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Automatic Processing of Psychological Distance: Evidence from a Stroop Task

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Abstract

A picture-word version of the Stroop task was used to test the automatic activation of words carrying various senses of psychological distance: temporal (tomorrow, in a year), social (friend, enemy), and hypotheticality (sure, maybe). The pictures implied depth with the words appearing relatively close or distant from the observer. The participants classified the spatial distance of words faster when the word's implicit psychological distance matched their spatial distance (e.g., a geographically close word was classified faster when it was 'friend' than when it was 'enemy'). The findings are consistent with the notion that psychological distance is accessed automatically, even when it is not directly related to people's current goals, and suggest that psychological distance is an important dimension of meaning, common to spatial distance, temporal distance, social distance, and hypotheticality.

Keywords

Construal level; word-picture Stroop paradigm; psychological distance; automatic activation

Consider the four contrasts: here – there, tomorrow – in a year, we – others, and certain – maybe. What do these four pairs have in common? According to Construal Level Theory (CLT, Liberman, Trope & Stephan, in press; Trope & Liberman, 2003), each of these pairs forms a continuum that denotes a different dimension of psychological distance. Psychological distance refers to the distance of a stimulus (object or event) from the perceiver's direct experience. The four dimensions are: (1) spatial – how distal in space is the stimulus from the perceiver; (2) temporal – how much time (past or future) separates the perceiver's present time and the target event; (3) social – how distinct is a social object from the perceiver's self (e.g., self vs. others, friend vs. stranger) and (4) hypotheticality – how likely is the target event to happen (or an object to exist), or how close it is to the perceiver's reality. According to CLT, values on these dimensions are related to psychological distance and thus have a shared meaning. The present research investigates whether this shared meaning is automatically accessed when people encounter values on these dimensions (e.g., whether the stimulus "tomorrow" activates meaning of psychological proximity).

CLT contends that spatial distance, temporal distance, social distance, and hypothetically are different manifestations of a similar underlying meaning, psychological distance. Distancing a target along any of these dimensions increases the gap between the target and the perceiver's direct experience. A maximally proximal target would be at the zero point of the four dimensions – it would be located *here*, occur *now*, pertain to the *self*, and exist in *reality*. In other words, direct experience, which is the reality of me, here and now, is the common zero point of all dimensions of psychological distance.

Psychological distance is related to the way people think about stimuli because the distance between the stimulus and the perceiver's direct experience affects the perceiver's construal of the stimulus. As stimuli become more distant on any of these dimensions, the amount of sensory information and concrete knowledge about them tend to diminish. Consequently, the perceiver's construal of psychologically distal targets requires higher-level, more abstract mental representations. For example, at this moment you are reading a paper. You probably possess a great amount of concrete knowledge about this event: How does the paper look, what is the shape of the paper, the immediate surroundings (e.g., the light in the room), or how this action makes you feel. However, as the psychological distance between the perceiver and the event increases, the amount of concrete knowledge tends to decrease. Thus, you would probably know much less about the event if you were thinking about reading a paper a year from now (temporally distant target), if you were thinking about reading the paper in a different country (spatially distant target), if you were thinking about a stranger who reads this paper (socially distant target), or if you were thinking about reading a scientific paper printed in magic ink (a highly hypothetical target). In all these examples, you will need to resort to high level, schematic knowledge to construe more distal events or objects.

Although people usually have less concrete knowledge about more psychologically distant targets, this rule has many exceptions. For example, sometimes people are equally familiar with their siblings and their distant acquaintances. We might, occasionally, know much more about events that are distal in time or space than about more proximal events, and people often know more about imaginary objects than about real ones. Nevertheless, CLT maintains that people tend to use high level construals when they think of distant stimuli and low level construals when they think of proximal stimuli, even if the amount of available knowledge about the stimuli is similar. In other words, CLT proposes that people tend to adjust the level of construal according to the psychological distance of stimuli, even when the available information about the stimuli does not favor one construal level over another (see Liberman, Trope & Stephan, in press, for a review).

