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Texture and visual memory span capacities are dissociable

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ABSTRACT

Experiencing and remembering objects using the sense of touch is an important aspect of our interactions with our environment, but the cognitive processes of long-term tactile memory for surface textures have not previously been studied. We administered a novel tactile texture memory span task, which required participants to identify new textures among a constantly increasing set of previously experienced stimuli. Performance on that task was compared to a span task employing novel visual objects. We found no correlation between participants' tactile texture span and visual span performance. Additionally, there was no correlation between participants' ability to name textures and their tactile texture span performance. These findings provide some initial evidence for a possible dissociation between long-term memory capacity for stimuli of different sensory modality, and for the mnemonic representation of texture information independent of verbal descriptors.

1. Introduction

Processing and retaining information about objects comprising our environment are vital adaptive abilities. Object information that assists us in recognition, aesthetic judgments, and action can be based on both geometric properties (e.g., size, shape, orientation) and surface properties (e.g., texture, compliance, temperature). Visual, auditory, and tactile modalities contribute to the representation of objects based on these characteristics (Lederman & Klatzky, 2004). Object texture is a key component of object identity, and in some circumstances can be its only available aspect. Importantly, using texture information to interact effectively with objects in our environment requires not only initial perception, but also memory for such tactile representations.

Tactile consciousness has been defined as the “neural activity elicited by the presentation of tactile stimuli that is available for explicit report” (Smith & Scott, 1996, p. 371). Physiological evidence has suggested that the neural network for tactile awareness involves the same structures that initially process the stimulus, the primary somatosensory cortex (S1). However, subsequent evidence, suggested that information processed by the S1 does not directly enter awareness (Crick & Koch, 1995). Instead, higher-order areas (e.g., S2, temporo-parietal junction; posterior parietal cortex; and the premotor cortex) commonly implicated in the execution and planning of movements are presumed to be involved. It is thought that the synchronous firing of neurons in this circuit activates a form of short-term memory (possibly involving the perirhinal cortex and the posteroventral insula; Bonda et al., 1996) to maintain this stimulus within the “window of the tactile present” and to integrate it with incoming information from additional sensory modalities. Tactile perception of objects or surfaces has been conceptualized as reflecting multiple psychophysical dimensions that characterize perception. These include: roughness/smoothness, hardness/softness, coldness/warmness; degree of friction; moistness/dryness; and stickiness/slipperiness (Okamoto et al., 2012). Most previous studies assessing tactile texture perception have been conducted using artificial stimuli such as grating patterns, dot surfaces, and abrasive papers (Yoshioka et al., 2001).

Although a great amount of research has considered tactile texture perception (e.g., Hollins & Bensmaïa, 2007) as well as visual texture perception (e.g. Landy & Bergen, 1991) relatively few studies have explored tactile memory (Gallace & Spence, 2009), and those have focused on tactile location (e.g., sequence of fingers touched; Heled et al., 2021; Sugiyama et al., 2020), frequency of vibrotactile stimulation (in short-term memory; Bancroft et al., 2012), object shape (Lawson et al., 2015) or 3D objects (Kappers & Schakel, 2011; Reales & Ballesteros, 1999). For example, Mahrer and Miles (2002) investigated recognition memory for vibrotactile sequences of contact to participants' fingers. Participants were tested using a discrimination task whereby

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they had to articulate the sequence of stylus touches presented to their fingers. Findings indicated the involvement of verbal repetition and visuospatial encoding strategies in memory for tactile sequences. The results also suggested limitations in the capacity and duration of tactile sensory memory and the integration of visual and tactile information in memory processes. Other types of mnemonic assessment have been used to investigate immediate/short-term tactile working memory. These have included the “match to sample” procedure, in which participants are presented with a target fingertip vibration and must then decide if an immediately subsequent vibration is the same as the target (Bancroft et al., 2012; Spitzer & Blankenburg, 2011); a haptic-perception version of the Corsi Block-Tapping task (Ruggiero & Iachini, 2010), and the tactile n-back task (Bliss & Hämäläinen, 2005). However, none of these tests have specifically explored long-term memory for texture identity within the tactile domain.

