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Distance-dependent memory for pictures and words

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ABSTRACT

Three experiments explored the effect of medium of presentation (pictures, words) and psychological distance (proximal, distal) on episodic memory. In particular, we predicted that memory would be better for congruent combinations of medium and distance (i.e., pictures of psychologically proximal entities and verbal labels of psychologically distal entities) than incongruent combinations (i.e., pictures of psychologically distal entities and verbal labels of psychologically proximal entities). Our results support this hypothesis. In Experiments 1 and 2, recall was better when medium and temporal distance were congruent than not. In Experiment 3 people recognition was better when medium and spatial distance were congruent than not. These findings suggest that the decay of memory for details over time is a specific case of a broader principle that governs our memory system and is based on psychological distance between the individual and the target entity. More broadly, these results speak to the growing literature, which suggests that one of the major roles of memory is prospection. Within this framing, our findings suggest that the memory system serves prospection using qualitatively different information processing devices, depending on the psychological distance of the target from the individual.

Introduction

Our ability to prospect enables us to make predictions and plan for future events, and therefore constitutes a clear evolutionary advantage (Seligman, Railton, Baumeister, & Sripada, 2013). Recent approaches to memory suggest that memory is an adaptive tool that plays a role in thinking and planning for the future (e.g., Buckner & Carroll, 2007; Nairne & Pandeirada, 2008, 2016; Nairne, VanArsdall, & Cogdill, 2017; Schacter & Addis, 2007; Schacter, Addis, & Buckner, 2008; Suddendorf & Corballis, 1997, 2007; Szpunar, Spreng, & Schacter, 2016). A central question is how the mental architecture of the memory system serves this goal. In the current article we argue that one way it does so is by using visual representations for objects and events that are (temporally or geographically) close to the individual, and verbal representations for objects and events that are remote from the individual. In particular, we predict that this mental architecture will manifest in the form of better performance when the representational format and the psychological distance are congruent (i.e., visual representations of psychologically proximal objects and verbal representations of psychologically distal objects) than when they are incongruent (i.e., visual representations of psychologically distal objects and verbal representations of psychologically proximal objects).[2]

This mental architecture presumably developed for functional reasons. When we anticipate the future and make plans for it, we often need to consider objects and events that exist in our immediate surroundings. Those objects are *psychologically proximal* to us. But much of our lives revolve around objects and events that are far away from us in time or location. Those objects and events are *psychologically distant* from us. Here we argue that the characteristics of visual and verbal representations endow them with differential advantages in remembering objects that are psychologically proximal versus psychologically distal, respectively. In what follows we will first describe past

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[1] Means shared first co-authors.
[2] Such effects are not expected to be exclusive: we do not predict that it would be impossible to process incongruent combinations of medium and distance, or that congruent words would outperform the picture superiority effect.

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research on psychological distance and explain why it is central to human thinking. We will then discuss the difference between visual and verbal representations. Finally, we will explain how and why psychological distance affects memory for visual and verbal information.

What is psychological distance and why is it central in human's thinking?

People's experience of the world is limited to what is present. Despite this limitation, our thoughts often extend to other times, places, and minds. Our ability to prospect into the future and plan ahead, consider events that happen in other places or take the perspective of other people enables us to direct our actions toward long-term gain, and is therefore adaptive (Seligman et al., 2013). How do we achieve this amazing feat of "mental travel"? The process of mental travel begins with identifying how distant a target object or event is from the self. This egocentric distance is called *psychological distance* and could be temporal, spatial, social, or hypothetical. The concept of psychological distance and related concepts such as "mental travel" and "prospection" received growing attention in recent years (Bar-Anan, Liberman, Trope, & Algom, 2007; Liberman & Trope, 2014; Parkinson, Liu, & Wheatley, 2014; Seligman et al., 2013; Tamir & Mitchell, 2011). Together, this research shows that psychological distance is accessed automatically, and that psychological distance is an important dimension of meaning, common to spatial distance, temporal distance, social distance, and hypotheticality. For example, in a set of Stroop-like experiments (Bar-Anan et al., 2007) participants showed facilitation effects when two distance dimensions were congruent (e.g., the word "we" located within a perceived proximal location in a picture that conveys depth, and the word "they" in a perceived distal location in the depth picture) than when they were incongruent combinations. Consistent with the notion that information about (spatial, temporal, social) distance is processed automatically, Amit, Algom and Trope (2009) showed that (temporal, geographical and social) psychological distance influenced information processing despite the fact that the task was not about distance assessment, but rather about the semantic meaning of the presented items. This suggests that distance is processed automatically when one encounters a target object or event. Psychological distance is assessed automatically because of the fundamental, unconditional importance for survival to know whether an object is real or imagined, certain or probable, present, future or past, mine or somebody else's.

The above findings were recently corroborated by a growing number of neuroimaging studies, which provide evidence regarding the underlying neural machinery that supports psychological distance representation. For example, Tamir and Mitchell (2011) explored the spontaneous engagement of the default mode network (DMN) while perceivers consider experiencing events from temporal, spatial, social, and hypothetical proximal and distal perspectives. They found two regions in the DMN that were more active for proximal than distal events across all of those dimensions. Similarly, Parkinson, Liu, and Wheatley (2014) showed that information about social, temporal, and spatial distance was encoded in the right inferior parietal lobule (IPL). This finding suggests that the organization of the brain reflects the adaptive value in processing information about the egocentric distance of an entity from the individual, and that this is true regardless of whether it is spatial, temporal, or social distance.

Together, the behavioral and neuroimaging research suggests that due to its centrality to survival, there may be a "distance axis" in the brain, which activates automatically and is shared across various distance dimensions (Parkinson, Liu, and Wheatley, 2014; Tamir & Mitchell, 2011; Trope & Liberman, 2010).

Notably, research has shown that the automatic identification of the egocentric distance of an entity from the self shapes the way we process information about this entity. In particular, it was shown that people think about remote entities using more abstract representations (Parkinson et al., 2014; Trope & Liberman, 2003, 2010). The process of abstraction can take many forms, all of which serve the same function of enabling mental travel (for reviews, see Burgoon, Henderson, & Markman, 2013; Liberman & Trope, 2014; Rim et al., 2015; Soderberg, Callahan, Kochersberger, Amit, & Ledgerwood, 2015). One of the central forms of abstraction is language. In what follows we will describe the main differences between linguistic and non-linguistic representations.

Language as a form of mental abstraction

One of the most important developments in human phylogeny and ontogeny is the emergence of language. But what is so special about language? The philosopher Charles S. Peirce famously distinguished between non-linguistic or iconic representations on the one hand, and linguistic representations on the other, based on the fidelity of the representation to the referent object. A representation is an icon or picture if it is "like the thing it represents" (Peirce, 1902), implying that the representational quality of a picture is based on physical similarity to the object. In contrast, the representational quality of a symbol or a word is based on convention or law. As a result, the relationship between a word and an object is arbitrary. As Coulmas (2003) convincingly argued, words are not visual signs of objects, but rather visual signs of the (oral) *names* of the objects.

Critically, the arbitrary nature of words enables them to abstract information. Abstraction is the process of distinguishing between features that are central to the target and are therefore invariant, and features that are non-central and therefore incidental and idiosyncratic. Distinguishing between central and incidental features is relative to a particular goal, giving rise to multiple possible abstractions of the same object, and could be an explicit or implicit process (for reviews, see Liberman & Trope, 2008, 2014; Trope & Liberman, 2003, 2010). Words retain the central and invariant features of a target relative to a particular goal and omit the incidental concrete details that are unavoidably present in pictures (Amit, Algom, & Trope, 2009; Amit, Algom, Trope, & Liberman, 2008; Glaser, 1992; Johnson-Laird, 1983; Liberman & Trope, 2014; Pinker & Jackendoff, 2005; Trope & Liberman, 2010). For example, one could choose to represent a target using the word 'dog' and omit all additional information. But even a schematic picture of a dog specifies the leg–torso proportion. Of course, one *could* add to the verbal description more information, such as the leg-torso proportion and other details (e.g., "a white Chihuahua with short legs and long torso"). But these additions are not a by-product of the representation of the target. Rather, they are elective additions that are central to the representation, given the individual's subjective goals. Moreover, when details are important, a visual representation would be more efficient and more complete than a verbal representation in delivering this information. This is most likely why, whenever possible, the police provide the public with a visual facial composite rather than a verbal depiction of the suspect.

