

Meaning making in an art context affects semantic distance: The case of semantic inconsistencies in written language

Marina Iosifyan^{*}, Judith Wolfe, Brendan Wolfe

School of Divinity, University of St Andrews, St Mary's College, St Andrews KY16 9UB, Scotland, UK

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ABSTRACT

When people know they are encountering art, that awareness may change how they interpret what they experience. However, it is not clear how engaging with art affects cognition in everyday life. This collection of studies investigates how meaning-making in an art context influences semantic distance. Semantic distance involves connecting weakly-related concepts and plays an important role in cognitive processes such as memory and creativity. Across four studies, participants attributed meaning to semantically incongruent sentences («Most cats see well at court»), believing either that they were or were not created by artists. We then measured the effects on semantic distance using a network-based approach (Studies 1 and 2) and a sensorimotor distance-based approach (Studies 3 and 4). In Studies 1 and 2, participants decided whether two words were related or unrelated in word pairs with varying path lengths (e.g., ashtray-smoking, sea-survey). In Studies 3 and 4, participants made similar decisions for word pairs that were either closely associated ('to see' – 'colour') or distantly associated ('to see' – 'song') with different sensory modalities. In Studies 1 and 3, both prime and target words were presented without time limitations, and participants in the art condition evaluated distant word pairs as more strongly associated compared to those in the baseline condition. In Studies 2 and 4, participants performed similar tasks, but prime and target words appeared only briefly, reducing the influence of top-down deliberation processes and decreasing the observed effects. These findings suggest that meaning-making in an art context facilitates connecting distant concepts, offering insights into how art impacts cognition in everyday life.

what is important is not so much what people see in the gallery or the museum, but what people see after looking at these things, how they confront reality again. Really great *art* regenerates the perception of reality; the reality becomes richer, better or not, just different.

Gabriel Orozco (Fineman, 2004)

^{*} Corresponding author.

E-mail addresses: marina.iosifyan@gmail.com (M. Iosifyan), judith.wolfe@st-andrews.ac.uk (J. Wolfe), brendan.wolfe@st-andrews.ac.uk (B. Wolfe).

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1. Introduction

To the extent that perception of art differs from the perception of everyday life, we may speak of engaging with a work of art as activating the art schema. The art schema is a mental representation of what art can or should be. When people perceive something as a work of art (e.g., in a museum or concert hall), their art schema is activated. Researchers may attempt to understand and explain the mechanisms by which the art schema affects the way people cognitively process and emotionally react to art (Jacobsen, 2006). There are several characteristics of the art schema that might activate different mechanisms, accounting for some of art's effects on cognition.

First, art is not supposed to physically harm the viewers (Hanich, 2014; Rozin et al., 2013), and this characteristic of the art schema may allow art viewers to embrace the experience of negative emotions, creating a more intense, interesting, and pleasing experience (Menninghaus et al., 2017). Second, art schema may heighten the expectation of a pleasurable experience (Cupchik, 1995; Kirk et al., 2009; Leder et al., 2004; Russell, 2003; Silveira et al., 2015) and heighten positive emotional responses, even when images of repulsive objects are presented as artworks (Wagner et al., 2014). The third characteristic of the art schema is the focus of this paper: artistic objects usually do not serve immediate pragmatic goals. This approach to the art schema is rooted, among others, in Kant's idea of disinterested interest (Kant, 2008 [1790]). Kant suggests that the appreciation of art is 'disinterested' in the sense of being free from concern for the object's utility or pragmatic purpose, and attentive only to the pleasure given by its intrinsic quality (A3–6, 15–17). In this sense, encounters with works of art are not pragmatic: they are not directed towards immediate practical action in the world (though they may inspire such action). In line with this reasoning, we speculate as a direction for future research that the art context reduces the salience of an object's pragmatic qualities (e.g. a banana as food), making it easier for people to associate remote concepts afterwards, as the less salient attributes of these objects become more accessible.

To emphasize that interactive (everyday life) versus non-interactive (art) contexts have a crucial impact on cognition, the notion of 'aesthetic affordances' was introduced in philosophical research (Brincker, 2015). The concept of 'affordance' was first proposed by James Gibson in his ecological theory of perception (Gibson, 1977). It assumes that objects and situations can be related to or acted upon in specific ways (e.g. a banana lying on the table in my kitchen implies affordances of grasping and eating) and these affordances change our perception.

'Aesthetic' affordances are specific because they do not imply action: it is not possible to eat a painted banana. Moreover, even a real banana in a modern art gallery usually does not allow the affordances of grasping or eating.¹ This might suggest that the art schema changes the way people perceive objects' qualities, shifting their attention away from pragmatic, day-to-day affordances. Developing the idea of differences between aesthetic and pragmatic perception, Cupchik and colleagues suggested that the art schema makes people shift their attention away from recognizing and semantically categorizing objects towards focusing on the formal aspects of the work and the sensory experience elicited by it (Cupchik, 1992; Cupchik et al., 2009).

This redirection of focus brought about by the art schema, aligns closely with the principles of divergent thinking in creativity research. Shifting attention from the more salient characteristics of an object to alternative ones is at the heart of the divergent-thinking paradigm in the psychology of creativity (Gilhooly et al., 2007). The classic divergent-thinking task involves listing alternative uses for a common object, such as a brick, and this process is often disrupted because more salient uses come to mind first (e.g. a common use for a brick is building a house). By encouraging a shift in attention from the obvious to the less conventional, the art schema may foster the kind of flexible thinking necessary for generating novel ideas.

Some research findings support this idea. Studies have shown that the same images of remotely related objects, when presented in an art context (i.e., when observers believe they are artworks), are perceived as more closely associated than when viewed in an everyday context (e.g. a cup and a ball vs. a cup and a spoon; Iosifyan & Wolfe, 2024a). Furthermore, an art context increases the perceived meaningfulness of semantically non-congruent objects and words (Iosifyan & Wolfe, 2024b). Since these effects only occur for semantically non-congruent objects, they cannot be explained by the second mechanism of the art schema: the anticipation of a pleasurable and rewarding experience when engaging with art. It is thus possible that engaging with art facilitates remote associations. If the art schema affects the way people cognitively process art, can it also affect cognitive processing in everyday life, and facilitate the connection of weakly-related concepts?