The current study follows the distinction offered by Gallace and Spence (2009) between microgeometric, macrogeometric, and spatial qualities of haptic perception and focuses on the microgeometric properties (e.g. texture, roughness, and spatial density of surfaces concerning objects that can fall within a single region of the skin). This addresses a significant gap in knowledge about ecologically relevant memory abilities, as remembering the identities of surface textures that we have recently encountered can be effective in guiding behavior when visual cues are unavailable.

Examining long-term tactile recognition memory for textures under controlled conditions presents a set of challenges not generally faced by research into long-term memory for visual object, location, auditory, or verbal stimuli. One such challenge is the relative difficulty in assembling appropriate collections of perceptually discriminable tactile texture stimuli, which constrains the numbers of trials that can be conducted using yes/no or multiple-choice recognition memory tests. One type of memory assessment providing a solution for that challenge, and which has been found appropriate for other aspects of tactile memory, is the span task (Heled et al., 2021), including the Braille tactile span task (Cohen et al., 2010). Span memory tasks are a type of continuous recognition test, in which participants are generally asked to identify novel items among a constantly increasing set of previously experienced items. Typically, participants are presented with multiple stimuli in constantly growing sequential sets, with one new stimulus added in each successive trial. Participants try to identify the newly added stimulus, and the number of consecutive correct identification trials is the participant's span score. Numerous studies have found span scores to be predictive of performance on other cognitive tasks. For instance, younger adults with a high memory span are better able to comprehend text (Masson & Miller, 1983), learn vocabulary (Daneman & Green, 1986), and follow directions (Engle et al., 1991). According to Conway et al. (2005), span performance also depends on domain-specific factors that are associated with the storage component of working memory. However, once span sets surpass working memory capacity, especially given the long delay times between trials, working memory is unlikely to be sufficient to support effective performance, such that span tasks can be an efficient method of assessing long-term memory. Span tasks seem to be an especially appropriate instrument when stimulus set size is limited; in contrast to thousands of potential stimuli that can be utilized in verbal or visual object recognition tests, our pilot studies indicated that there are many fewer discretely dissociable textures. Accordingly, a paradigm such as the span task which can assess long-term memory capacity using a relatively small stimulus set can be valuable for exploring parameters of texture memory and potentially characterizing its neural substrates. Indeed, Heled et al. (2021) have recently used a span format to assess memory for location of tactile stimulation.

Span tasks have been used for assessing memory in other modalities. For example, in a study by Levy et al. (2003) amnesic patients with bilateral hippocampal damage were given three visual or olfactory recognition memory span tasks (involving line drawings of objects, kaleidoscope designs, and odors, respectively). Participants were presented with a stimulus display and asked to identify the novel item at each stage, that is, the one that had just been incorporated into the array. Amnesic participants displayed a significantly lower performance than the control group in all three tasks. Levy et al. (2003) concluded that the hippocampus was equally implicated in long-term declarative memory in the visual and odor domains, particularly in span tasks. As other studies (e.g., Shrager et al., 2008) have found such patients to have intact working memory performance, this finding reinforces the contention that span memory tasks tap into long-term memory.

Accordingly, the current study was designed to explore performance characteristics of a texture memory span task. The span task employed required participants (who wore blindfolds and listened to white noise during the task to prevent use of visual or auditory information) to serially palpate sets of ecological textured surfaces, in which each set contained one novel texture. They were asked to identify the novel texture at each stage. Accordingly, this task (a modified version of Levy et al.'s (2003) paradigm) may be considered a type of continuous recognition test with frequent repetition of part of the stimulus set and varying levels of stimulus familiarity depending on the history of each stimulus – arguably a challenging assessment of long-term episodic recognition memory.

Previous tactile studies have used familiar everyday objects as stimuli (Hutmacher & Kuhbandner, 2018), which could arguably be visually or verbally encoded, and so not provide a measure of pure tactile texture memory. We attempted to address this challenge by employing visual and auditory masking during the entire task to focus attention on the tactile properties of the stimuli. Furthermore, in contrast to studies such as Hutmacher and Kuhbandner (2018) in which participants fully explore the object three-dimensionally, we standardized the format of all stimuli such that the surface available to touch was functionally two-dimensional. These relatively flat surfaces were placed on a table in front of participants and could not be grasped or manually weighed, making verbal labelling slightly more challenging. Additionally, we conducted a post-span-task naming test, to determine for each participant whether they could produce a verbal label for each of the stimuli employed. This enabled us to examine the influence of texture nameability on novelty detection. Indeed, it seems almost impossible to completely eliminate verbal labelling during recognition memory tests, even for visual and auditory fractal designs, though previous research has endeavored to use such stimuli to moderate verbal labelling (Borders et al., 2017; Parks & Yonelinas, 2015).