How and why does psychological distance affect memory for visual and verbal information?

In the current research we explore the role of the memory system in the process of transcending the here and now and mentally traveling to other times, places, and minds. A growing literature is interested in this question. Adopting a functional perspective, this approach suggests that episodic memory enables past experiences to be flexibly used in order to imagine novel hypothetical events (Buckner & Carroll, 2007; Schacter, Addis, & Buckner, 2008; Suddendorf & Corballis, 1997). Because hypothetical events differ from each other on how (temporally, geographically, or socially) remote they are from the self, in the current research we hypothesized that the nature of these memories will change as a function of the psychological distance of the target from the self. In particular, memory will be better for visual representations of proximal objects and verbal representations of distal objects than for visual representations of distal objects and verbal representations of proximal objects. Construal level theory provides the rationale for this hypothesis by explaining the causal link between psychological distance and abstraction (CLT, see Liberman & Trope, 2014; Trope & Liberman, 2010). Construal level theory is concerned with how we transcend the "here and now" and suggests that abstraction is the very process that enables mental travel to other places, times, and minds. This is because abstract representations (i.e., high-level construals), compared to relatively more concrete representations (i.e., low-level construals), ignore peripheral details and instead highlight the central and general aspects of an experience, and therefore tend to remain invariant across time, space, and perspective. High-level construals are more suitable for transcending the particularities of the here-and-now, and therefore to regulate effectively in pursuit of distant ends.

A large number of studies provide strong converging evidence that people gradually increase the level of abstraction with increasing (temporal, social, and spatial) psychological distance (for a recent review and meta-analysis, see Soderberg et al., 2015). These studies used various dimensions of distance (social, temporal, spatial) and various forms of abstraction, including wide versus narrow categories, primary versus secondary features, causes versus effects, traits versus behaviors, abstract versus concrete action verbs, overarching goals versus subordiante means, and values versus specific behaviors (for reviews, see Bar-Anan, Liberman, & Trope, 2006; Liberman & Trope, 2008, 2014; Soderberg et al., 2015; Rim et al., 2015).

Recently, building on the notion that language is more abstract than visual representations, Amit et al. (2009) suggested that the development of language in human history and in the child's life may have resulted from environmental pressures to transcend the "here and now" and address more remote challenges. In particular, Amit et al. (2009) suggested that the visual system was developed to handle immediate challenges that surrounded the individual. In contrast, language was developed in order to address challenges that are remote from the self. Consistent with this idea, research showed that people elect to use verbal (vs. visual) means of communication when communicating with remote (vs. proximal) others (Amit, Wakslak, & Trope, 2013). Verbal representations also helped people more than visual representations to focus on their long-term goals (e.g., diet; Carnevale et al., 2014). Moreover, it was found that the preference to use congruent combinations of medium and distance (i.e., verbal for distant, visual for proximal), translates to enhanced information processing of congruent combinations of medium and distance in perceptual tasks. This is presumably because the tendency to represent remote entities more abstractly resulted in a constant pairing between medium and psychological distance, and a formation of a generalized and strong association between them (Amit et al., 2008, 2009; Carnevale, Fujita, Han, & Amit, 2015).

Taken together, the research on the effect of psychological distance on visual and verbal information processing suggests a novel hypothesis regarding the role of memory system in mental travel, arguing that it facilitates memory of congruent (vs. incongruent) combinations of distance and medium. This role is efficient. In order to make predictions about proximal entities and plan for the immediate future, it is efficient to remember visual information of the target objects because the concrete features represented visually are more likely to manifest in proximal objects but might change in distal ones. Therefore, visual details could facilitate accurate and quick recall or recognition for psychologically proximal objects but could inhibit memory for remote objects. In contrast, in order to make predictions about remote entities and plan for the long-term future, it is efficient to remember verbal information of the target object because words maintain the invariant features of the target and therefore are more immune to incidental changes. For example, suppose that you are visiting your grocery store. It might be efficient to remember what the jug of your favorite maple syrup looks like or where it is located on the shelf if you plan to go to the store to buy it tomorrow. This visual memory would facilitate quick and accurate recognition of it. But if you plan to go to the store in a few months, it might be more efficient to remember the name of the maple syrup as the store might change the location or position on the shelf, or use a jug that has a different shape. The same logic also explains the differentiation between the recent versus distal past. For instance, suppose that you are about to visit a city you are unfamiliar with. It may be efficient to visually remember the subway map of the city from a travel guidebook that was recently published, but if the travel guidebook you have is old, it might be more efficient to remember verbally that this city has a subway system and search for an updated map when you get there.

Note that the fact that it is often functional to remember visual details about proximal events and verbal information about distal events does not mean that people cannot do the opposite. We *can* remember visual information about distant events, and we *can* remember the verbal information about proximal events. And although it is generally more adaptive to use congruent than incongruent combinations of medium and distance, there could be circumstances in which it is actually more adaptive to use incongruent combinations. Furthermore, we do not expect that the effect of distance on memory for visual or verbal information to be mutually exclusive (we may remember both the shape and the name of the maple syrup), but we do expect the relative weight of the two modalities to reflect the functional advantage of abstract vs. concrete information, as follows from their psychological distance. Thus, verbal information gradually gets more weight the more remote the target is, and visual information gradually gets more weight the more proximal the target is. Finally, there are also individual differences between people in the extent to which they rely on visual versus verbal representations (Amit, Hoeflin, Hamzah, & Fedorenko, 2017). This leeway gives room for variation in how we think about the world, and the possibility that different types of representational formats may be better or worse for different purposes.

Past research on memory for abstract and concrete information

The current hypothesis is consistent with past work on memory for abstract and concrete information. A central finding in memory research is that memory for details becomes less accessible over time (Altmann & Gray, 2008; Altmann & Schunn, 2012; Ebbinghaus, 1885; Reyna & Brainerd, 1995; Schacter, 1999), thus making memories of the distant past more abstract than memories of the recent past. For example, Fuzzy-Trace Theory (FTT; Brainerd & Reyna, 1990; Reyna & Brainerd, 1995) distinguishes between memories for gist versus verbatim. "Gist" representations capture the broader meaning of information and are therefore abstract (e.g., "the cell phone is compact"; Burgoon et al., 2013). In contrast, "verbatim representations" capture the details and are therefore concrete (e.g., "the cell phone is 4.5 in. long and 2.3 in. wide"; Fukukura, Ferguson, & Fujita, 2013). Research has shown that although there is initial parallel storage of verbatim and gist trace, there are differential survival rates such that verbatim traces become inaccessible more rapidly than gist traces, leading to a tendency to recall information in terms of gist rather than specifics (for a review, see Brainerd & Reyna, 2002; Reyna & Brainerd, 1995).

Do "verbal representations" encourage more or less "verbatim" encoding than pictures? Israel and Schacter (1997) used the DRM paradigm to test how medium of representation of targets (visual, verbal) affect false memories of gist non-presented item. They found that false recognition of gist occurred with verbal stimuli but less so with visual stimuli. Thus, studying pictures that are rich in perceptual detail interferes with the encoding of gist (encouraged by words). Explaining this finding, Israel and Schacter (1997) argued that (p. 580):

> "Item-specific or "verbatim" representations encourage recognition decisions based on identity between the test probe and a previously studied item, whereas gist representations lead to decisions based on similarity. Because words generally lack the specific and varied perceptual information provided by pictures, the participants in the

word encoding condition were led to rely on … semantic similarity or gist information."