Connecting weakly related concepts plays an important role in creativity. Research found that observing object-context inconsistencies (e.g., a book in a car workshop²) increases cognitive flexibility and the production of more original ideas (Hooijdonk et al., 2022). It is suggested that semantic inconsistencies violate a familiar set of associations, inhibit object-specific associations (Bar, 2004) and consequently facilitate a more original rather than conventional flow of ideas. Moreover, it was found that when people observe semantic inconsistencies in art (paintings), they elicit distinct brain activation patterns, different from those observed in everyday life scenes with similar inconsistencies (Markey et al., 2019).

¹ It should be noted that the concept of interactive art (Preston, 2014) might seem to challenge the idea of a lack of action and pragmatism in the art context. However, we argue that even such interactions in art context are distinct from everyday life interactions. Here, we draw on philosophers who explore the idea of the aesthetic stance, which involves approaching objects from an aesthetic perspective (Prinz, 2010). For example, when encountering an object in a supermarket, like a banana, we focus on its practical use—assessing it as food. However, when the same object is part of an art installation, our interaction may shift. We might view it through an aesthetic lens, considering its form, symbolism, and meaning, rather than its function.

² Semantic information plays an important role in how people categorize objects around us. When semantic inconsistencies in our surroundings occur (e.g., a ship on a highway) they elicit distinct brain activation and affect cognitive processing (Davenport & Potter, 2004; Ganis et al., 1996; Vö and Henderson, 2009).

One way to investigate how people connect concepts is by examining the concept of semantic distance (Beaty et al., 2014; Kenett, 2018; Mednick, 1962). Semantic distance assumes that the closer two concepts are in a semantic space, the more similar they are to each other (Collins & Loftus, 1975; Den-Heyer & Briand, 1986). It can also be defined as the number of steps that connect two concepts in semantic memory (Kenett, 2018). Semantic distance plays an important role in creativity, encompassing both classical and contemporary theories of creativity (McRae & Jones, 2013).

Mednick's classic associative theory of creativity posits that the novelty of created concepts is the expression of the prior remoteness of the concepts, now creatively connected (Mednick, 1962). According to this theory, some individuals are more creative than others because the structure of their memory facilitates the retrieval of remote concepts. However, more recent theories, such as the controlled-attention theory, suggest that high creativity is related to top-down cognitive processing (e.g. control of attention), which enables people to retrieve remote concepts from memory more easily (Beaty & Silvia, 2012; Benedek et al., 2014; Jauk et al., 2014).

2. Research purpose and questions

In the present set of studies, we are particularly interested in how the art schema affects the connection of remote concepts outside the art context. As associating remote concepts has significant implications for creativity, understanding how an art context influences this process holds both theoretical and practical importance, such as incorporating art-based contexts into learning environments to encourage connections between seemingly unrelated concepts, thereby enhancing creative thinking abilities.

There is evidence in previous research that engaging with art can later affect cognitive abilities. Research has shown that engaging with art fiction affects social cognition (theory of mind) in everyday life, enabling people to better understand others' emotions, beliefs, and intentions (Black & Barnes, 2015; Dodell-Feder & Tamir, 2018). In this paper, we investigate how meaning-making in an art context affects semantic distance. We hypothesize that, when people are in an art context, they will more easily associate remote concepts with each other. Thus, they are likely to perceive remote concepts as more closely associated.

We adopted two distinct approaches to semantic distance—the network-based approach (Studies 1–2) and the sensorimotor distance approach (Studies 3–4)—to enhance the validity of our results. Furthermore, we investigated the effects of art on semantic distance under conditions where top-down deliberation processes were either facilitated (Studies 1 and 3) or controlled (Studies 2 and 4). This methodology allowed for a detailed exploration of the role of top-down processes in the effects of the art schema on semantic distance.

2.1. Study 1

Study 1 investigated how meaning-making in art versus everyday life conditions affects semantic distance. Participants randomly assigned to the experimental group were told that they would evaluate a set of sentences extracted from poems, exploring how people perceive poetry. Participants randomly assigned to the baseline group were informed that they would evaluate a set of sentences, studying language processing. After this manipulation, all participants completed the Semantic Distance Task (Kenett et al., 2017) to measure semantic distance. We employed a network-based approach to measure semantic distance, which applies network science to investigate semantic relationships and quantifies semantic distance by path length: the number of steps required to connect one word within a semantic network to another (Kenett et al., 2017). The Semantic Distance Task used in our study was developed within this framework (Kenett et al., 2017).

2.2. Study 1: method

2.2.1. Sample

Power analysis conducted in G*Power (Faul et al., 2007) indicated that the minimal sample size to detect a difference between two independent groups with a medium effect size ($d = 0.5$), a power of 0.95, and an alpha level of 0.05, would be 88 participants in each. Two hundred and one participants from 19 to 82 years old ($M = 42$, $SD = 14$, 121 females, 79 males, 1 non-binary) were recruited on Prolific, a platform for online research. To ensure high-quality data, we only recruited participants with >80% success rate on Prolific platform (meaning these participants have high rates of successful experiment completion). As noted above, participants were randomly assigned to the experimental and baseline conditions.

2.2.2. Procedure

The study was developed using PsychoPy (Peirce et al., 2019) and administered on Pavlovia (<https://pavlovia.org/>), an online platform for conducting psychological experiments. The manipulation task was similar to one used in a previous study investigating meaning-making in art versus everyday life contexts (Iosifyan & Wolfe, 2024b). Participants randomly assigned to the 'art' condition were informed that the study investigated how people perceive poetry, and that the sentences were derived "from various poems written by professional poets, including free verse poetry, which is an open form of poetry that tends to follow the rhythm of natural speech." Participants in the baseline condition did not receive specific information about the nature of the sentences and were

informed that the study investigated language processing.