Finally, inspired by Levy et al.'s (2003) comparison of amnesia effects on olfactory and visual span memory, we examined how individuals' texture span performance compared with their performance in a visual object span task, employing difficult-to-name novel visual objects. This enabled us to begin exploring the question of whether texture memory capacities might be modality specific. The overall aim of the study was to initiate exploration of long-term memory for textures and to determine whether individuals' memory capacity is constant across stimulus modalities. Such behavioral evidence might inform studies examining anatomical substrates of texture memory in relation to memory for other sensory modalities. Furthermore, the study used a discrimination task to test whether textures could be differentiated between, to ensure any errors made by participants were due to memory processes and not to perceptual confusion. To our knowledge, this is the first study assessing long-term human memory for texture, and its comparison with visual object memory in a parallel paradigm.

2. Method

2.1. Participants

The sample consisted of 45 undergraduate students (15.6 % males, 84.4 % females) ranging from 18 to 32 years of age (M = 22.51, SD = 2.83). Participants were recruited through the university's research recruitment system and participated voluntarily in exchange for academic credits. Participants self-reported no psychiatric or neurological disorders. Ethical approval was obtained from the local human participants research ethics committee, and participants provided signed informed consent before beginning the experiment.

2.2. Materials

2.2.1. Tactile modality

An assortment of 40 different tactile texture surfaces, chosen to represent a wide range of texture qualities, were originally selected for the study. Rather than using 3D objects, flat textures were used reduce the possibility of identifying the texture. A pilot study was conducted to assess textures nameability whilst participants' sight and hearing was blocked. Participants were asked to put a name to the texture they were scanning. The nameability was calculated by summing the number of times the texture was correctly named. The final stimuli set of 20 texture surfaces was chosen by taking the least nameable textures from the original set, each measuring 5 × 5 cm (see Appendix B for a full list of textures with nameability scores and Appendix C for texture images). The stimuli were placed on a rubber surface in order to equate movement of the texture tile during tactile interaction.

2.2.2. Visual modality

Several pilot studies were conducted to identify a visual comparison task of comparable difficulty to the tactile task, similarly employing difficult-to-name stimuli (see Appendix A). Ultimately, a stimulus set consisting of 20 Greebles (Appendix D; see Fig. 2 for examples) was chosen and piloted for the visual modality (see Gauthier and Tarr (1997), for a full description of features). Greebles were originally designed as a control set for faces; discriminating between them requires participants to pay attention to small detail changes in shape and features. Therefore, these were used for the visual modality comparison span task.

2.3. Procedure

All participants were exposed to both the tactile and visual modality tasks. Counterbalancing was used so that 24 participants were exposed to the tactile task first and 21 to the visual task first.

2.3.1. Tactile modality

The procedure was similar to Levy et al.'s (2003) odor span task. During the entire procedure, participants were blindfolded so they could not see the textures, and auditory cues were masked utilizing white noise played through headphones (see Fig. 1). A consistent room temperature was kept, to minimize touch sensitivity variation. In the first trial, a single texture was placed in front of the participant for tactile sampling. Subjects scanned with their three middle fingers, using the distal phalanx only, along the surface with velocity and exploration force of their choice. On the second trial (and subsequent trials), the previously sampled texture(s) were presented again, along with a novel texture, arranged in random order in a single-row or dual row linear array placed directly in front of the participants. They were initially asked to sample the textures from left to right to feel all of them in a controlled order, and then indicate which was the novel texture. Participants indicated the novel texture by returning to it and stating aloud that they had decided that it is the novel one. Each texture was sampled for five seconds, with duration controlled by the experimenter manually, using a stopwatch. If after all textures on the trial were sampled a decision had not yet been reached, they were instructed to sample them again in whatever order they preferred, similarly to Levy et al. (2003), and then to choose the novel stimulus. On each consecutive trial, an additional novel texture was added to the array of texture samples, presented in a pseudo-randomized trial order, and participants were asked to identify the novel item. When a correct choice was made, the subsequent trial was presented, in which a new texture was added. When the choice was incorrect, the incorrectly chosen (old) texture was removed from the display, and participants continued to choose among the remaining surfaces until the novel texture was identified. This continued until all 20 textures were presented in the final trial. Due to the number of textures, and to reduce the movement of participants across the table, half of the textures were on the table directly in front of participants and half were on a platform raising them above the first half (see Fig. 1).