The above insight gets further support from the mental model theory (e.g., Knauff & Johnson-Laird, 2002). In particular, they distinguished between visual imagery and spatial representation, and argued that spatially organized mental models are not to be identified with visual images. In fact, visual images contain large amounts of irrelevant and incidental information and therefore put an unnecessary load on working memory. As a result, reasoners have to isolate the information that is relevant to the inference, and in so doing, they might be sidetracked by irrelevant visual details. Therefore, visual images could interfere with reasoning.

Together, the above theories and findings suggest that people are more likely to rely on semantic similarity or gist when encoding verbal information and on detailed perceptual information when encoding visual information. The literature further provides evidence that details are forgotten at a faster rate than gist and that gist memory increases with psychological distance (e.g., Brainerd & Reyna, 2002; Israel & Schacter, 1997; Rim, Uleman, & Trope, 2009; Smith & Trope, 2006).

Although the decay of memory for details over time might seem as a flaw of the memory system, vast research suggested that this is in fact an adaptive feature. For example, Bjork and Bjork (1988) suggested that it is often useful to forget information that is no longer current, such as old phone numbers or where one parked the car yesterday. Similarly, Anderson and Schooler (1991; Schooler & Anderson, 1997) argued that forgetting over time reflects an adaptation to the structure of the environment because it frees resources for future use and allows memory retrieval to continue quickly and efficiently. Finally, Altmann and Schunn (2012) argued that decay plays a functional role in cleaning up episodic detritus. Critically, although consistent with the current approach, our hypothesis goes beyond these functional accounts for decay and argues that forgetting details over time is a specific case of a more general principle that governs the mental architecture of episodic memory; namely, the psychological distance of the target entity from the individual.

Note that while our hypothesis does not mean that other decay accounts are incorrect, it generates distinct predictions regarding the behavior of the memory system. First, if the current approach based on CLT is correct, then even when holding the objective time lag between learning and retrieval constant, the *subjective* distance (i.e., the psychological, egocentric distance between the individual and the target) should affect memory. Second, past research suggests that various distance dimensions (e.g., spatial, social, temporal) share a common underlying meaning of *psychological distance* (Bar-Anan et al., 2007; Maglio, Trope, & Liberman, 2013a, 2013b; Parkinson, Liu, & Wheatley, 2014; Tamir, & Mitchell, 2011). Therefore, the effect of distance on memory should generalize beyond temporal distance. The following experiments were designed to assess the current hypothesis using the above two critical tests.[3]

[3] Broadly consistent with situation models of memory (Johnson-Laird, 1983; van Dijk & Kintsch, 1983; Zwaan & Radvansky, 1998), we believe that people form mental representations of the *content* described by the word and/or picture, rather than of the word and/or picture themselves. Furthermore, people's situation models incorporate spatial-temporal information such that the location and time associated with the foreground of the model are more accessible in memory than a different location and time (e.g., Glenberg, Meyer, & Lindem, 1987; Morrow et al., 1987; Zwaan, 1996). In this literature, spatial and temporal information refers to the events occurring in the situations themselves (i.e., the space occupied by the protagonist and the timeframe of the described situation. In our framework, distance refers to the egocentric distance between the self and the to-be-remembered information, which is conceptually different.

Overview of studies

We conducted three experiments to test our hypothesis. In all three experiments we hypothesized that memory would be better for congruent combinations of representational format and distance (i.e., visual representations of proximal objects and verbal representations of distal objects) than incongruent combinations (i.e., visual representations of distal objects and verbal representations of proximal objects). Experiment 1 and 2 focused on temporal distance and Experiment 3 focused on spatial distance. Critically, we kept the objective time lag constant and changed only the subjective, psychological distance from the event.

Note that our hypothesis refers to the effect of congruency between medium and distance on memory and is agnostic with regards to the main effect of medium, which often reflects a memory advantage for pictures over words (*the picture superiority effect*, e.g., Arieh & Algom, 2002; Paivio & Csapo, 1973; but see Mintzer & Snodgrass, 1999). We were also agnostic with regards to the simple effects of distance within each medium, which could be affected by the specific features of each experiment, and therefore our hypothesis is focused on the effect of congruency between medium and distance on memory.

Experiment 1

Past research showed that memory for details becomes less accessible over time (Altmann & Gray, 2008; Altmann & Schunn, 2012; Ebbinghaus, 1885; Reyna & Brainerd, 1995; Schacter, 1999). Would that be true even when holding the objective time lag between learning and retrieval constant, and changing only the *subjective* temporal distance? The purpose of Experiment 1 was to explore this question.

During the study phase, participants were presented with a list of items, either in picture or word form. The list consisted of temporally proximal items (e.g., laptop, car) and temporally distal items (e.g., lantern, carriage). Subsequently, participants free-recalled the items from the study phase. We predicted that memory for congruent items (temporally proximal pictures and temporally distal words) would be better than for incongruent items (temporally proximal words and temporally distal pictures).

Method

Participants. Two hundred and two participants (110 female, $M_{age} = 20.23$, $SD_{age} = 12.78$) were recruited online from Amazon Mechanical Turk (MTurk) in exchange for payment.

Stimuli and pretest. The stimuli were 10 temporally proximal items and 10 temporally distal items selected based on a pretest of perceived temporal distance and level of familiarity (see Fig. 1 for sample stimuli).

Pretest of stimuli. Twenty-one participants who did not participate in the main study were recruited through MTurk. They were presented with 38 items. Eleven participants received the items in picture format and the rest in word format. The pictures were colored photographs found online. The width of the pictures varied between 2 cm and 6 cm, and their height varied between 2 cm and 5 cm. The words appeared in English, Times New Roman font, size 12, bold and uppercase. Participants rated each item on two scales: (1) perceived temporal distance (1 = proximal, 7 = distal); and (2) familiarity (1 = unfamiliar, 7 = familiar). We first explained what we mean by "temporal distance". In particular we said "*an object may be considered temporally proximal to the extent that it generally belongs to recent times or the present. In contrast, an object may be considered as temporally distant to the extent that it generally belongs to the distant past times. For example, a modern car could be considered as temporally proximal whereas a carriage can be considered as temporally distant.*" Subsequently, we explained the difference between familiarity and temporal distance. Specifically, we said: "*Sometimes, something familiar to you might still be temporally distant. For*

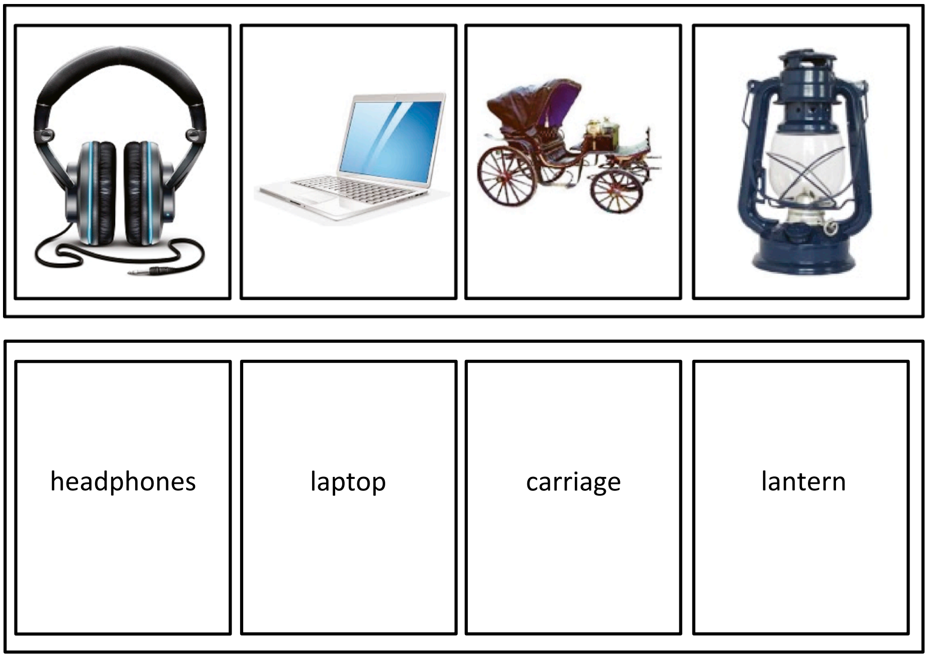

Fig. 1. Sample of stimuli from Experiment 1. Half of the items were identified by an independent group of subjects as belonging to the distant past (e.g., carriage, lantern) whereas the other half of the items were identified by the pretest group as temporally proximal (e.g., headphones, laptop).

example, a carriage might be very familiar to you, though it belongs to the past; it is well known and easily recognizable, but generally belongs to distant times." Finally, as an additional measure of familiarity, we asked participants to either name the picture, or to describe the item that was presented verbally.