Participants evaluated 25 sentences with incongruous endings³ (e.g. “Most cats see well at court”), selected from a published stimulus set (Bloom & Fischler, 1980). We specifically chose sentences with incongruous endings because their meaning is not immediately apparent and their perceived meaningfulness increases in an art context compared to everyday life context (Iosifyan & Wolfe, 2024b). The sentences were presented in a randomized order, and participants were asked to rate the meaningfulness of each sentence (“How meaningful is this sentence?”) on a sliding scale ranging from 1 (“Not at all”) to 100 (“Very much”).

After the manipulation task, the main task followed, which was the semantic distance task where participants were asked to determine whether two words were related to each other or not. This task utilized a network analysis approach that calculates association correlations between each pair of words and generates a connectivity matrix (Kenett et al., 2017). From this matrix, a distance matrix is constructed, indicating the number of steps separating one word from another in the network. For example, if only one step separates one word from another (e.g. bus-car), it is considered a 1-step word pair; if there are four steps separating one word from another (e.g. storm – bay – sunset - pale blue - kite), it is a 4-step word pair, and so on (Kenett et al., 2017). As the path length increases, the semantic strength between two words decreases.

We selected 42 pairs of words from a study that replicated and extended Kenett et al. (2017) in the English language (Kumar et al., 2020). Each participant viewed seven pairs of word from path lengths 1, 2, 3, 4, 6, and 15 (Kumar et al., 2020). For the full list of word pairs, please refer to the Supplementary materials.

Each trial began with a fixation cross displayed in the centre of the screen for 1 second, followed by the target and prime words presented side by side on the screen. Participants were instructed to evaluate the strength of association between the two words using a slider scale ranging from 1 (unrelated) to 100 (strongly related). The words remained on the screen until the participant made their decision. After responding, the next trial began immediately.

2.3. Study 1: results

First, we compared manipulation task between groups (Art vs Baseline). As expected, participants in the Art condition perceived the sentences as more meaningful ($M = 31.18$, $SD=17.44$) compared to participants in the Baseline condition ($M = 19.10$, $SD=13.96$), $t(199)=5.40$, $p<.001$, $d = 0.76$.

Second, we compared the semantic distance task results between groups. A repeated measures Analysis of Variance (ANOVA) with Greenhouse-Geisser correction was conducted, with path length as within-participants factor (1, 2, 3, 4, 6, 15) and condition (Art vs Baseline) as between-participants factor on relatedness judgments. We observed a significant main effect of path length, $F(3.8, 763.6)=1248.10$, $p<.001$, $\eta_p^2 = 0.862$. The main effect of condition (Art vs Baseline) was not significant, $F(1, 199)=2.26$, $p=.134$, $\eta_p^2 = 0.011$. Interaction between the path length and condition was significant, $F(3.8, 763.6)=2.93$, $p=.022$, $\eta_p^2 = 0.015$. Post-hoc analysis revealed that the difference between conditions (Art vs Baseline) increased with path length (see Table 1). With greater distance between words (4–15 steps), relatedness judgments were greater in the Art group compared to the Baseline group (see Fig. 1).

2.4. Study 1: discussion

Study 1 investigated how meaning-making in art versus everyday life conditions affects semantic distance. We hypothesized that the semantic distance between words would be shorter in the art condition compared to the everyday condition. Interestingly, this was only true for mostly unrelated pairs of words with longer path lengths between them. This suggests that the art condition enables people to perceive connections between remote words (e.g. storm-kite) but does not significantly affect words that are closely related to each other (e.g. bus-car).

In Study 1, we did not impose a time limit for participants when performing the semantic distance task, which might have facilitated top-down deliberation processes (Rossell et al., 2001). To investigate whether the observed art schema effects are related to top-down processes rather than automatic ones, and to determine if the art schema effects diminish or become non-significant under time-limited conditions, we conducted Study 2.

2.5. Study 2

Study 2 investigated how meaning-making in art versus everyday life conditions affects semantic distance when top-down deliberation processes are controlled. Participants randomly assigned to the experimental group were informed that they would evaluate a set of sentences extracted from poems, exploring how people perceive poetry. Participants randomly assigned to the baseline group were informed that they would evaluate a set of sentences studying language processing. After this manipulation, all participants completed the Semantic Distance Task (Kenett et al., 2017) to measure semantic distance. Unlike in Study 1, both the prime and target words appeared only for a short period of time.

³ For the full list of sentences, as well as their perceived meaningfulness ratings, see Supplementary Materials, Table S3.

Table 1
Relatedness judgments between conditions (Art vs Baseline) in Study 1.

Condition		Path length					
		1-step	2-step	3-step	4-step	6-step	15-step
Art (N = 104)	M	83.06	51.01 (15.72)	47.64	40.76 (14.75)	33.30 (14.13)	17.01
	(SD)	(9.13)		(9.97)			(11.12)
Baseline (N = 97)	M	84.74	50.33	45.31 (10.99)	36.59 (13.50)	29.66 (14.91)	13.53 (11.70)
	(SD)	(11.19)	(16.58)				
Post hoc analysis	P	.244	.765	.118	.038	.077	.032
	D	0.16	0.04	0.22	0.29	0.25	0.30

Note. d=Cohen's d.