Subsequently, participants were exposed to all 20 stimuli and asked to identify each texture by its name. This was conducted to see if increased nameability of textures contributed to a better span. Surfaces were positioned one by one in the middle of the display, and participants were asked to follow the same three-finger scanning procedure described above.

To address the possible confound of span length being a factor of discriminability differences between stimuli on any given trial, textures were serially introduced as novel items using one of two different predefined pseudo-randomized sequences of texture presentation, with each sequence given to half of the participants.

2.3.2. Visual modality

Up to twenty Greeble images were presented on a computer screen in a randomized order for span memory judgments of increasing numbers of images. Pictures were presented one at a time (from left to right across the screen), for five seconds; to maintain a parallel structure with the tactile task, after each was presented, it would disappear just before the new one was presented. After all images for a particular trial were exposed, participants were requested to identify the novel stimulus by clicking on the image. To ensure that they could only look at one at a time, all images were covered with an on-screen button that could reveal the Greeble by hovering over the space where the image previously appeared. When a correct choice was made, the subsequent trial was automatically presented. When the choice was incorrect, in parallel to the tactile task, that image and cover was removed from the display, and subjects continued to choose among the remaining stimuli until the new stimulus was identified. A brief break was provided in between trials, whereby the time spent on each trial increased as the experiment progressed, as in the tactile phase of the study.

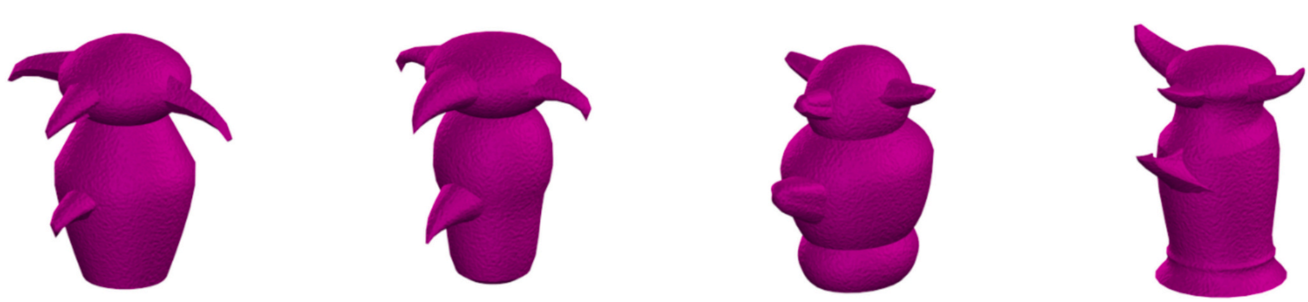

Fig. 2. Example Greeble stimuli (Gauthier & Tarr, 1997).

Fig. 1. Example setup for tactile modality test stage.

2.3.3. Scoring

Participants were scored on three factors: texture span length, number of errors, and percentage of correct trials. Texture span length reflected the number of consecutive trials in which the participant correctly chose the new texture/greeble before committing an error (maximum = 19). For example, a correct choice on the second trial and third trial followed by an error on the fourth trial was counted as a span length of two. The number of errors recorded the number of wrong guesses made. This represents the total number of errors made throughout the study (including multiple errors made on one trial). The percentage of correct trials recorded the overall percent of correct first-time guesses across all span lengths. To calculate this, the number of correct first-time guesses was divided by 19 (as there is no error is possible on the first trial where participants interact with one texture).

