are easier to process. In both samples, this association tended to be stronger for the novelized metaphors (especially in the SONA sample), indicating that the preference for easier metaphors was stronger when processing novel metaphors than when processing familiar metaphors.

Although broadly similar in estimated magnitude, effects of SST (verbal ability) tended to be smaller (i.e., closer to 0) and less statistically significant in the SONA sample than in the Prolific sample (models 2 and 3, middle and bottom panels in Figure 2). This may be related to the overall somewhat higher SST scores in the SONA sample ($M = 24.30, SD = 5.58$) compared to the Prolific sample ($M = 22.12, SD = 6.88$). That is, the effect of verbal ability may be somewhat weaker among participants who, overall, have somewhat higher verbal ability.

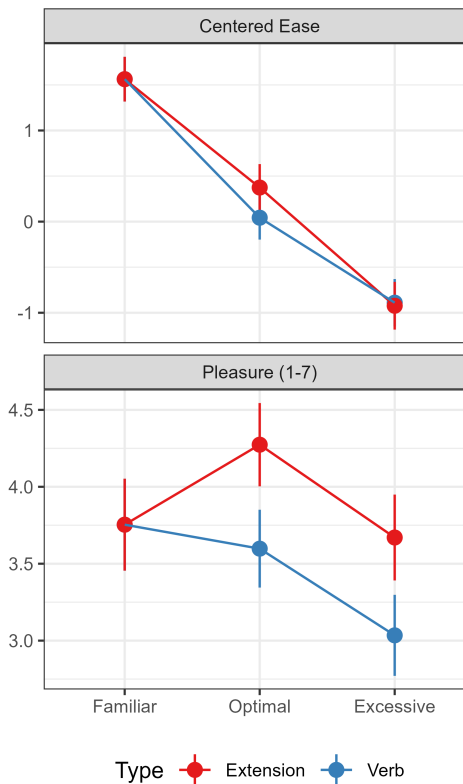


Figure 1. Ease (top) and pleasure (bottom) ratings by condition and novel metaphor type.

For the combined participant sample (SONA and Prolific), SST did not substantially modulate pleasure ratings (only a marginal negative association for familiar metaphors). SST was positively associated with ease ratings, especially for the familiar metaphors (Estimate = 0.045, SE = 0.013, $t(148.5)=3.38, p < 0.001$), indicating that (not surprisingly) familiar metaphors were rated easier to understand by participants with higher verbal ability. This effect was smaller for the novel metaphor variations, though the difference was statistically significant only for the excessive verb variations (Estimate = -0.044, SE = 0.016, $t(148.2)=2.72, p < 0.01$).

Effects of Individual Differences

Overall, the association of individual differences with ease and pleasure ratings tended to be very small and not statistically significant. There were two exceptions to this overall pattern. First, for ease ratings there was an interaction between openness to experience and metaphor type (Figure 3, left panel): higher openness to experience was associated with higher ease of comprehending familiar metaphors, a weaker association for optimal verb and extension metaphors, and an even weaker association for excessive verb and extension metaphors. That is, as the degree of difficulty and distance from the familiar metaphor increased, there was a decreased association between openness to experience and ease of metaphor comprehension.

and ease were decoupled: pleasure ratings tended to be higher despite lower ease ratings. The correlation with creative hobbies suggests that people who engage in more creative hobbies may be particularly prone to experience pleasure from comprehending moderately difficult and innovative metaphors.

Discussion

The present results replicated a recent study, showing the same pattern of partial support for the inverted U-shaped relationship between ease and pleasure predicted by the ‘optimal innovation hypothesis’ and related theories. Individual differences in verbal ability, personality, and experience had minimal association with ease and pleasure ratings of metaphor sentences, with only a few reliable exceptions. Participants with better verbal ability (as measured by SST) tended to rate metaphors easier to understand, and this was strongest for familiar metaphors and weakest for excessive variations. A similar pattern was observed for the ‘openness to experience’ personality trait. While both SST and openness to experience had similar associations with ease ratings, neither was substantially associated with pleasure ratings. Engagement with creative hobbies was associated with higher pleasure ratings, especially for the critical optimal extension condition, but not with ease ratings.