Results of pretest. The mean rating for temporal distance across all 38 items was $M = 3.4$ ($SD = 1.46$). We selected 10 items that were above and 10 items that were below this mean. The proximal objects selected were: speakers, printer, laptop, desk lamp, headphone, car, bicycle, watch, gun, and mobile phone. The distal objects were: well, wagon, sword, spinning wheel, quill pen, Polaroid camera, corset, helmet, carriage, and lantern (see Fig. 1).

Subsequently, we examined the familiarity ratings for the 20 items selected. Temporally proximal items were rated as more familiar than temporally distal items $F(1, 19) = 30.21$, $p < 0.001$, $\eta_p^2 = .61$. Critically, however, the mean rating of familiarity for *both* the 10 temporally proximal items ($M = 6.22$, $SD = 1.23$, $t(20) = 8.23$, $p < .0001$) and the 10 temporally distal items ($M = 4.74$, $SD = 1.36$, $t(20) = 2.5$, $p = 0.021$) were significantly above the mid-point of the scale. In other words, both temporally proximal items and temporally distal items were highly familiar. Finally, there was no significant effect of medium ($F < 1$) and no interaction between medium and distance ($F < 1$) on perceived familiarity.

Finally, we examined participants' descriptions of the verbal items and labeling of the visual items. We ranked participants' descriptions/labels using "1" for correct description/label and "0" for incorrect description/label. Consistent with the high familiarity ratings, participants were at ceiling or almost at ceiling in their familiarity with the items. Specifically, the mean score for description/label was 1.0 out of 1.0 for proximal words and proximal pictures, 0.97 out of 1.0 for distal words, and 0.97 out of 1.0 for distal pictures. The interaction between medium and distance was not significant, $F(1, 18) = 0.75$, $p = .39$, $\eta_p^2 = .04$.

To summarize, although the temporally proximal and temporally distal items we selected differed on familiarity, the familiarity ratings of *both* temporally proximal and temporally distal items were very high. Furthermore, the participants showed familiarity with the items in both conditions by providing accurate descriptions/verbal labels of the items.

Procedure of main task. Participants were randomly assigned to one of two conditions: word encoding (102 participants) or picture encoding (100 participants). Items were presented one at a time, for one second each, in random order. After viewing all 20 items, participants completed an easy math distraction task, which consisted of 12 simple math questions (e.g., $5 * 9$). Following this buffer task, participants were asked to write down as many items as they could remember. They were specifically told that the order of items listed was not important.

Results[4]

Recall was better for congruent combinations of medium and distance (proximal pictures and distal words) than for incongruent combinations

The results are presented in Fig. 4A and Table 1. The main dependent variable was recall performance, indicating whether an item was recalled or not. Jaeger (2008) showed that analyzing categorical data with analysis of variance could yield spurious results, for example, when averaging recall performance for each participant and condition. We therefore decided to follow his recommendation and conduct an item-level analysis using a generalization of logistic regression, referred to as *mixed logit models*. Mixed logit models describe an outcome as the linear combination of fixed effects, i.e., the independent variables, and random effects, such as variance associated with participants or items. This means that mixed logit models are ideally suited to analyze categorical data from a range of different designs, including mixed designs.

The analysis was implemented in the *glmer* function in R 3.4.2 (R Core Team, 2017) package lme4 1.1.14 (Bates, Maechler, Bolker, & Walker, 2015). The data and analyses scripts are publicly available at https://doi.org/10.17605/OSF.IO/V76XA. Models were fitted using Laplace Approximation and built empirically using likelihood ratio tests

[4] In Experiment 1 in which a free recall task was used, items written by participants were corrected for spelling mistakes and naming variations prior to analysis. Total number of corrections was negligible (< 0.1%), including minor corrections (e.g., "phone" and "smartphone" were corrected to "mobile phone", "quill" was corrected to "quill pen", and "spindle" was changed to "spinning wheel").

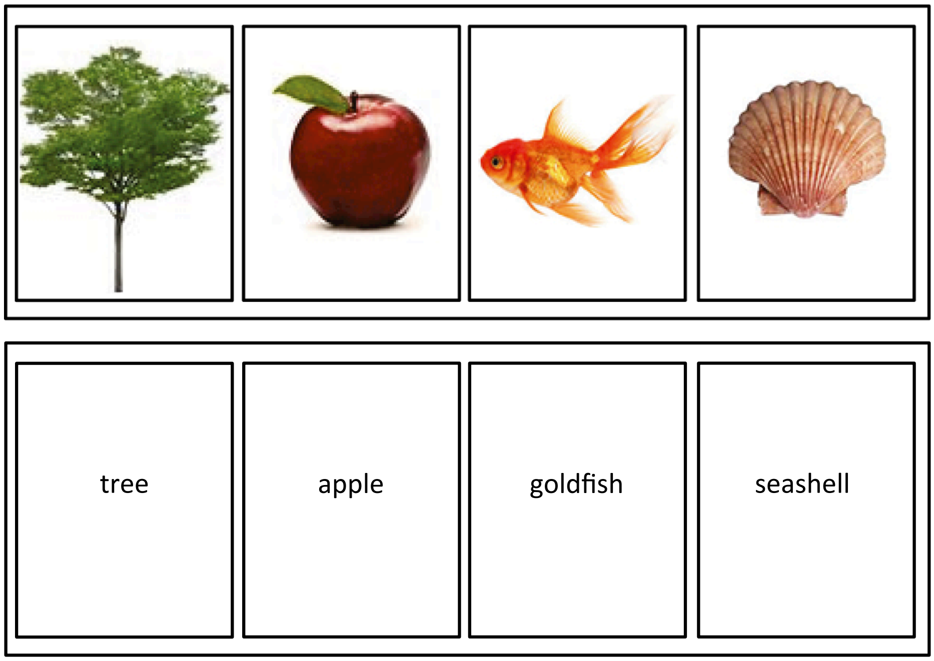

Fig. 2. Sample of stimuli from Experiment 2. The identity of the items was kept constant across temporal distance conditions and varied between subjects. The medium (visual, verbal) of each item was varied across subjects.

for model comparisons via R's ANOVA command. This means that we only included fixed and random effects in the statistical model to the extent that they significantly improved the model's ability to explain observed variance in recall performance. In other words, we aimed to identify the simplest model of recall performance as justified by the data (Baayen, Davidson, & Bates, 2008). As potential fixed effects, we coded the hypothesized congruency-contrast (1 0, for proximal pictures and distal words vs. distal pictures and proximal words, respectively), medium (1 0, for pictures vs. words, respectively), and distance (1 0, for proximal vs. distal, respectively) as well as item familiarity as measured in the pretest (ranging from 1 = unfamiliar, to 7 = familiar). Random intercepts were defined by-participant and by-item.