2.3.4. Experimental software

The serial presentation was designed and run using Gorilla Experiment Builder (Gorilla Experiment Builder - Easily Create Online Behavioural Experiments, n.d. https://gorilla.sc/). This was also used to provide accuracy data on all scoring measures.

2.3.5. Discrimination task

To assess the relationship between the discriminability of the specific textures employed in the tactile task and memory span performance, a pairwise discrimination task was conducted. This involved presenting all possible pairs of the 20 textures to participants with them having to identify whether the pair included two different textures or the same texture. Ten participants, who did not take part in the main study, executed this task. They were presented with 190 pairs of different textures and a further 20 pairs in which the textures were the same. The same procedure as the main task was used, whereby participants were blindfolded and wore headphones playing white noise to prevent use of visual or auditory information. To maintain the same procedure as the span task, participants were presented with one texture at a time. Participants were asked to palpate the first texture for five seconds and were then presented with the second texture to palpate for five seconds. After this, participants stated whether the textures were different or the same. The order of presentation of pairs was randomized, and the presentation of each pair was counterbalanced so that five participants received one of the textures first and five received the other one first.

2.3.6. Statistical analysis

Paired samples *t*-tests were conducted to test the difference between texture and visual modalities on each of the scoring variables; span, errors made and percent of first-time correct identifications of the novel texture. Following this, Pearson correlations were used to assess the relationship between each of the scoring variables for tactile and visual object stimuli. Further correlations were then conducted to assess whether there was a relationship between the texture scoring variables and participants ability to name the textures. A final correlation was used to identify whether there was a relationship between the nameability of each individual texture and the success of participants in correctly identifying it as novel or familiar. Finally, to assess whether there were differences in presentation order of tactile texture stimuli, participants scores in both counterbalanced orders were compared using independent samples t-tests for each of the scoring variables.

3. Results

3.1. Preliminary tests

To test whether there was a difference between texture and visual modalities in span length, total errors, and percent correct trials (Table 1), three paired samples t-tests were conducted, and Cohen's d was calculated using the sample standard deviation of the mean difference. No ceiling effects were observed for any participants in either modality during piloting, such that performance on the tasks could be effectively compared within-participants. Although pilot testing had indicated that the tasks were likely to be comparable in difficulty, in practice significant differences between the two modalities were found for span length, $t(44) = 4.76$, $p < .001$, Cohen's d = 0.71; total number of errors, $t(44) = 6.72$, $p < .001$, Cohen's d = 1.00; and percent correct trials, $t(44) = 5.59$, $p < .001$, Cohen's d = 0.834, showing that the tactile task had longer spans, fewer errors and better performance.

3.2. Correlations across modalities

To examine the key question of the study, Pearson's correlations were run to assess the relationship between each of the scoring variables for tactile and visual object stimuli. There was no significant relationship between texture and visual spans, $r = -0.001$, $p = .99$, nor was there a significant relationship between texture and visual percent correct rates, $r = 0.225$, $p = .137$ (see Fig. 3 for scatterplots). There was a moderate, positive, significant relationship between the number of errors made for texture and greeble stimuli, $r = 0.46$, $p = .002$, such that the more errors participants made on tactile texture stimuli, the more likely they were to have a greater number of errors for visual object stimuli. Bayesian correlations showed greater evidence for H_0 over H_1 when comparing the relationship for texture and visual spans (BF01 = 5.382) and proportion of correct responses (BF01 = 1.389).

3.3. Correlation between nameability and memory span measures

Overall nameability accuracy was found to be 26.22 %. In other words, most stimuli were not nameable by most participants, indicating that they likely mostly used tactile experience memory to perform the span memory task, rather than verbal labels. To identify whether there was a significant relationship between texture scoring variables and participants ability to name the textures (see Appendix B), three Pearson's correlations were conducted. No significant correlations were found between texture span and naming ability, $r = 0.12$, $p = .43$ (Fig. 4); the number of errors made and naming ability, $r = -0.14$, $p = .37$; nor between the percentage of correct trials and naming ability, $r = 0.23$, $p = .16$. Bayesian correlations showed greater evidence for H_0 over H_1 when comparing the relationship between naming ability and texture span ($BF_{01} = 3.998$), number of errors ($BF_{01} = 3.622$) and percentage of correct trials ($BF_{01} = 2.021$).