Psychological distance is implicated as a fundamental processing principle guiding human cognition and action. Distance from the observer can be expressed in various ways (temporal, spatial, social, or hypothetical). However, regardless of the carrier of distance information, it has similar effects on construal. Stimuli removed from the self are processed in a qualitatively different fashion than those near or at the self. Various features of the physical environment – spatial, temporal, social, or hypothetical – activate the core psychological construct of psychological distance. Virtually all stimuli in people's perceptual milieu are embedded in a certain distance relation to the (observing) self. Inevitably, psychological distance is activated and the appropriate mode of cognition ensues. Given the all-engulfing nature of psychological distance, it is likely activated in virtually every act of perception and judgment in an automatic, often unconscious, fashion. This applies to the values of all four dimensions of distance; for all their surface differences (after all, there does not seem to be a great deal of similarity between "certain" and "we", for example), these values are perceived similarly in terms of the implied or implicit

psychological distance. Therefore, a central hypothesis tested in this work states that the various carriers of distance convey common information and meaning.

The goal of this research is two-fold. First, we tested the prediction that psychological distance is automatically activated even in cases in which it is completely unrelated to the task at hand and can even impede performance. Second, we tested the prediction that all representations of psychological distance produce the same pattern of responding. We demonstrate that cues that pertain to temporal distance, social distance, or hypotheticality can affect and be affected by people's processing of the spatial location of a target stimulus in systematic and predictable ways.

Our experimental tool was the picture-word version of the Stroop task (e.g., Ariei & Algom, 2002; Shaki & Algom, 2002; see Melara & Algom, 2003, for a recent review and a theory of the Stroop phenomenon). The Stroop effect (Stroop, 1935) is psychology's classic measure to test the selectivity of attention (indeed, its failure), to a relevant aspect of the stimulus. When naming the print color in which color words are printed, people are affected by the meaning of the carrier words (although reading words is not similarly hindered by irrelevant print colors). Word reading cannot be suppressed even when irrelevant to the task at hand given its automatic activation upon exposure to the stimulus. We should mention, however, that under certain circumstances a reverse Stroop effect is routinely observed by which print color intrudes on words more than vice versa (Algom, Dekel, & Pansky, 1996; Melara & Mounts, 1993; see Stroop, 1935, Experiment 3 for the first demonstration of the reverse Stroop effect).

A popular extension of the Stroop task entails the replacement of the original attribute of print color by a picture (see MacLeod, 1991, for a review). A word (not one of color) is embedded inside a line drawing, and the observer's task is to name the picture or to name (read) the word. The typical result in the picture-word naming task reproduces that obtained with the original stimuli: Words are named faster than pictures, and they interfere with naming the pictures more than do pictures with reading the words. However, this pattern reverses when the task changes to one of categorization (Smith & Magee, 1980). Pictures are categorized faster than words and interfere with the latter more than vice versa.

The extension of the Stroop task from the original color-word compounds to the popular picture-word compounds is by no mean straightforward. Print color is a physical dimension, whereas picture is a semantic dimension (i.e., represents a referent object just like a word does). Consequently, pictures invite various semantic tasks, not merely naming. Tasks such as categorization (Ariei & Algom, 2002; Smith & Magee 1980) are capable of tapping picture activation even in cases in which pictures are irrelevant to the task at hand and can hurt performance.

In this study, we developed a unique version of the picture-word task. The observer responded to the embedded word only. The picture served to create depth and convey various amounts of distance (of the word) from the observer. A word appeared on the background of the picture, located either near or farther away from the observer. We used two tasks with respect to the target word: naming and distance classification. It is important to realize that the words themselves were not words related to distance in any usual dictionary sense. On the surface, the words and their locations did not form Stroop-like stimuli (e.g., the combinations of the words "maybe" with long distance does not, *prime facia*, seem more or less congruent than, say, the word "sure" with long distance). Such stimuli do not usually fall into congruent and incongruent classes. They only did so in terms of CLT, which maintains that any concept along the four dimensions carries an underlying meaning associated with psychological distance from the observer.

To appreciate the experimental task, look at the four panels of Figure 1. In each panel, a word is embedded in a picture of a landscape, and your task is to indicate, while timed, whether the word is near or far. Because (a) you can ignore the word itself, and (b) the words are irrelevant to the task at hand, as well as (c) there is not an apparent association between the meanings of the words and your task anyway, there is no compelling reason to expect a difference in performance across the four panels. CLT does predict a difference. According to CLT, panels A and D depict congruent stimuli and panels B and C depict incongruent stimuli, so that performance should be better in the former than in the latter. The present research examines this prediction as well as the reverse one: Naming the words that carry various senses of psychological distance is affected by their spatial location.