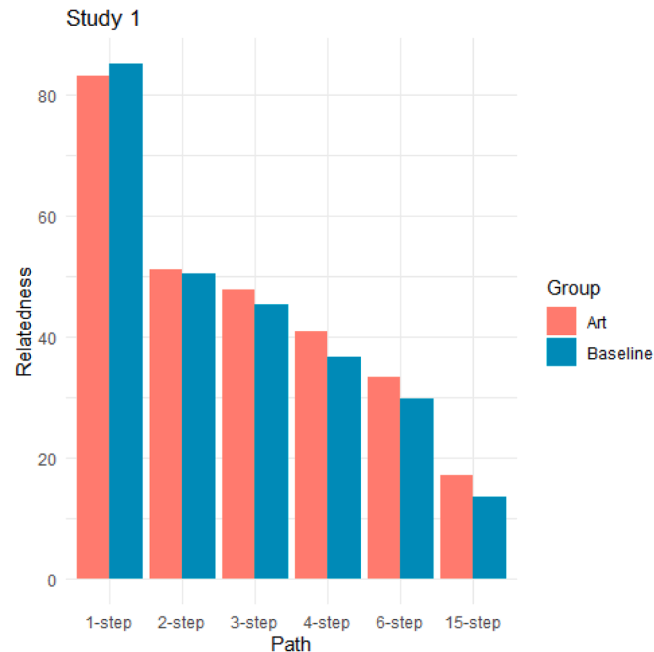


Fig. 1. Relatedness judgments at different path lengths between conditions (Art vs Baseline) in Study 1.

2.6. Study 2: method

2.6.1. Sample

Power analysis was similar to Study 1 (see above). Two hundred and one participants from 18 to 74 years old ($M = 42$, $SD=14$, 122 females, 77 males, 1 non-binary, 1 did not report their gender) were recruited on Prolific, a platform for online research.⁴ To ensure high-quality data, we only recruited participants with $>80\%$ success rate on Prolific platform (meaning these participants have high rates of successful experiment completion). Participants were randomly assigned to the experimental ($N = 99$) and baseline ($N = 102$) conditions.

2.6.2. Procedure

The study was developed using PsychoPy (Peirce et al., 2019) and administered on Pavlovia (<https://pavlovia.org/>), an online platform for conducting psychological experiments. The manipulation task in both the experimental and baseline conditions was similar to Study 1 (see above). After completing the manipulation task, participants in both conditions performed the semantic distance task. Following the procedure described by Kenett et al. (2017), each trial began with a fixation cross (presented for 80 ms), followed by the prime word (presented for 120 ms), a second fixation cross (presented for 80 ms), and then the target word (presented for 120 ms). Immediately after the appearance of the target word, a slider appeared on the screen, and participants were asked to indicate whether the pair of words were related to each other on a scale from 1 (unrelated) to 100 (strongly related). Once the participant responded, the next trial began immediately. As in Study 1, we used 42 pairs of words validated in Kumar et al. (2020); for the full list,

⁴ Different participants were recruited for each of the four studies reported in this manuscript. This approach was employed to ensure independence of observations and to minimize potential biases arising from repeated exposure to the experimental materials.

Table 2
Relatedness judgments and RT between conditions (Art vs Baseline) in Study 2.

Condition		Path length					
		1-step	2-step	3-step	4-step	6-step	15-step
Relatedness judgments							
Art (N = 99)	M	83.63	47.99	42.99	36.62 (14.11)	30.15 (15.37)	14.70
	(SD)	(10.36)	(17.86)	(11.29)			(12.67)
Baseline (N = 102)	M	84.60	52.60	45.11	37.10 (12.66)	29.30 (14.71)	14.39 (11.17)
	(SD)	(11.43)	(15.11)	(10.38)			
Post hoc analysis	P	.529	.049	.169	.803	.690	.853
	D	0.09	0.28	0.19	0.03	0.06	0.02
Reaction Times							
Art (N = 99)	M	1.43	1.58	1.40	1.53	1.53	1.49
	(SD)	(0.54)	(0.73)	(0.53)	(0.69)	(0.74)	(0.62)
Baseline (N = 102)	M	1.41	1.74	1.48	1.62	1.65	1.53
	(SD)	(0.50)	(0.73)	(0.56)	(0.69)	(0.68)	(0.61)
Post hoc analysis	P	.719	.122	.308	.356	.234	.591
	D	0.04	0.22	0.15	0.13	0.17	0.06

Note. d=Cohen's d.

see Supplementary materials.

2.7. Study 2: results

First, we compared manipulation task between groups (Art vs Baseline). As expected, participants in the Art condition perceived the sentences as more meaningful ($M = 29.41$, $SD=18.94$) compared to participants in the Baseline condition ($M = 22.05$, $SD=15.53$), $t(199)=3.10$, $p=.002$, $d = 0.44$.

Second, we compared the semantic distance task results between groups. A repeated measures Analysis of Variance (ANOVA) with Greenhouse-Geisser correction was conducted with path length as within-participants factor (1, 2, 3, 4, 6, 15) and condition (Art vs Baseline) as between-participants factor on relatedness judgments. We observed a significant main effect of path length, $F(3.61, 719.46)=1357.15$, $p<.001$, $\eta_p^2 = 0.872$. The main effect of condition (art vs baseline) was not significant, $F(1, 199)=0.63$, $p=.427$, $\eta_p^2 = 0.003$. Interaction between the path length and condition was marginally significant, $F(3.61, 719.46)=2.39$, $p=.056$, $\eta_p^2 = 0.012$. Post hoc analysis revealed that the difference between conditions (Art vs Baseline) was not significant (see Table 2, see Fig. 2).

A repeated measures Analysis of Variance (ANOVA) with Greenhouse-Geisser correction was conducted, with path length as within-participants factor (1, 2, 3, 4, 6, 15) and condition (Art vs Baseline) as between-participants factor on reaction times.⁵ We observed a significant main effect of path length, $F(4.39, 874.96)=16.78$, $p<.001$, $\eta_p^2 = 0.078$. The main effect of condition (Art vs Baseline) was not significant, $F(1, 199)=0.94$, $p=.333$, $\eta_p^2 = 0.005$. Interaction between the path length and condition was marginally significant, $F(4.39, 874.96)=2.01$, $p=.084$, $\eta_p^2 = 0.010$. Post hoc analysis revealed that the difference between conditions (art vs baseline) was not significant (see Table 2, see Fig. 2).