We also examined whether the nameability of each individual texture predicted how successful participants would be in correctly identifying it as novel or familiar. This analysis was necessarily incomplete, as while we randomized the order of sampling of textures in each trial, the trial stage at which each texture was presented as the novel stimulus was kept semi-fixed (i.e., following one of two sequence orders, to minimize presentation order error, as explained in the Method section). Given that reservation, we did not find a significant correlation between nameability of each texture and its likelihood of erroneous identification, $r = -0.211$, $p = .371$. Bayesian correlation again showed greater evidence for H_0 over H_1 when comparing the relationship between nameability of each texture and its likelihood of erroneous identification ($BF_{01} = 2.483$).

Table 1
Performance data, means and SDs, for texture and greeble stimuli.

	Texture mean (SD)	Greeble mean (SD)
Span	10.29 (3.91)	6.84 (2.88)
Errors	7.07 (4.86)	15.33 (9.25)
Percent correct	84.68 (8.23)	74.03 (11.79)

3.4. Tests of order effects

Finally, to examine whether the specific mean span measures observed were a function of the specific order of stimulus introduction, we compared performance of the two halves of participants for whom stimuli were introduced into the task in different pseudo-randomized but fixed orders. and possible interaction between pairwise discrimination differences. Independent samples *t*-test indicated no significant differences between participants who received the different texture orders, span; $t(43) = 0.146$, $p = .884$; number of errors; $t(43) = 0.146$, $p = .885$; percent correct; $t(43) = 0.786$, $p = .436$; or nameability; $t(43) = 0.273$, $p = .786$. Thus, span length (and the other measures) seem not to be only a function of a discriminability difficulty X stimulus order interaction.

3.5. Texture discriminability

Results of the discrimination task showed that participants made errors on only 23 of the 210 possible pairs (see Appendix E for a table of the number of errors per pair). Only two pairs of textures had errors by more than half of the participants. These were canvas bag and art canvas, and canvas bag and denim. To assess how that specific discriminability challenge might have affected span length, we inspected the two pseudo-randomized orders of stimulus presentation employed in the main study to identify the earliest time point participants would have encountered these textures together within the span task. As detailed in Appendix F of the Supplementary Materials, this was found for only one of the sequences, on trial 14. Five participants succeeded in getting to trial 13 without making an error and continued to not make an error on trial 14. Six participants succeeded in getting to trial 13 without making an error but did make an error on trial 14. The remaining participants made errors earlier than this. To examine whether this pair discriminability issue affected the comparisons reported above, we removed the errors which might have been caused by a discriminability problem in both sequences and recalculated the correlations and comparisons. As noted in Appendix F, this did not change any of the results substantively. Accordingly, although discrimination may be a factor, it seems to play a minor role in determining participants' specific span lengths in the current paradigm.

4. Discussion

This study represents the first attempt to characterize long-term episodic recognition memory for textures, in the form of span memory measures. Two key findings of this study were that texture memory capacity (as expressed in span length and percent of correct trials) was not correlated with performance on a parallel challenging visual span task, though there was a correlation in the total number of errors committed during the course of the tasks. Secondly, we found no correlation between participants ability to name the textures examined and their memory performance, in any of the measures employed.

While the absolute texture and visual object spans and other performance measures as assessed in the study are likely reflective of the specific materials employed, the relationships between performance in the two types of material might transcend the specific scores. It is instructive that there was no correlation whatsoever between span length on the two tasks, and only a weak, non-significant relationship between the numbers of correct trials across tasks. This provides some basis for the possibility that at least some different mnemonic mechanisms are recruited by the challenge of recognizing materials from different modalities. However, as some participants managed to achieve a texture span of 19 it is possible that, by expanding the stimulus set, some correlation between the modalities might be observed.