The replication of the pattern reported by Errington et al. (2022) provides a basis for better understanding the ‘optimal innovation’ effect for novel metaphor variations. The metaphor extensions showed exactly the inverse U-shaped pattern predicted by the ‘optimal innovation hypothesis’, but verb variations elicited a monotonic relationship between ease and pleasure. This discrepancy is now observed in two distinct and relatively large samples, and the minimal effects of individual differences suggest that this phenomenon does not result from simply having ‘missed the mark’ in finding the ‘optimal’ degree of innovation for our verb-based stimulus variations. As pointed out by Errington et al., timing of the novelty may play a key role here: verb variations come before the full metaphor is presented while extensions come after. Participants’ implicit expectations (task-set) when reading single sentences as part of a psychology experiment may also impact their aesthetic experience (as well as their assessment of ease of comprehension). These may represent avenues for further research.

That the pattern reported by Errington et al. (2022) and replicated here was found to be robust even when taking into account several individual difference measures is also important. The most significant association was that of participants’ engagement with creative hobbies with the pleasure experienced in metaphor processing. Especially notable is the case of the ‘optimal’ extensions, where those

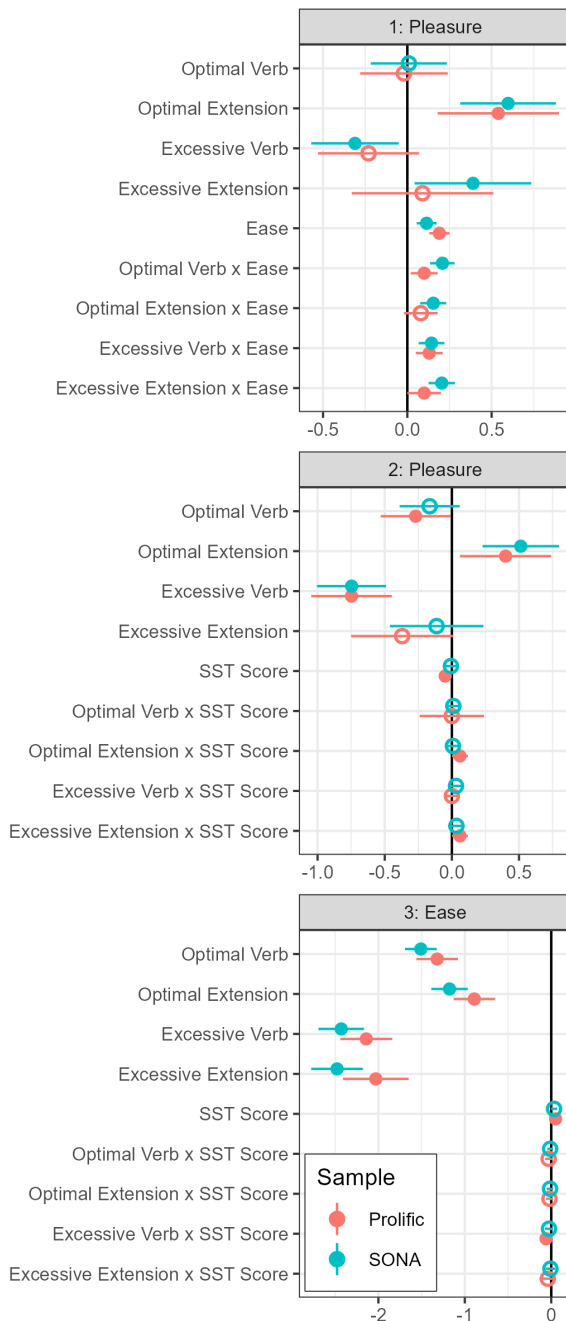


Figure 2. Regression coefficient estimates ($\pm 2SE$) from the prior study (Prolific sample) and the current study (SONA sample). All estimates are relative to the familiar metaphor condition and continuous predictors (Ease for model 1, SST for models 2 and 3) were centered. Statistically significant ($p < 0.05$) estimates are shown as filled circles, not statistically significant estimates are open circles.