2.8. Study 2: discussion

Study 2 investigated how meaning-making in art versus everyday life conditions affects semantic distance when top-down deliberation processes are controlled. Unlike in Study 1, we did not find any effect of condition on semantic distance. This was true even for mostly unrelated pairs of words with longer path lengths between them, which showed a significant effect in Study 1. The findings of Study 2 suggest that the effect of the art schema on semantic distance may be rooted in top-down deliberation processes, and this effect is no longer significant when these processes are controlled.

While Studies 1 and 2 used a network-based approach to measure semantic distance, it is important to replicate our findings using a different approach to semantic distance. Therefore, we conducted Study 3 and employed a sensorimotor distance-based approach to measure semantic distance.

2.9. Study 3

Study 3 investigated how meaning-making in an art versus an everyday life context affects sensorimotor distance, a novel measure of semantic distance. This measure is based on the idea that the similarity between concepts is determined by the similarity of their sensorimotor experiences, as outlined in the Lancaster Sensorimotor Norms (Lynott et al., 2020; Wingfield & Connell, 2023). Sensorimotor distance measures how much a concept can be perceived through various sensory modalities, such as visual, auditory, gustatory, haptic, interoceptive, and olfactory. For instance, the concepts of *symmetry* and *brightness* are relatively close in sensorimotor terms because both are primarily experienced through sight. In contrast, *brightness* and *softness* are more distant, as they involve

⁵ RTs faster than 200ms and slower than 5900ms (a mean and 2 standard deviations) were omitted from this analysis (1.67% of all trials).

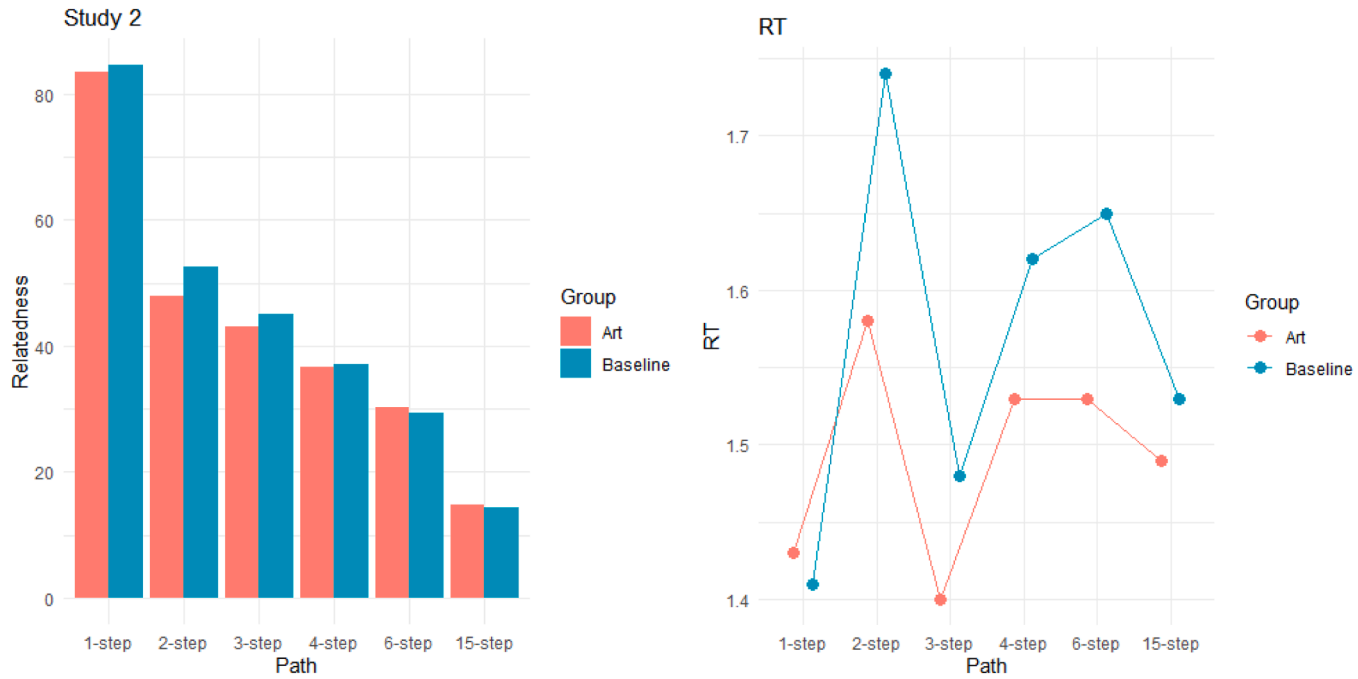


Fig. 2. On the left: Relatedness judgments at different path lengths between conditions (Art vs Baseline) in Study 2. On the right: Reaction times at different path lengths between conditions (Art vs Baseline) in Study 2.

minimal shared sensorimotor experiences.

Participants in both the art and baseline conditions evaluated the strength of associations between reference concepts related to auditory, gustatory, haptic, olfactory, and visual modalities and words closely (e.g. ‘to see’ – ‘colour’) and distantly (e.g. ‘to see’ – ‘song’) related to these reference concepts. We expected that participants in the art condition would evaluate distantly-related concepts as being more closely related, compared to participants in the baseline condition.

Moreover, this approach to semantic distance allows us to compare the observed effects on both concrete and abstract concepts. This is particularly important since the abstract concepts are less presented in semantic distance measures (Wingfield & Connell, 2023). We expected that the effect of meaning-making in an art context will affect the semantic distance of both concrete and abstract concepts.

2.10. Study 3: method

2.10.1. Sample

Power analysis was similar to Studies 1–2. Two hundred participants from 18 to 72 years old ($M = 36$, $SD=13$, 107 females, 89 males, 4 non-binary) were recruited on Prolific. Similar to previous studies, to ensure high quality data we only recruited participants with >80 % success rate on Prolific. Participants were randomly assigned to the experimental ($N = 99$) and baseline ($N = 101$) conditions.