The analysis proceeded as follows: Starting with a baseline model that only contained a by-participant random intercept, model comparisons suggested that the data justified the inclusion of a by-item random intercept, $\chi^2(1) = 207.87$, $p < .001$, as well as the predicted congruency-contrast, $\chi^2(1) = 15.01$, $p = .001$. The inclusion of the contrast suggests that the congruency of medium and distance can explain variance in recall performance. Moreover, model fit improved further by including a fixed effect of medium, $\chi^2(1) = 19.72, p < .001$, but not by including a fixed effect for distance, $\chi^2(1) = 0.07$, $p = .78$. Thus medium, but not distance, explained variance in recall performance beyond the variance captured by the congruency contrast. Having included both congruency and medium, we explored next whether medium or item familiarity qualified the effect of congruency. However, neither including a medium ∗ congruency interaction, nor a familiarity ∗ congruency interaction were justified, $\chi^2(1) = 0.08$, $p = .78$, and $\chi^2(2) = 3.72, p = .15$, respectively (including only a fixed effect of familiarity was also not justified, $\chi^2(1) = 2.05$, $p = .15$). This suggests that congruency effects for words and pictures, and for more and less familiar items, were comparable. Thus, the final model contained only fixed-effects for medium and congruency, revealing improved recall performance for pictures compared to words, $\beta = 0.46$, $SE = 0.10$, $z = 4.54$, $p < .001$, as well as the predicted improved performance when medium and distance were congruent, $\beta = 0.28$, $SE = 0.07, z = 3.94, p < .001$.

The fact we did not find an effect for familiarity on recall might be surprising, given past findings on the topic (e.g., Karlsen & Snodgrass, 2004). The null effect for familiarity might be the result of the fact that we a priori selected highly familiar items for this experiment. The restriction of range with regards to the familiarity dimension could therefore explain why we did not get any effect for familiarity while other experiments, which did not restrict the range, did. Note that this is not in conflict with the current approach. Rather, our goal was to manipulate psychological distance while keeping familiarity as constant as possible across conditions.

Experiment 2

In Experiment 1 we found that memory was better for congruent combinations of representational format and temporal distance (i.e., visual representations of proximal objects and verbal representations of distal objects) than incongruent combinations (i.e., visual representations of distal objects and verbal representations of proximal objects). However, since we used different items for proximal and distal conditions, it is possible that the items differ on factors other than psychological distance. To address this issue, in Experiment 2 we kept the items constant across distance conditions. In particular, we manipulated distance using a mindset task where participants were informed that the study was a replication of an experiment that was designed "last week" (proximal condition) or "in the 1980s" (distal condition). During the study phase participants were presented with a set of 20 items, half in word form and half in picture form. These items were purportedly generated either last week or in the 1980s for an experiment that took place at that time. After a short distractor task, they free-recalled the items from the study phase. As in Experiment 1, we predicted that memory for congruent items (temporally proximal picture and distal words) would be better than incongruent items (temporally proximal words and distal pictures).

Method

Participants. Ninety-eight participants (68 female, $M_{age} = 19.4$, $SD_{age} = 1.68$) were recruited from a university subject pool in exchange for credit.

Stimuli. The stimuli were 20 ordinary items (e.g., tree, apple, cat, scissors, carrot) presented either as pictures or words (Fig. 2). We created two counterbalancing sets. On each set there were a total of 20 items, half (10 items) in a picture format and the other half (10 items) in a word format. The medium of the presentation of the item was counterbalanced across sets, such that an item that was presented as a picture in Set #1 was presented as a word in Set #2. Thus, the identity of the items was kept constant across distance conditions (e.g., the "apple" was presented as belonging to the "temporally proximal" condition for one subject, and to the "temporally distal" condition for another subject) and the medium of presentation (e.g., whether the 'apple' is presented visually or verbally) was counterbalanced across subjects.

Procedure. During the study phase, participants were randomly assigned to one of the two counterbalancing sets. Each set consisted of 20 ordinary items, 10 in picture form and 10 in word form. Participants were randomly assigned to temporal distance condition: N = 52 were told that the experiment was a replication of a study that was designed last week so all of the instructions and materials they would see were generated at that time (temporally proximal condition). The remaining participants were told that the experiment was a replication of a study that took place in the 1980s (temporally distant condition). To get participants into the temporally proximal or distant mindset, we asked them to complete a 3-min writing task in which they were to imagine and write about the life of an ordinary person one week ago in the temporally proximal condition, or in April 1980, in the temporally distal condition. Subsequently, they viewed the 20 items, presented one at a time, in random order, for one second each. Above each item, we presented the heading, "Replicating an experiment from A WEEK AGO" or "Replicating an experiment from the 1980s," to keep temporal distance salient. Then they completed an easy math distraction task, which consisted of 12 simple math questions (e.g., $5 * 9$). Following this buffer task, participants were asked to write down as many items as they could remember. They were specifically told that the order of items listed was not important.

We conducted a manipulation check in order to verify that subjects perceived the temporally distal items as more distal than the temporally proximal items (see Appendix A). In particular, we presented the subjects with a mindset task followed by a group of items, and then a second mindset task followed by another group of items. Then we presented them with the items from both time frames in random order and asked them to report on a scale that ranged between 0 (very distal) and 100 (very proximal) how proximal or distal the item feels. Our manipulation check confirmed that subjects perceived the items that preceded with a proximal mindset as more psychologically proximal than items that preceded with a distal mindset task (p = .002). For full detail on the manipulation check and its results see Appendix A.

Results

Recall was better for congruent combinations of medium and distance (proximal pictures and distal words) than for incongruent combinations

The results are presented in Fig. 4B. Similar to Experiment 1's analysis strategy, we analyzed recall performance with a mixed logit model. Compared to the baseline model that only contained a by-participant random intercept, the data justified the inclusion of a by-item random intercept, $\chi2(1) = 26.87$, $p < .001$, and the predicted congruency contrast (coded 1 0, for proximal pictures and distal words vs. distal pictures and proximal words, respectively), $\chi^2(1) = 7.08$, $p = .008$. Model fit was further improved by including a fixed effect of medium (coded 1 0, for pictures vs. words, respectively), $\chi^2(1) = 58.77$, $p < .001$, but neither by including a fixed effect for distance (coded 1 0, for proximal vs. distal, respectively), $\chi^2(1) = 2.42$, $p = .12$, nor by including a medium * congruency interaction, $\chi^2(1) = 2.42$, $p = .12$. As expected, the final model revealed improved recall performance for pictures compared to words, $\beta = 0.79$, $SE = 0.10$, $z = 7.56$, $p < .001$, as well as the predicted improved performance when medium and distance were congruent, $\beta = 0.22$, $SE = 0.10$, $z = 2.16$, $p = .03$.

Experiment 3

The main goal of Experiment 3 was to generalize the results obtained in Experiments 1 and 2 to spatial distance. People regularly need to consider information about objects and events that are located in their immediate surroundings. However, they often need to consider information about objects and events that are located in a remote location. How does this spatial distance affect memory? Consistent with Experiments 1 and 2, we predicted that memory for congruent combinations of medium and spatial distance (visual representations of proximal objects and verbal representations of distal objects) would be better remembered than incongruent combinations (visual representations of distal objects and verbal representations of proximal objects). This is because we often have less certainty about the fine details of geographically remote objects relative to geographically proximal objects. As language maintains only the invariant features of remote objects and events it is more resistant to incidental changes and suits better memories about remote objects. Thus, it is efficient to remember visually how a dangerous intersection near your house looks like, but probably more efficient to remember that there is a dangerous intersection in a remote location, and search for the details when it becomes relevant.