To enable reaping the full theoretical gains from the present examination, two preliminary yet critically important conditions must be met. First, one should establish that the current setup yields the ordinary Stroop effect under standard preparation. Presenting the explicit words of distance, “near” and “far,” at different spatial distance creates standard Stroop stimuli (i.e., combinations that naturally divide into congruent and incongruent classes). It is equally important to establish that presenting just any two words within those landscapes does not yield a Stroop effect. Experiments 1-2 and 7-8 were planned to satisfy these indispensable conditions.

Overview of the Experiments

The same procedure was used in a series of 13 experiments. Each entailed a set of landscape pictures with a word embedded within each picture. The words could appear either in a proximal position or in a distant position from the observer. A pair of words conveying CLT-distance defined an experiment. Each word in the pair appeared within each of the pictures in each of the two spatial locations. In part I the participant’s task was speeded classification of distance. The pair of words conveyed temporal distance (Experiment 3), social distance (Experiments 4-5), or hypotheticality (Experiment 6). In part II, the participant’s task changed to that of classifying the words themselves, rather than their distance. The pairs of words conveyed temporal distance (Experiment 9), social distance (Experiments 10-11), or hypotheticality (Experiments 12-13).

Part I: How Near and Far is the Word from the Observer?

Experiments 1-2—The first experiment examined whether classifying distance of words that are related to distance themselves is affected by the words’ meaning. Stimuli appeared on a picture with clear depth cues (e.g., a picture of an alley of trees), ensuring clear discrimination between spatially proximal and distal stimuli in the picture. Participants indicated whether the target stimulus appearing within the pictures was near or far. The two target words were “near” and “far.” Participants were instructed to focus only on the location of the target word and ignore its meaning. On congruent trials, the meaning of the word matched its distance (e.g., the word “near” in a proximal position). On incongruent trials, location and meaning mismatched. We expected faster responses on congruent trials than on incongruent trials.

The second experiment sought to rule out the possibility that just any pair of words would yield similar Stroop effect. Therefore, in the second experiment we used the words “nail” and “screw” as targets. Neither CLT nor Stroop theory predicts a differential effect of word on distance classification under this preparation.

Method

Participants: Ten introductory psychology undergraduates participated in Experiment 1 (6 women, 4 men) and 13 (10 women, 3 men) participated in Experiment 2 in exchange for course credit. All were native Hebrew speakers. There were no gender effects in any of the results of these and subsequent experiments.

Materials: Experiment 1 used 16 color images. We found the images on the internet, through Google's Images search tool. We selected images that conveyed a clear depth perception, so that participants would be able to easily report the spatial location of an object on the picture. These were scenery pictures of alleys with trees, rolling hills, or roads. Superimposed in each of these 16 images was a green arrow pointing to a certain location in the picture. We made two versions of each image, one with an arrow that pointed to a relatively distal location, and one with an arrow that pointed to a relatively proximal location. The printed word appeared inside the arrow, in black ("courier new" font). The font size of the words was 24 when they were printed on a spatially proximal arrow and 18 when they were printed on a spatially distal arrow. The words were either "near" or "far." The words were written in Hebrew and were 4 letters each. Each of the 32 images (16 images X 2 spatial locations) was presented with each of the words, thus creating a total of 64 stimuli. See Figure 1 again for an illustration of the makeup of the stimuli. Experiment 2 used the same 64 stimuli, with a single notable exception: The words "far" and "near" were replaced with "nail" and "screw" (in Hebrew).

Apparatus: Displays were generated by a computer attached to a 19" TFT monitor, using 1152 × 864 resolution graphics mode. Responses were collected via the computer keyboard. Participants viewed this display from a distance of about 50 cm and gave left responses with left forefinger (using the D key) and right responses with right forefinger (using the J key).