2.10.2. Procedure

The study was developed and administered on the Qualtrics platform, an online software for conducting psychological studies (qualtrics.com). The manipulation task was similar to that used in Studies 1 and 2. Participants were randomly assigned to the art and baseline conditions with the same instructions as in previous studies (see above).

After the manipulation task, the main task followed, which was the semantic distance task where participants were asked to determine whether two words were related to each other or not. This task utilized a novel measure of semantic distance: sensorimotor distance, a grounded measure of semantic similarity (Wingfield & Connell, 2023). This measure determines the distance between concepts, based on sensorimotor strength ratings between a certain reference concept and whether it can be perceived through different modalities (e.g. olfactory modality). Sensorimotor experience is presented as an 11-dimensional space, and each concept (e.g. song) can be represented as a point in that space. The distance between two concepts can be thus calculated as the distance between points.

We selected 40 pairs of words from the Lancaster Sensorimotor Norms (Lynott et al., 2020). First, we selected five reference concepts related to five modalities: to see, to hear, to touch, to taste, to smell. Next, we selected words which are closely and remotely related to each of these reference concepts. We selected two which are closely related to the reference concept concrete words (hear: bark, touch: drums) and two which are closely related to the reference concept abstract words (hear: loudness, hear: tales). We also selected two which are remotely related to the reference concept concrete words (hear: wall, hear: mirror) and two which are remotely related to the reference concept abstract words (hear: decomposition, hear: warmth). Concreteness ratings were derived from the database of concreteness ratings for 40,000 generally-known English word lemmas (Brysbaert et al., 2014). Word frequency ratings were derived from Subtlex-UK database, a Word Frequency Database for British English (van Heuven et al., 2014). The abstract ($M = 2.64$, $SD=0.58$) and concrete words ($M = 4.69$, $SD=0.28$) we selected differed significantly on concreteness ratings, $t(38)=-14.28$, $p<.001$. At the same time, abstract and concrete words did not differ in frequency ratings, $p=.289$. Closely-related words did not differ in concreteness from remotely related words, $p=.592$, nor did they differ in frequency, $p=.184$.

Each participant observed 40 pairs of words, presented side by side on the screen. Participants were instructed to evaluate the strength of association between the two words using a sliding scale ranging from 1 (unrelated) to 100 (strongly related). The words remained on the screen until the participant made their decision. After responding, the next trial began immediately. Word pairs were presented in randomized order. For the full list of word pairs, please refer to the Supplementary materials.

2.11. Study 3: results

First, we compared manipulation tasks between groups (Art vs Baseline). As expected, participants in the Art condition perceived

Table 3
Relatedness judgments between conditions (Art vs Baseline) in Study 4.

Condition		Abstract		Concrete	
		Closely related	Remotely related	Closely related	Remotely related
Art (N = 99)	M	86.41	20.72	90.55	15.11
	(SD)	(13.69)	(14.96)	(10.94)	(12.89)
Baseline (N = 101)	M	86.92	16.38	90.12	10.48
	(SD)	(13.31)	(10.91)	(11.86)	(9.72)
Post hoc analysis	<i>p</i>	.828	.020	.791	.004
	<i>d</i>	0.04	0.33	0.04	0.41

Note. *d*=Cohen’s *d*.

the sentences as more meaningful ($M = 32.93, SD=17.64$) compared to participants in the Baseline condition ($M = 21.86, SD=14.92$), $t(198)=4.79, p<.001, d = 0.68$.

Second, we compared the semantic distance task results between groups. A repeated measures Analysis of Variance (ANOVA) was conducted with word concreteness (abstract vs concrete) and word relatedness (closely vs remotely related) as within-participants factors and condition (Art vs Baseline) as between-participants factor on relatedness judgments. We observed a significant main effect of word relatedness, $F(1, 198)=4550.28, p<.001, \eta_p^2 = 0.958$. We observed a significant main effect of word concreteness, $F(1, 198)=5.84, p=.017, \eta_p^2 = 0.029$, with abstract words judged as more closely related compared to the concrete words. The main effect of condition (Art vs Baseline) was not significant, $F(1, 198)=3.26, p=.072, \eta_p^2 = 0.016$.

Interaction between word abstractness and condition was not significant, $F(1198)=0.45, p=.502, \eta_p^2 = 0.002$. Interaction between word relatedness and condition was significant, $F(1198)=4.31, p=.039, \eta_p^2 = 0.021$. Post-hoc analysis revealed that the difference between conditions (Art vs Baseline) was only significant when pairs of words were remotely related but not closely related (see Table 3).

2.12. Study 3: discussion

Study 3 investigated how meaning-making in art versus everyday life conditions affects semantic distance, measured using a sensorimotor distance-based approach. We hypothesized that the semantic distance between words would be shorter in the art condition compared to the everyday condition. Consistent with the findings from Study 1, this effect was observed only for remotely-related pairs of words. This suggests that the art condition enables people to perceive connections between distant words (e.g. 'hear-wall') but does not significantly affect the perception of words that are closely related to each other (e.g. 'hear-sound'). Moreover, as expected, the observed effects applied to both concrete and abstract concepts.

In Study 3, as in Study 1, we did not impose a time limit on participants during the semantic distance task, which may have facilitated top-down deliberation processes (Rossell et al., 2001). Therefore, we conducted Study 4 to investigate whether the observed art schema effects are driven by top-down processes rather than automatic ones, and to determine if these effects diminish or become non-significant under time-limited conditions.

2.13. Study 4

Study 4 investigated how meaning-making in an art versus an everyday life context affects sensorimotor distance when top-down deliberation processes are controlled. Participants randomly assigned to the experimental group were informed that they would evaluate a set of sentences extracted from poems, exploring how people perceive poetry. Participants randomly assigned to the baseline group were informed that they would evaluate a set of sentences studying language processing. After this manipulation, all participants evaluated the strength of associations between reference concepts related to auditory, gustatory, haptic, olfactory, and visual modalities, and words closely and remotely related to these reference concepts. Unlike in Study 3, both the prime and target words appeared only for a short period of time.