Consistent with this prediction, a large body of work suggests that spatial distance affects the way information is being processed and used (Henderson, Fujita, Trope, & Liberman, 2006). For example, representations of spatially near objects are dependent on the axis of the body and the three-dimensional space surrounding the body, whereas representations of spatially distant objects have been associated with mental constructions that are more global and schematized (e.g., Bryant & Tversky, 1999; Tversky, 2003). Similarly, in representing spatially distant objects, individuals rely on categorical information rather than fine-grain metric values (e.g., Huttenlocher, Hedges, & Duncan, 1991; McNamara, 1986; Tversky, 1981). In this paper we explored how spatial distance affects the mental architecture of the memory system, which might underlie the subsequent effects on judgments.

A second goal of Experiment 3 was to replace the recall task used in Experiments 1 and 2 with a recognition task. Unlike recall, recognition does not require the translation of pictures into words and therefore the task remains constant across medium conditions.

Finally, objects that are presented remotely are smaller in their retinal size than the same objects that are located in more proximal location (Amit et al., 2009; Amit, Mehoudar, Trope, & Yovel, 2012). In order to keep perceived size constant, we changed retinal size such that distal items (both pictures and words) were slightly smaller in the distant (vs. proximal) condition. The change of retinal size could present a potential confound to the psychological distance account. Therefore, we added another condition in which we manipulated the size of the distal item to be smaller (perceived size constant across conditions: size condition (1) or equal (retinal size constant across conditions: size condition (2) to the proximal object's size. If distance and not size accounts for the effect, then the effect of congruency between distance and medium on memory would appear regardless of the size condition.

Method

Participants. Forty-eight undergraduates from the University of Trier (32 women, 13 men, 3 unreported; $M_{age} = 22.07$, $SD_{age} = 3.77$) participated in the experiment for course credit.

Stimuli and apparatus. Background scenes were 6 color photographs of outdoor scenery, rich in depth cues (adapted from Hansen & Wänke, 2010). Pictures and words were displayed within an arrow that was superimposed on this scenery at a near or a far position (see Fig. 3;

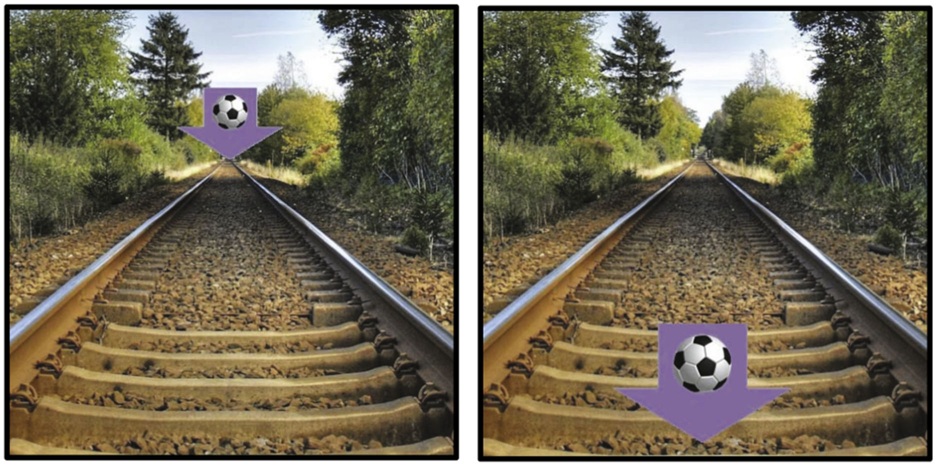

Fig. 3. Examples for proximal and distal pictorial stimuli. In the verbal condition the pictures were replaced with verbal labels (Experiment 3).

Bar-Anan et al., 2007). One hundred and twenty words and their corresponding pictures were selected based on high familiarity, high imaginability, low arousal, and neutral valence, drawn from German word norms (Lahl, Goritz, Pietrowsky, & Rosenberg, 2009). The size of the pictures during study phase was either 4.5 cm by 4.5 cm (100%) or 2.71 cm by 2.71 cm (60%). The size of the pictures during test was 4.5 cm by 4.5 cm. Words were presented in Times New Roman, 25 pt (100%) or 15 pt (60%) during study, and 25 pt during test. The stimuli were generated by a PC and presented on a monitor set at a resolution of 1024 × 768 pixels at 60 Hz.

Procedure. During the study phase, participants viewed 40 items presented one at a time, half pictures and half words, for 1000 ms each. Within each medium condition, half of the items were presented in a proximal location, and the other half in a distal location. Items' presentation medium and location were counterbalanced across participants. Moreover, distal items were presented as 60% of the size of proximal items for half of the participants, and 100% for the other half. Participants classified each item as "near" or "far." Incorrectly classified or omitted items were excluded from subsequent analyses (18.7% of responses). Next, participants completed a Sudoku (numerical) puzzle for 15 min. Finally, participants saw the 40 old items plus 80 new items (half pictures, half words), one at a time, in random order, and made old/new judgments. Old items were presented in the same medium that they were learned. Incorrectly classified or omitted items during study were excluded from subsequent analyses (15.7% of responses). During test, responses outside of the allotted response window (1000 ms) were recorded as errors (5.1% of responses).

Results

Recognition was better for congruent combinations of medium and distance (proximal pictures and distal words) than for incongruent combinations

The results are presented in Fig. 4C. The main analysis focused on the accuracy of recognition during the test phase. That is, analyzing hit rates ("old" responses to "old" stimuli) while controlling for false alarm rates ("old" response to "new" stimuli, see Snodgrass & Corwin, 1988) (Table 2). We used the distance classification task during study as a manipulation check, and analyzed only the correctly classified items.

Data from one participant who correctly classified only 5% of the items during study and four whose overall accuracy during test fell below chance level were excluded. For the remaining 43 participants, hits for old items that were correctly classified during study were analyzed using a mixed logit model, using a similar analysis strategy as in Experiment 1 (here, additional fixed effects were coded for retinal size and participant-level false alarm rates). That is, compared to the baseline model that only contained a by-participant random intercept, the data did not justify the inclusion of a by-item random intercept, $\chi^2(1) = 0.44$, $p = .51$, but the predicted congruency-contrast (coded 1 0, for proximal pictures and distal words vs. distal pictures and proximal words, respectively), $\chi^2(1) = 7.02$, $p = .008$. Moreover, it was justified to include a fixed effect for participant-level false alarm rates (aggregated separately for pictures and words), $\chi^2(1) = 4.41$, $p = .04$, and a fixed effect for medium (coded 1 0, for pictures vs. words, respectively), $\chi^2(1) = 50.92$, $p < .001$. However, model fit did not improve by including a medium ∗ congruency interaction, $\chi^2(1) = 0.12$, $p = .73$, a fixed effect for distance (coded 1 0, for proximal vs. distal, respectively), $\chi^2(1) = 0.12$, $p = .73$, or a fixed effect for retinal size

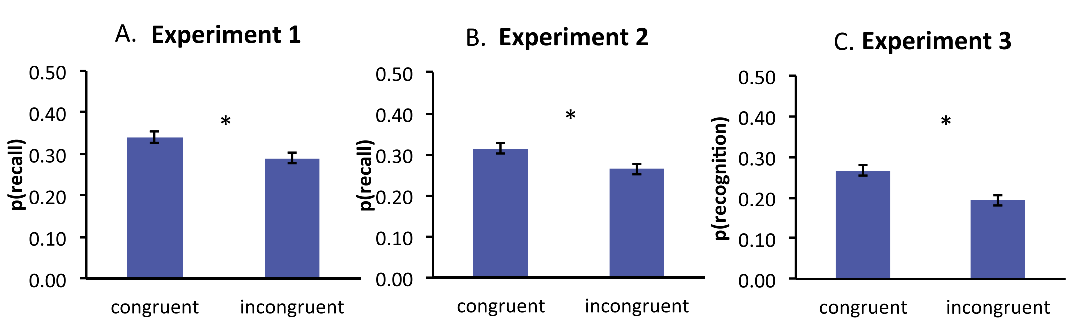

Fig. 4. Proportion of accurate recall (A: Experiment 1 and 4B: Experiment 2) and recognition accuracy (hits – false alarms, C: Experiment 3) with standard errors as a function of congruency between medium and distance.