Second, specifically for optimal extension metaphors, there was a positive association between engagement with creative hobbies and pleasure ratings (Figure 3, right panel). Note that the optimal extension condition is the one that showed the critical optimal innovation effect where pleasure

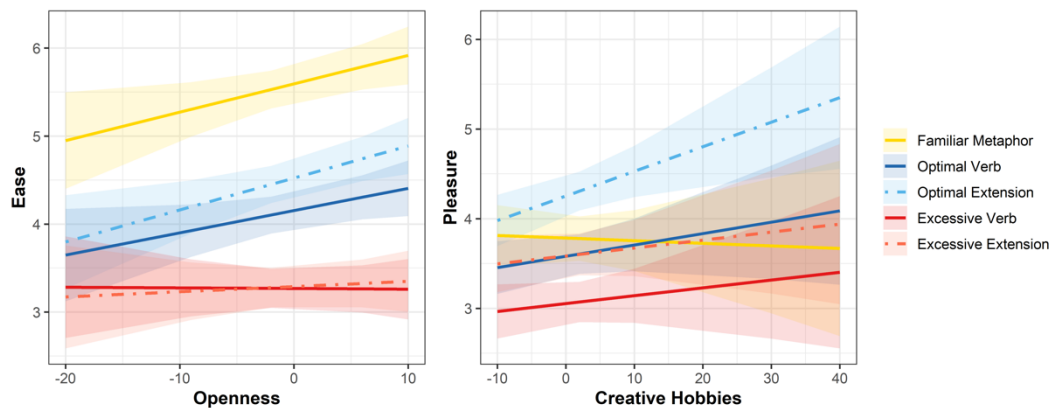


Figure 3. Significant individual differences analyses. The left panel shows the effect of Openness to Experience on Ease ratings across the 5 sentence types. The right panel shows the effect of engagement in Creative Hobbies on Pleasure ratings across the 5 sentence types.

with greater engagement with creative hobbies experienced greater pleasure despite finding those metaphors more difficult than the average. Our results seem to indicate that increased engagement with creative activities is not associated with increased skill in metaphor comprehension (perhaps because the creative hobbies were not necessarily related to literature) but is associated with greater pleasure when reading moderately difficult ones. It is possible that individuals who ‘naturally’ find greater pleasure in moderately difficult creative tasks (i.e., novel metaphor comprehension) tend to seek out more creative hobbies.

Previous studies (see Bannister, 2019; Colver & El-Alayli, 2016; Fayn, et al., 2015; Nusbaum & Silvia, 2011; McCrae, 2007; Silvia, et al., 2011, 2015; Williams et al., 2022) have reported that certain personality traits – most notably ‘openness to experience’ – may play a pivotal role in the aesthetic experience of artistic stimuli (music in particular), as well as in the processing of metaphors. We similarly found that more ‘open’ individuals tended to rate metaphors easier to comprehend, but we found little association with the pleasure of reading metaphors, complicating the findings of those previous studies. The lack of association with pleasure hints at a general division between empirical work on the aesthetic experience of linguistic stimuli compared to non-linguistic artistic stimuli. Although metaphor processing has received significant attention from cognitive psychologists, the majority of studies consider metaphor as a linguistic phenomenon to be ‘comprehended’ or ‘resolved’ accurately (i.e., the process of resolving a metaphor like ‘I grasp the situation’ into something equivalent to ‘I understand’) rather than as an aesthetic phenomenon whose resolution might be experienced aesthetically (as, for example, music or visual art might) or not at all. Studies of non-linguistic artistic stimuli, meanwhile, privilege the aesthetic experience, often without even defining what ‘accurate’ perception might mean. Yet metaphor – indeed language itself – can also be experienced aesthetically, producing pleasure and ‘moving’ people as a result of its rhythm, sound, novelty, and other such features

(Cutler 1994), as well as the images (visual or otherwise) that its processing might evoke, with no ‘correct’ comprehension to be defined.