2.14. Study 4: method

2.14.1. Sample

Power analysis was similar to Studies 1–2. Two hundred and one participants from 18 to 84 years old ($M = 38, SD=13$, 113 females,

Table 4
Relatedness judgments and RT between conditions (Art vs Baseline) in Study 4.

Relatedness judgments		Abstract		Concrete	
Condition		Closely related	Remotely related	Closely related	Remotely related
Art (N = 98)	M	81.83	22.83	84.56	17.80
	(SD)	(12.36)	(13.10)	(12.58)	(10.69)
Baseline (N = 103)	M	82.15	18.95	84.30	15.13
	(SD)	(11.29)	(16.52)	(14.56)	(13.62)
Post hoc analysis	p	.850	.068	.893	.126
	d	0.03	0.26	0.02	0.22
RT		Abstract		Concrete	
Condition		Closely related	Remotely related	Closely related	Remotely related
Art (N = 98)	M	1.92	1.73	1.35	1.63
	(SD)	(3.38)	(1.06)	(0.78)	(1.47)
Baseline (N = 103)	M	1.47	1.60	1.30	1.46
	(SD)	(0.72)	(0.76)	(0.55)	(0.74)
Post hoc analysis	p	.212	.708	.953	.723
	d	0.18	0.14	0.07	0.15

Note. d=Cohen's d.

77 males, 2 non-binary, 9 did not report their gender) were recruited on Prolific. Similar to previous studies, to ensure high quality data we only recruited participants with >80 % success rate on Prolific. Participants were randomly assigned to the experimental (N = 98) and baseline (N = 103) conditions.

2.14.2. Procedure

The study was developed using PsychoPy (Peirce et al., 2019) and administered on Pavlovia (<https://pavlovia.org/>), an online platform for conducting psychological experiments. The manipulation task in both the experimental and baseline conditions was similar to previous studies (see above). After completing the manipulation task, participants in both conditions performed the semantic distance task. The procedure was similar to Study 2, with one exception: we used 40 pairs of words selected in Study 3 (see above). For a full list, see Supplementary materials.

2.15. Study 4: results

First, we compared manipulation tasks between groups (Art vs Baseline). As expected, participants in the Art condition perceived the sentences as more meaningful ($M = 36.60, SD=17.86$) compared to participants in the Baseline condition ($M = 23.10, SD=17.18$), $t(199)=5.06, p<.001, d = 0.71$.

Second, we compared the semantic distance task results between groups. A repeated measures Analysis of Variance (ANOVA) was conducted with word concreteness (abstract vs concrete) and word relatedness (closely vs remotely related) as within-participants factors, and condition (Art vs Baseline) as between-participants factor on relatedness judgments. We observed a significant main effect of word relatedness, $F(1, 199)=2812.26, p<.001, \eta_p^2 = 0.934$. The main effect of word concreteness was not significant, $F(1, 199)=2.05, p=.154, \eta_p^2 = 0.010$. The main effect of condition (Art vs Baseline) was not significant, $F(1, 199)=1.97, p=.162, \eta_p^2 = 0.010$.

Interaction between word abstractness and condition was not significant, $F(1, 199)=0.05, p=.819, \eta_p^2 < 0.001$. Interaction between word relatedness and condition was not significant, $F(1, 199)=1.84, p=.177, \eta_p^2 = 0.009$. Post-hoc analysis revealed that the difference between conditions (Art vs Baseline) was only significant when pairs of words were remotely related but not closely related (see Table 4).

Finally, we compared the reaction time (RT) in the semantic distance task between groups. A repeated measures Analysis of Variance (ANOVA) was conducted, with words concreteness (abstract vs concrete) and word relatedness (closely vs remotely related) as within-participants factors and condition (Art vs Baseline) as between-participants factor on RT in relatedness judgments. We observed a significant main effect of word concreteness, $F(1, 199)=5.39, p=.021, \eta_p^2 = 0.026$, with abstract words having longer RT compared to the concrete ones. The main effect of word relatedness was not significant, $F(1, 199)=1.38, p=.242, \eta_p^2 = 0.007$. The main effect of condition (Art vs Baseline) was not significant, $F(1, 199)=0.95, p=.330, \eta_p^2 = 0.005$.

Interaction between word abstractness and condition was not significant, $F(1, 199)=1.03, p=.311, \eta_p^2 = 0.005$. Interaction between word relatedness and condition was not significant, $F(1, 199)=0.939, p=.334, \eta_p^2 = 0.005$.

2.16. Study 4: discussion

Study 4 investigated how meaning-making in art versus everyday life conditions affects sensorimotor semantic distance when top-down deliberation processes are controlled. Unlike in Study 3, we did not find a significant effect of conditions on semantic distance. However, there was a non-significant tendency for participants in the art condition to evaluate remotely-associated word pairs as more strongly related.

These findings suggest that the effect of the art schema on semantic distance, as observed in Study 3, may be driven by top-down deliberation processes. When these processes are controlled, the effect appears weaker and no longer significant.

3. General discussion

This paper investigated how meaning-making in an art context affects semantic distance across four experimental studies. Across all studies, individuals in the art context perceived semantically non-congruent sentences as more meaningful. This manipulation enabled them to connect remote concepts more easily in Studies 1 and 3. Associating remote concepts is considered one of the key cognitive mechanisms of creative thinking. Thus, our findings suggest that creativity is related not only to art creation but also to art reception.

This reasoning is in line with theories which suggest that art creation and art perception are intertwined. One such theory, the mirror model of art creation and art perception, was developed for visual arts, and proposes that the processes of creating and perceiving art mirror each other (Tinio, 2013). Specifically, both the viewer and the artist undergo similar stages in art perception/creation, from low-level characteristics of an artwork (e.g. colour perception) to high-level characteristics (meaning-making).