Table 1
Recall rates (Experiments 1 & 2) and recognition accuracy (Experiment 3) as a function of medium and distance (standard deviations in parentheses).

	Experiment 1		Experiment 2		Experiment 3	
	Pictures	Word	Pictures	Word	Pictures	Word
Proximal	.41 (.17)	.27 (.17)	.41 (.15)	.20 (.13)	.37 (.26)	.08 (.17)
Distal	.33 (.18)	.29 (.18)	.33 (.15)	.21 (.11)	.32 (.23)	.17 (.20)

(coded 1 0, for identical retinal vs. perceived size, respectively), $\chi^2(1) = 3.27$, $p = .07$.

As expected, the final model thus revealed improved recognition performance for pictures compared to words, $\beta = 0.87$, $SE = 0.12$, $z = 7.02$, $p < .001$, a positive relation between hits and false alarms (thus controlling for response biases), $\beta = 2.91$, $SE = 0.57$, $z = 5.14$, $p < .001$, as well as the predicted improved performance when medium and distance were congruent, $\beta = 0.28$, $SE = 0.11$, $z = 2.54$, $p = .01$.

General discussion

The current research shows that there is a mnemonic advantage for congruent combinations of distance and medium (i.e., psychologically proximal entities represented visually and psychologically distal entities represented verbally) than incongruent combinations. Our results converge across two distance dimensions (temporal and spatial) and two measures of memory (recall and recognition). In Experiments 1 and 2, we used a recall task and found that memory for congruent combinations of medium and distance produces better recall than incongruent combinations. In Experiment 3 we switched to a recognition task, which allowed for the to-be-remembered information to appear in the same medium during encoding and at test. We found again that memory for congruent combinations of medium and distance produces better recognition than incongruent combinations. Critically, in all three experiments the objective time lag between learning and retrieval was kept constant across psychological distance conditions, and what changed was only the perceived distance between the individual and the target entity. These findings lend support to the idea that episodic memory is not an automatic recording device but rather a tool, which serves the needs and goals (conscious or not; Amit et al., 2013) of the individual (e.g., Buckner & Carroll, 2007; Morris, Bransford, & Franks, 1977; Nairne, & Pandeirada, 2016). In particular, the mental architecture of the memory system is designed in an efficient way to prospect about the future, using different cognitive devices for different needs.

More broadly, the current study points to the lingering effect of psychological distance on behavior. Past studies have shown that psychological distance affects immediate experiences and behavior (e.g., Amit et al., 2009; Mobbs et al., 2007; Trope & Liberman, 2010). However, our immediate experiences often become relevant at a later point in time. Our study shows that the distinct effect of psychological distance (whether temporal, geographical, or other dimensions of distance) on memory arises even after significant time has passed between the original experience and the moment when this experience becomes relevant to think about again.

This latter conclusion is consistent with prior work that showed the effect of psychological distance on memory using related forms of abstraction. In research that explored the effect of social power on abstraction processes, Smith and Trope (2006; Experiment 4) showed that priming high power distance led to increased false memories of gist words. Similarly, Rim, Uleman, and Trope (2009; Experiments 1 and 2) used the false recognition paradigm to demonstrate that spatial and temporal distance (vs. proximity) led people to falsely remember that they had seen a general trait word that describes a target person, when in fact they read about more concrete behaviors that implied that trait. These experiments provide initial evidence that psychological distance affects memory through various forms of abstraction. A more thorough exploration of this idea awaits future research.

In Experiment 1, different stimuli were used for the proximal and distal conditions, and our pretest showed that the proximal and distal items differ in familiarity. Could differences in familiarity account for the effects we observed in Experiments 1? Our analyses suggest that is not the case. First, all of our stimuli – both proximal and distal – were highly familiar, as shown in their ratings and in the descriptions subjects gave to the verbal and pictorial items, which reached ceiling in accuracy. In addition, the correlations between recall and familiarity ratings indicates that familiar items were not recalled more than unfamiliar items, perhaps due to the ceiling effect in familiarity that was observed in the pretest. Moreover, it was not justified to add familiarity to the mixed model, neither as a main effect of recall nor as a moderator of the effect of congruency on recall. Finally, in Experiment 2 we controlled for familiarity by using the exact same items for the near and distal conditions. Together, our analysis and converging evidence across experiments suggests that familiarity cannot serve as an alternative explanation for our results.

It is worth noting that we did not predict nor find that memory generally gets worse with psychological distance. Although we would expect psychological distance to increase as time goes by and thus affect memory for visual and verbal representations differentially, psychological distance can be (and was) manipulated independently from the objective time lag in the current experiments. Specifically, we manipulated psychological distance without confounding additional factors associated with the passage of time. Consistent with this reasoning, psychological distance did not exert a main effect on either recall or recognition performance in any of the three experiments, as indicated by the fact that including distance in the models did not result in improvements in model fit; psychological distance only exerted an effect in combination with the medium of the presented information.

Recent approaches to memory suggest that the operating characteristics of memory are influenced by fitness-relevant processing and fitness-relevant stimuli (Nairne & Pandeirada, 2008; Nairne et al., 2017; Nairne, & Pandeirada, 2016). From an evolutionary and developmental perspective it is intriguing to consider the mutual emergence of language and the growing need to traverse psychological distance as a way

Table 2
Mean hit and false alarm rates (standard deviations in parentheses) for pictures and words of Experiment 3.

Hit rates				False alarm rates	
Pictures		*Words*		*Pictures*	*Words*
Near	*Far*	*Near*	*Far*		
.58 (.23)	.54 (.22)	.39 (.24)	.47 (.26)	.22 (.13)	.31 (.14)

to improve fitness. Our ancestors, young children, and non-human primates react to challenges they perceive in their immediate surroundings, such as a snake in the forest, a toy that is just slightly out of reach, or a bottle of milk that signals that lunch is about to start. These objects are spatially and temporally close to the individual. Visual memories are well suited to address those immediate challenges. Imagine, for example, one of our ancestors going to hunt in the forest one morning and seeing a snake. If the following hunting trip is to take place in the immediate or very near future, then remembering as many visual details as possible might be helpful in order to anticipate where the snake could be and plan how to avoid it or fight it. This detailed visual memory would be of less use if the following hunting trip was to take place in the distant future, as many things can change in the meantime.

With few exceptions, unlike our ancestors, young infants, and non-human primates, the modern adult human often needs to address remote challenges. Notably, the emergence of language paralleled the growing need to address those remote objects and events, and potentially it is what enabled the adult human to develop the skill of mental travel and to prospect about other times and places (Amit, Wakslak, & Trope, 2013). It would have been useful for our more recent ancestors to remember that "the mammoths pass next to the river in their annual winter migration."

Finally, an intriguing question that is left open is what is the mechanism that makes congruency on the representational format emphasized by the memory system (as a consequence of psychological distance) and the information present in the stimuli (as a consequence of their modality) beneficial for memory. One possibility is that during encoding the psychological distance of the target creates a metacognitive expectation, conscious or not, for future usability of a particular type of information (visual, verbal). This metacognitive expectation emphasizes relatively more visual information of proximal stimuli and relatively more verbal information of distal stimuli and encourages more encoding of congruent versus incongruent information, that ultimately results in mnemonic advantage for congruent (vs. incongruent) representations.[5] For example, imagine you are visiting a certain city for the first time. The metacognitive expectation that you will visit the art museum at a remote time during your vacation might encourage you to encode the verbal directions from your guidebook on how to get there. But when time comes and you are about to leave the hotel in order to get to the museum, it might be more efficient to encode a visual map of the path, to get a better sense of the nature of the path (e.g., sharp vs. wide curve) and learn about visual landmarks (e.g., a park) that could help you recognize your location and confirm you are in the right place.