Procedure & Design: Participants performed the task in individual cubicles. Each participant was first presented with an example – one of the 64 possible stimuli selected randomly for each participant. Participants were informed that they would next see similar images with clear depth perspective and with similar green arrows pointing to either a proximal or a distal location in the image. Participants were requested to respond according to the location of the arrow. Half of the participants were requested to respond with a left response to indicate proximal spatial location and with a right response to indicate distant spatial location. The responses were reversed for the other half of the participants. It was made clear to the participants that they would probably have no problem in discriminating between proximal and distal locations, because proximal arrows were always very close to the most proximal location in the image, and distal arrows were always very close to the most distal location in the image. Participants were informed that the words, printed on the arrows, were irrelevant to the current task. The stimuli remained on the screen until the participant responded. The intertrial interval between participant's press and the display of the next stimulus was 500-msec. Error trials were followed by a 500-msec feedback beep. Stimuli were selected randomly. Each of the 64 stimuli (16 images X 2 locations X 2 words) appeared two times. Thus, there were a total of 128 trials for each participant.

Results and Discussion: The mean reaction time in all four conditions (Word x Distance) for each experiment are presented in Table 1. The graphs in Figure 2 illustrate the difference between congruent and incongruent trials for each experiment.

Experiment 1: The first 10 trials of each participant were ignored in the analyses. Reaction times (RT) exceeding the mean of all correct responses by more than 3 standard deviations were excluded. The same procedure was repeated in all subsequent experiments, and

resulted in the removal of less than 1% of all observations in each experiment. In all reaction time analyses, error trials (less than 3% of all trials) were excluded. We conducted a within participants ANOVA with spatial location (proximal, distal) and word type (“near,” “far”) as independent variables¹.

The interaction of Distance and Word, $F(1, 9) = 25.07$, $p < .001$, $\eta^2 = .73$, documented the presence of an appreciable Stroop effect in the data. Our participants classified distance faster when it matched the word’s meaning (mean of 715 ms for congruent trials), than when distance and word mismatched (mean of 750 ms for incongruent trials). The Stroop effect amounted to 35 ms.

Experiment 2: The critical term to examine is again that of Word x Distance. Notably, the interaction was not present in the data ($F < 1$). We did not detect differences in performance with the word as a function of distance.

Experiment 1 demonstrated that distance words that were irrelevant to a distance discrimination task nonetheless affect performance. When the arrow pointed to a relatively proximal location, participants responded faster when the word was “near” than when the word was “far.” When the arrow pointed to a relatively distal location, participants responded faster when the word was “far” than when the word was “near.”

In Experiment 2, we did not find an interaction between words unrelated to distance and judgments of distance. The standard Stroop effect obtained in Experiment 1, but no Stroop obtained in Experiment 2. These experiments set the stage for the experiments that would test our main question of interest: Would the semantic meaning of words that denote social distance, temporal distance and hypotheticality interfere with (or facilitate) distance discrimination of that words?

Experiments 3-6—In the next 4 experiments, we tested pairs of words that denote proximity or distance on social, temporal, and hypothetical dimensions, and thus, according to CLT, share meaning with spatial distance. In experiment 3, which tested the temporal dimension, the two words were “tomorrow” (proximal entity) and “year” (distal entity). In Experiment 4, which tested the social dimension, the two words were “friend” (proximal entity) and “enemy” (distal entity). In order to rule out valence as an alternative explanation for a Stroop effect in Experiment 4 (people prefer friends to be near and enemies far), Experiment 5 used another pair of words related to social distance, “we” (proximal entity) and “others” (distal entity). In Experiment 6, which tested the dimension of hypotheticality, the words were “sure” (proximal entity) and “maybe” (distal entity). We predicted that in each of these experiments, participants would respond faster to congruent trials – trials in which psychological distance matched spatial distance, than to incongruent trials – trials in which psychological distance mismatched spatial distance.

Method

Participants: Eighteen introductory psychology undergraduates participated in Experiment 3 (11 women, 7 men), 13 (10 women, 3 men) participated in Experiment 4, 15 in Experiment 5 (10 women, 5 men) and 12 (10 women, 2 men) in Experiment 6. All participants participated in exchange for course credit. All were native Hebrew speakers.

¹Main effects of word and spatial location are irrelevant to the present research, and we do not report them in detail. We found a main effect of spatial location in Experiments 1-6, indicating faster response to spatially proximal words. No main effect for word was found in Experiments 1-6.