The one measure in which correlation was found across the tasks was in the total number of errors committed. We speculate that this relationship might reflect personality, attention or individual cognitive

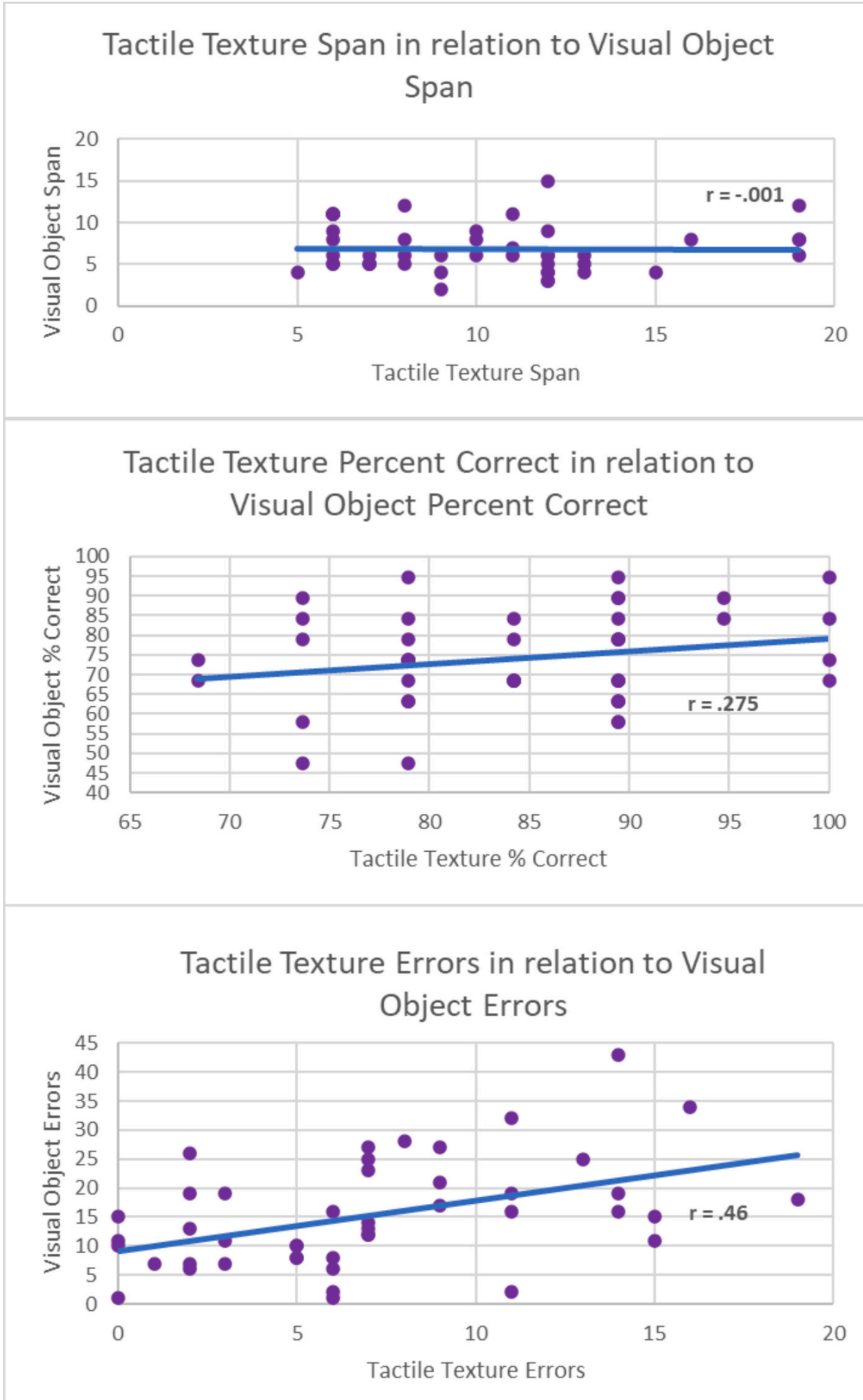

Fig. 3. Scatterplots comparing span, errors and percent correct for the two modalities.

strategy factors. In the absence of a strong memory trace for the probe stimulus, some individuals might be more likely to guess randomly among options, while others might be more inclined to examine the probes carefully, thus limiting the number of errors per trial. Such tendencies might be expressed across stimulus types. For example, research has shown direct evidence that attentional strategies affect performance in tactile-related tasks (Salgues et al., 2021, 2023). In contrast, recognition success based on memory trace strength seems to be individually specific to the material type under examination.