In the domain of music, Hargreaves and colleagues' theory of music processing suggests that music perception (listening) and music production (both composition and performance) hold equal importance (Hargreaves, 2012). Imagination, which is at the heart of creativity, serves as the cognitive foundation for both the perception and production of music (Hargreaves, 2012).

It is particularly important for empirical and theoretical research to describe the detailed mechanisms that explain how art creation and art perception are related to each other. Our study explored one of these mechanisms. Creativity lies at the heart of art production, involving the ability to move beyond obvious connections between concepts and to link seemingly-unrelated concepts to create something new (novel, original) as well as valuable (useful, meaningful), Runco & Jaeger, 2012. Meaning-making in an art context enables individuals to associate remote concepts more easily. Interestingly, we found that the effect of the art schema on associating

remote concepts is not automatic but rather controlled or deliberate, as evidenced by its lack of significance in Study 2 and Study 4 where we used short stimulus delays to control for deliberate top-down processes. Our findings suggest that the art schema may facilitate the retrieval of remote concepts through top-down processes. The non-significant result in Study 2 and Study 4 implies that this effect arises from deliberate top-down cognitive processing.

At the same time, all studies demonstrated that the art schema—believing that a sentence is a piece of poetry—significantly influenced how people evaluated the perceived meaningfulness of the sentence. It is important to understand why this manipulation only affected semantic distance in tasks without time restrictions. Previous research has shown that art schema influences the perception of semantic inconsistencies in images, as evidenced by both behavioural and EEG data (Markey et al., 2019). While the differences observed in EEG data aligned with the behavioural data, they were not entirely consistent: certain effects found in the behavioural data did not appear in the EEG recordings. This suggests that the two measures may partly reflect different processes. Taken together, these findings point to the possibility that art schema effects differ in their impact on immediate versus delayed processing (Markey et al., 2019).

Since we have shown that meaning-making in an art context allows people to connect remote concepts more easily, this suggests that the art schema affects cognition in everyday life. It is possible that, when individuals are in the context of art perception (e.g. reading poetry, being in a gallery), they are more inclined to perceive less-salient characteristics of words and objects and anticipate them. For instance, when observing a banana in an art gallery, we may not focus on its affordance of being grasped and eaten. Instead, we might perceive other affordances that are not apparent when we view the same object in real life. This idea aligns closely with contemporary understandings of art, as expressed by artists like Marcel Duchamp: “*An ordinary object [could be] elevated to the dignity of a work of art by the mere choice of an artist*” (Bréton & Duchamp, 1947).

Understanding how art creation and art reception are related is crucial, not only for comprehending how people engage with art, but also for understanding cognition from an evolutionary perspective. Art evolved alongside human cognition and language and emerged as a product of this development. Importantly, evolutionary psychologists posit a reciprocal relationship: “*Human consciousness was necessary for art, yet the two coevolved, each influencing the development of the other to some extent*” (Solso, 2003, p. 42). Understanding how art affects cognition in everyday life can shed light on this dynamic and underscore why engaging with art is important.

Artists like Gabriel Orozco argue that art alters how people approach everyday reality. Empirical research has demonstrated that engaging with art influences cognition in daily life. For example, art engagement enhances social cognition by improving theory of mind—understanding others’ emotions, intentions, and beliefs (Barnes, 2018; Black & Barnes, 2015; Dodell-Feder & Tamir, 2018; Oatley, 2012). Our findings illustrate how the ability to associate remote concepts—a cornerstone of creativity—can be bolstered within an art context.

4. Limitations and conclusion

This study has several important limitations that should be considered. First, participants in the four studies were recruited through online platforms, which may introduce bias by favouring individuals who have access to the internet and are specifically motivated to complete online surveys. Second, the sentences containing semantic inconsistencies, used across all four studies, were not taken from actual poems. Since contemporary poetry often incorporates such inconsistencies, future studies could use sentences from poems to determine whether the findings remain consistent. It is possible that actual poetry might increase the observed effects of the art schema on semantic distance. Third, this study focused on written language and did not explore other forms of art that may also feature semantic inconsistencies, such as visual arts. For example, previous research has shown that art schemas can influence how people interpret semantic inconsistencies in the visual domain (Markey et al., 2019). Future research could examine whether semantic inconsistencies across different art forms produce similar effects on semantic distance. Finally, it should be mentioned that all texts were presented in digital form due to the online nature of the research. While this format aligns with contemporary reading habits, research has shown that digital and print texts may elicit different responses (Pikhart et al., 2024). As such, the findings should be interpreted with an understanding that they pertain primarily to digital text interpretation.

Nevertheless, it was established that meaning-making in an art context facilitates connecting distant concepts. These findings have practical applications in educational programs that incorporate art to enhance cognitive functioning in everyday life. For instance, the discovery that reading fiction improves social cognition can inform strategies encouraging individuals to read novels, thereby enhancing their theory of mind abilities. Similarly, our findings can be applied in programs designed to foster specific aspects of creative thinking, such as remote associations, bisociation, and divergent thinking. These creativity components are essential in a wide range of domains, from mathematics to visual arts education (Stoppel & Czarnocha, 2021; van de Kamp et al., 2015). More specifically, our research identifies that engagement with certain types of art—especially those involving semantic inconsistencies—may be particularly beneficial for boosting creative thinking. Contemporary poetry, for example, often features semantic non-congruence and other deviations from standard language use (Menninghaus et al., 2024), and engaging with such works could further stimulate creativity.

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CRedit authorship contribution statement

Marina Iosifyan: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Judith Wolfe:** Writing – review & editing, Validation, Project administration, Funding acquisition, Conceptualization. **Brendan Wolfe:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

None.

Data accessibility statement

The data that support the findings of this study are openly available at <https://osf.io/h69n8/>, DOI 10.17605/OSF.IO/H69N8

Ethics statement

All studies described in this paper were approved by the University of St Andrews School of Psychology & Neuroscience Ethics Committee, approval code PS16745.

Supplementary materials

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Data availability

Data will be made available on request.

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