The focus of most studies of metaphor comprehension on ‘correct’ interpretation over aesthetic experience of metaphor likely influences how participants approach the given stimuli. Not being able to understand the meaning of ‘I tickle the meaning’, for instance, may prove frustrating if tasked (implicitly or explicitly) with coherently resolving it or translating it into literal language. Yet it might not be so if invited to simply enjoy whatever mental pictures it evokes. While our study, by design, did not require that readers ‘interpret’ the metaphor stimuli they were given, it is likely that test conditions (and in particular the inclusion of questions of ‘ease’ of comprehension) nevertheless biased readers toward attempting to create a coherent understanding of each given phrase rather than treating the sentences primarily as aesthetic objects. This might explain why ‘openness to experience’ personality traits would be linked to metaphor comprehension (consistent with previous studies) but not aesthetic experience (as in studies of music or other arts), since readers were engaging them primarily as objects to be comprehended rather than objects to be experienced. The role subjective rating tasks may play in the comprehension process indicates the limitations of this behavioral approach, which other methods such as neuroimaging might conceivably remedy.

Readers’ implicit goals or task-set when reading likely have impacts on the comprehension and aesthetic experience of metaphors beyond the relationship to personality. Further investigation of readers’ task-set effects, particularly if employing neuroimaging techniques to avoid the potentially confounding effects of test questions, would be productive avenues for better understanding the aesthetic experience of metaphors and literary language in general.