The lack of correlation between participants' performance and their success in naming the stimuli employed, and the absence of a correlation between individual texture nameability and its likelihood to be involved in an erroneous response, suggests that at least part of the recognition process involved remembering the sensory experience of the texture being probed, rather than the verbal label for that texture. Isolating processes that are unique to texture memory will require further efforts to create sets of stimuli for which verbal labels do not provide recognition cues – perhaps by requiring discrimination between several exemplars of textures that are found to share the same verbal label (though it may be impossible to completely eliminate descriptive nuances). The

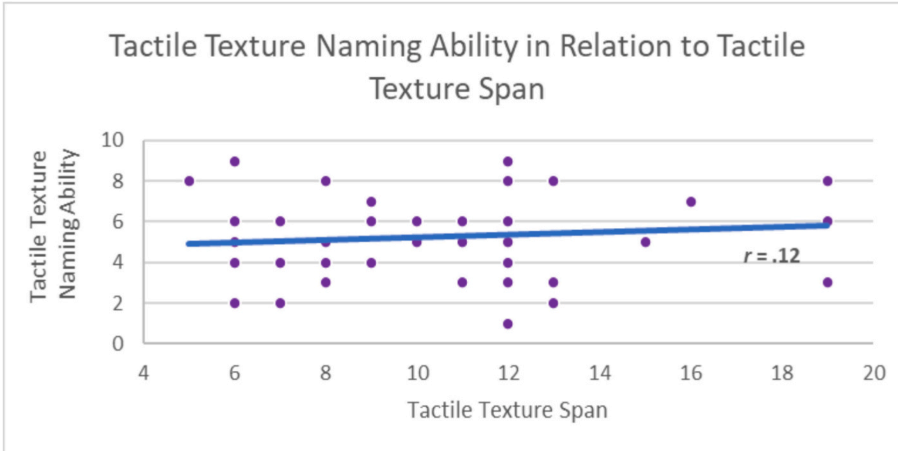

Fig. 4. Scatterplot comparing participants' ability to name textures with their tactile texture span.

current data provide a preliminary basis to guide future work in that direction.

Whilst differences were found between performance on the two modalities, we acknowledge that the difficulty levels of the visual and tactile tasks may not have been equivalent, making it uncertain whether the differences in results fully reflect modality differences. Furthermore, using a randomized order of stimulus presentation for each participant could reduce order bias.

While the span and related measures reported in this study are instructive not only in cross-sensory comparison but potentially as preliminary indicators of span capacity for the stimulus types in general, we should not be understood as claiming that these are a final and absolute determination that mean human texture span is 10 items. We certainly acknowledge that different span measures, overall correct trial numbers and total error rates might have emerged if different test stimuli were used. However, we attempted to address the issue of the interaction between discriminability differences and trial order by using two pseudo-random presentation sequences across participants. As we found no performance differences between participants tested with the two sequences, we do suggest that mean performance in the three measures that we examined are not a random product of that interaction, rather reflecting a reasonable initial estimate of tactile long-term memory characteristics.

5. Conclusions

To the best of our knowledge, this study is the first to investigate the relationship not only between individuals' long-term recognition memory abilities for tactile texture and visual object stimuli, but for any type of sensory stimuli. While some past studies have made group comparisons of memory capacity for visual and auditory materials (e.g., Bigelow & Poremba, 2014; Cohen et al., 2011), none have examined correlations between memory abilities across participants, which arguably provides a basis a preliminary indication of the possible dissociability of processes involved in memory for various stimulus types. Future research may make use of texture span as a paradigm for investigating neurophysiological correlates of texture encoding and retrieval, and neuroanatomical substrates of memory for textures compared to memory for other sensory modalities.

CRediT authorship contribution statement

Michael Batashvili: Writing – original draft, Visualization, Resources, Investigation, Formal analysis, Data curation, Conceptualization. **Omer Dado:** Resources, Investigation, Data curation. **Daniel Edery:** Resources, Investigation, Data curation. **Noam Kane:** Resources, Investigation, Data curation. **Gui Xue:** Writing – review & editing, Methodology, Conceptualization. **Daniel A. Levy:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

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Declaration of competing interest

All authors report no conflicts of interest.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2024.104525.

Data availability

Data is publicly available via a link in the article.

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