A complementary explanation revolves around retrieval, rather than encoding. Here, the psychological distance of the individual from a target creates a need to retrieve a particular type of information (visual, verbal). This need emphasizes visual or verbal information that is already stored in memory and facilitates its recall or recognition. This idea is consistent with the approach that memory enables prospection through mental simulation (e.g., Buckner & Carroll, 2007; Schacter, Addis, & Buckner, 2008; Suddendorf & Corballis, 1997). For instance, before entering a dangerous intersection, it may be useful to run a mental simulation of crossing it using past visual memories. However, when planning a trip, a verbal recollection (e.g., "there is a dangerous intersection near Boston") might be more useful. These two possibilities are not mutually exclusive and await future research. In both, the adaptive relationship between congruent (vs. incongruent) combinations of medium and distance might be overgeneralized to situations in which it is no longer relevant, as in our experiments (Trope & Liberman, 2003).

Acknowledgements

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Appendix A

Task manipulation check for Experiment 2 shows the manipulation was effective

Past research provides strong evidence that people perceive distance automatically, without being explicitly asked to pay attention to this aspect of the stimulus (e.g., Amit et al., 2009). The literature also provides a rationale for the automatic nature of distance processing, embedded in the evolutionary advantage it provides to one's survival (Parkinson, Liu, and Wheatley, 2014; Tamir & Mitchell, 2013; Trope & Liberman, 2010). We nevertheless saw a benefit to providing empirical evidence that distance was processed along with processing of the stimuli in the current research (Fig. A1). As in the main study, we told all participants (N = 30, 14 female, 16 male, M_{age} = 27.93, SD_{age} = 1.99) that we were trying to replicate two studies, one conducted in the 1980s and one from last week, and that they would be shown the same instructions and materials that were generated during each experiment. In the first phase of the experiment, participants were asked to do two mindset tasks – one of thinking about a person's life in the 1980s and one of thinking about a person's life last week. Each mindset task was immediately followed by viewing 10 items (5 pictures, 5 verbal labels) that were supposedly used in the "1980's" experiment or the "last week" experiment, respectively. The items were presented in random order. We counterbalanced the order of presentation of the two mindset tasks and the medium of presentation of items across subjects. To counterbalance medium of items, we created two sets where the items that appeared as pictures in Set 1 appeared as words in Set 2 and those that appeared as words in Set 2 appeared as pictures in Set 1. In the second phase of the experiment, all participants saw all items from both the "1980s" and "last week" experiments in random order and were asked to indicate for each item how close or distant in time the item felt to him/her, on a 0 (very distant, 1980 s) to 100 (very close, last week) scale. Consistent with work using similar subjective measures of temporal distance (e.g., Rim, Hansen, & Trope, 2013; Wakslak, 2012), we told them that there were no correct answers and that we were just interested in their subjective judgments.

As expected, a 2 (distance: 1980s vs. last week) × 2 (medium: pictures vs. words) repeated-measures ANOVA of the proximity ratings revealed only a main effect for distance, $F(1, 29) = 11.16$, $p = .002$, $\eta^2 = .28$, all other Fs $< .1.4$, $ps > .25$. Items in the last week-condition were rated as more proximal ($M = 71.43$, $SD = 15.45$) than items in the 1980s-condition ($M = 52.54$, $SD = 27.75$). Thus, this provides empirical evidence that the stimuli were indeed associated with greater temporal distance when they were supposedly taken from a study conducted in the 1980s versus last week (see Fig. A1).

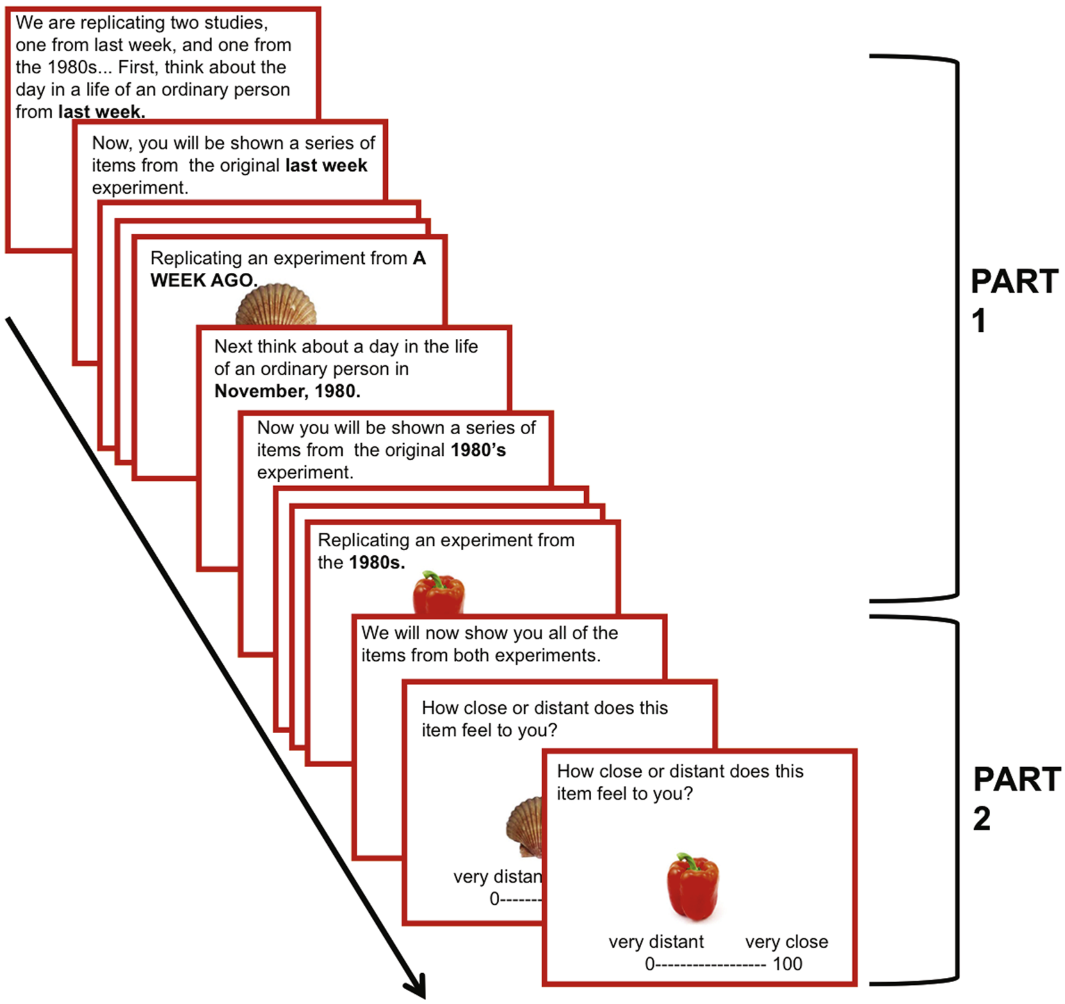

Fig. A1. Manipulation check for Experiment 2. Medium (picture and word) and temporal distance (last week and 1980s) were manipulated within-subjects. We counterbalanced the order of the two time-frames and the medium of presentation of items. In **Part 1**, participants completed the distance mindset tasks – one to think about the 1980s and the other to think about last week – and then immediately viewed 10 items that were supposedly related to the 1980s experiment or the last week experiment, respectively. In **Part 2**, all 20 items were shown in random order and participants indicated their subjective feeling of temporal distance to the items.

Appendix B

See Table 1.

C. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jml.2019.01.001.

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[5] Note that as we said before, by no mean to we argue that visual and verbal memories are mutually exclusive. Rather, we refer to the effect of distance on representational format as a matter of relative weight of a particular type of information, given how distant the target is.

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