References

- Adkins, O. C., & Norman, J. F. (2016). The Visual Aesthetics of Snowflakes. *Perception, 45*(11), 1304–1319. <https://doi.org/10.1177/2041669516661122>
- Altaras-Dimitrijević, A., & Tadić, M. (2007). Figuring out the figurative: Individual differences in literary metaphor comprehension. *Psihologija, 40*, 399–415. <https://doi.org/10.2298/PSI0703399A>
- Asquith, S. L., Wang, X., Quintana, D. S., & Abraham, A. (2022). Predictors of creativity in young people: Using frequentist and Bayesian approaches in estimating the importance of individual and contextual factors. *Psychology of Aesthetics, Creativity, and the Arts, 16*, 209–220. <https://doi.org/10.1037/aca0000322>
- Bannister, S. (2019). Distinct varieties of aesthetic chills in response to multimedia. *PLOS ONE 14*, Article e0224974. <https://doi.org/10.1371/journal.pone.0224974>
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software, 67*(1), 1–48. <https://doi.org/10.18637/jss.v067.i01>
- Berlyne, D. E. (1971). *Aesthetics and Psychobiology*. New York, NY: Appleton-Century-Crofts.
- Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology, 42*, 116–131. <https://doi.org/10.1037/0022-3514.42.1.116>
- Chiappe, D. L., & Chiappe, P. (2007). The role of working memory in metaphor production and comprehension. *Journal of Memory and Language, 56*(2), 172–188. <https://doi.org/10.1016/j.jml.2006.11.006>
- Colver, M. C., & El-Alayli, A. (2016). Getting aesthetic chills from music: The connection between openness to experience and frisson. *Psychology of Music 44*(3), 413–427. <https://doi.org/10.1177/0305735615572358>
- Chmiel, A. & Schubert, E. (2017). Back to the inverted-U for music preference: A review of the literature. *Psychology of Music 45*(6), 886–909. <https://doi.org/10.1177/0305735617697507>
- Cutler, A. (1994). The perception of rhythm in language. *Cognition, 50*, 79–81.
- Duffy, S. E., & Feist, M. I. (2014). Individual differences in the interpretation of ambiguous statements about time. *Cognitive Linguistics, 25*(1), 29–54. <https://doi.org/10.1515/cog-2013-0030>
- Errington, P. J., Thye, M., & Mirman, D. (2022). Difficulty and pleasure in the comprehension of verb-based metaphor sentences: A behavioral study. *PLOS ONE 17*(2), e0263781. <https://doi.org/10.1371/journal.pone.0263781>
- Fayn, K., MacCann, C., Tiliopoulos, N., & Silvia, P. J. (2015). Aesthetic emotions and aesthetic people: Openness predicts sensitivity to novelty in the experiences of interest and pleasure. *Frontiers in Psychology 6*, Article 1877. <https://doi.org/10.3389/fpsyg.2015.0187>
- Friedenberg, J. & Liby, B. (2016). Perceived beauty of random texture patterns: A preference for complexity. *Acta Psychologica 168*, 41–49. <https://doi.org/10.1016/j.actpsy.2016.04.007>
- Giora, R., Fein, O., Kronrod, A., Elnatan, I., Shuval, N., & Zur, A. (2004). Weapons of Mass Distraction: Optimal Innovation and Pleasure Ratings. *Metaphor and Symbol, 19*(2), 115–141. https://doi.org/10.1207/s15327868ms1902_2
- Giora, R., Fein, O., Kotler, N., & Shuval, N. (2015). Know hope: Metaphor, optimal innovation and pleasure. In G. Brône, K. Feyaerts, & T. Veale (Eds.), *Cognitive Linguistics and Humor Research* (pp. 129–146). <https://doi.org/10.1515/9783110346343-007>
- Giora, R., Givoni, S., Heruti, V., & Fein, O. (2017). The Role of Defaultness in Affecting Pleasure: The Optimal Innovation Hypothesis Revisited. *Metaphor and Symbol, 32*(1), 1–18. <https://doi.org/10.1080/10926488.2017.1272934>
- Iskandar, S., & Baird, A. D. (2014). The role of working memory and divided attention in metaphor interpretation. *Journal of Psycholinguistic Research, 43*(5), 555–568. <https://doi.org/10.1007/s10936-013-9267-1>
- Kazmerski, V.A., Blasko, D.G. & Dessalegn, B.G. (2003) ERP and behavioral evidence of individual differences in metaphor comprehension. *Memory & Cognition 31*, 673–689. <https://doi.org/10.3758/BF03196107>
- Kool, W., McGuire, J. T., Rosen, Z. B., & Botvinick, M. M. (2010). Decision making and the avoidance of cognitive demand. *Journal of Experimental Psychology: General, 139*(4), 665. <https://doi.org/10.1037/a0020198>
- Kuiken, D., Douglas, S., & Kuijpers, M. (2021). Openness to experience, absorption-like states, and the aesthetic, explanatory, and pragmatic effects of literary reading. *Scientific Study of Literature, 11*(2), 148–195. <https://doi.org/10.1075/ssol.21007.kui>
- Kurzban, R., Duckworth, A., Kable, J. W., & Myers, J. (2013). An opportunity cost model of subjective effort and task performance. *Behavioral and Brain Sciences, 36*(6), 661–679. <https://doi.org/10.1017/S0140525X12003196>
- Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. (2017). lmerTest package: tests in linear mixed effects models. *Journal of Statistical Software, 82*, 1–26. <https://doi.org/10.18637/jss.v082.i13>
- Lakoff, G., & Johnson, M. (1980). *Metaphors We Live By*. Chicago: University of Chicago Press.
- McCrae, R. R. (2007). Aesthetic chills as a universal marker of openness to experience. *Motivation and Emotion 31*(1), 5–11. <https://doi.org/10.1007/s11031-007-9053-1>
- Morsanyi, K., Hamilton, J., Stamenković, D., & Holyoak, K. J. (2022). Linking metaphor comprehension with analogical reasoning: Evidence from typical development and autism spectrum disorder. *British Journal of Psychology, 113*(2), 479–495. <https://doi.org/10.1111/bjop.12542>
- Nusbaum, E. C., & Silvia, P. J. (2011). Shivers and timbres: Personality and the experience of chills from music. *Social Psychological & Personality Science 2*, 199–204. <https://doi.org/10.1177/1948550610386810>
- Olkonemi, H., Ranta, H., & Kaakinen, J. K. (2016). Individual differences in the processing of written sarcasm

- and metaphor: Evidence from eye movements. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 42(3), 433–450. <https://doi.org/10.1037/xlm0000176>
- Prat, C. S., Mason, R. A., & Just, M. A. (2012). An fMRI investigation of analogical mapping in metaphor comprehension: The influence of context and individual cognitive capacities on processing demands. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 38(2), 282–294. <https://doi.org/10.1037/a0026037>
- R Core Team. (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing. <https://www.r-project.org/>
- Sandra, D. A., & Otto, A. R. (2017). Cognitive capacity limitations and Need for Cognition differentially predict reward-induced cognitive effort expenditure. *Cognition*, 172, 101–106. <https://doi.org/10.1016/j.cognition.2017.12.004>
- Silvia, P. J., Fayn, K., Nusbaum, E. C., & Beaty, R. E. (2015). Openness to experience and awe in response to nature and music: Personality and profound aesthetic experiences. *Psychology of Aesthetics, Creativity, & the Arts* 9(4), 376–384. <https://doi.org/10.1037/aca0000028>
- Silvia, P. J., & Nusbaum, E. C. (2011). On personality and piloerection: Individual differences in aesthetic chills and other unusual aesthetic experiences. *Psychology of Aesthetics, Creativity, & the Arts* 5(3), 208–214. <https://doi.org/10.1037/a0021914>
- Holyoak, K. J., & Stamenković, D. (2018). Metaphor comprehension: A critical review of theories and evidence. *Psychological Bulletin*, 144(6), 641–671. <https://doi.org/10.1037/bul0000145>
- Stamenković, D., & Holyoak, K. J. (2022). Linking metaphor comprehension with analogical reasoning: Evidence from typical development and autism spectrum disorder. *British Journal of Psychology*, 113(2), 479–495. <https://doi.org/10.1111/bjop.12542>
- Stamenković, D., Ichien, N., & Holyoak, K. J. (2019). Metaphor comprehension: An individual-differences approach. *Journal of Memory and Language*, 105, 108–118. <https://doi.org/10.1016/j.jml.2018.12.003>
- Stamenković, D., Ichien, N., & Holyoak, K. J. (2020). Individual differences in comprehension of contextualized metaphors. *Metaphor and Symbol*, 35(4), 285–301. <https://doi.org/10.1080/10926488.2020.1821203>
- Stamenković, D., Milenković, K., Ichien, N., & Holyoak, K. J. (2023). An individual-differences approach to poetic metaphor: Impact of aptness and familiarity. *Metaphor and Symbol*, 38(2), 149–161. <https://doi.org/10.1080/10926488.2021.2006046>
- Shenhav, A., Musslick, S., Lieder, F., Kool, W., Griffiths, T. L., Cohen, J. D., & Botvinick, M. M. (2017). Toward a rational and mechanistic account of mental effort. *Annual Review of Neuroscience*, 40, 99–124. <https://doi.org/10.1146/annurev-neuro-072116-031526>
- Shklovsky, V. (1917/1997). Art as Technique. In: Newton KM (Ed.), *Twentieth Century Literary Theory*. London: Palgrave (pp. 3–5).
- Van Geert, E., & Wagemans, J. (2021). Order, complexity, and aesthetic preferences for neatly organized compositions. *Psychology of Aesthetics, Creativity, and the Arts*, 15(3), 484–504. <https://doi.org/10.1037/aca0000276>
- Westbrook, A., & Braver, T. S. (2015). Cognitive effort: A neuroeconomic approach. *Cognitive, Affective, & Behavioral Neuroscience*, 15, 395–415. <https://doi.org/10.3758/s13415-015-0334-y>
- Williams, P. G., Johnson, K. T., Bride, D. L., Baucom, B. R. W., & Crowell, S. E. (2022). Individual differences in aesthetic engagement and proneness to aesthetic chill: Associations with awe. *Psychology of Aesthetics, Creativity, & the Arts*. Advance online publication. <https://doi.org/10.1037/aca0000045>