Materials, Design, Apparatus and Procedure: The materials were the same as in Experiment 1, except for the two printed words in each experiment. The words in Experiment 3 the Hebrew words for “tomorrow” and “year”; the words in Experiment 4 were the Hebrew words for “friend” and “enemy”; the words in Experiment 5 were the Hebrew words for “we” and “others”; the words in Experiment 6 were the Hebrew words for “sure” and “maybe.” The apparatus, procedure and design were the same as in Experiment 1.

Results and Discussion

Experiment 3: The results revealed a Stroop effect engendered by the words associated with temporal distance. The Word x Distance interaction, $F(1, 17) = 13.12$, $p < .01$, $\eta^2 = .44$, documented faster distance response to congruent (mean of 622 msec) than to incongruent (mean of 637 msec) combinations

Experiment 4: As predicted, words associated with social distance also engendered a Stroop effect. The Word x Distance interaction, $F(1, 12) = 19.53$, $p < .001$, $\eta^2 = .62$, documented faster distance response to congruent (mean of 649 msec) than to incongruent (mean of 663 msec) combinations.

Experiment 5: Again, the results revealed a Stroop effect engendered by words associated with social distance. The Word x Distance interaction, $F(1, 14) = 22.81$, $p < .001$, $\eta^2 = .62$, documented faster distance response to congruent (mean of 640 msec) than to incongruent (mean of 652 msec) combinations.

Experiment 6: Words related to hypotheticality also led to results that reveal the predicted Stroop effect. The Word x Distance interaction, $F(1, 11) = 8.46$, $p < .05$, $\eta^2 = .43$, documented faster distance response to congruent (mean of 627 msec) than to incongruent (mean of 643 msec) combinations.

Experiments 3-6 demonstrated that words related to psychological distance affect decisions with respect to the spatial distance of the words. These words intruded on spatial distance despite the fact that they were irrelevant to the task at hand and are not explicitly associated with spatial distance. The results are consistent with the assumption, suggested by CLT, that psychological distance is a common meaning which spatial distance shares with temporal distance, social distance and hypotheticality.

Part II: Classifying the Meaning of Words Presented at Various Distances from the Observer

Experiments 3-6 demonstrated the automatic activation of psychological distance by words associated with different dimensions of psychological distance. Our goal was to demonstrate that psychological distance is activated to affect perception and action even when distance is implicit and unrelated to the task at hand. Is the reverse activation also presented? Does the spatial position in which a word appears influences the perception of the word? Of course, the activation in question is confined to CLT-uncovered words denoting various senses of distance from the self. Would participants process spatial cues when asked to classify words associated with temporal distance, social distance, or hypotheticality?

Because all respects of distance are closely associated according to CLT, responding to one activates all. Classifying words that convey temporal distance, therefore, activates other notions of distance, notable, spatial distance. Consequently, classification of words conveying psychological distance is bound to be affected by spatial distance. Therefore, in the next part of our study, we set to demonstrate that Stroop-like effects can be obtained

when the words serve as the to-be-attended stimuli (and their spatial distance is the task-irrelevant attribute).

In part II, we repeated the previous experiments with a single notable exception: Participants were instructed to respond to the words and ignore their spatial distance. To set the stage for these experiments, we first established that the effect is engendered by the classification of distance words and distance words only. Experiments 7 and 8, thus, parallel Experiments 1 and 2. They show that Stroop effect is obtained with words that explicitly mean distance (near, far), but that no effect is obtained with words unrelated to distance.

Experiments 7-8—Experiments 7 and 8 assessed the effect of spatial distance on the classification of words. Experiments 7 examined whether classification of words related to spatial distance (“near” and “far”) is affected by their spatial distance on a landscape. Presented with the same pictures as in previous experiments, participants were instructed to focus on the word and ignore its position. We expected participants to perform faster on congruent trials (e.g., the word “near” in proximal position) than on incongruent trials (e.g., the word “near” in distal position). Experiment 8 sought to rule out the possibility that just any pair of words would yield a similar Stroop effect. In Experiment 8 we used the words “nail” and “screw” as targets.

Method

Participants: Ten introductory psychology undergraduates participated in Experiment 7 (All women), and 13 (8 women, 5 men) participated in Experiment 8 in exchange for course credit. All were native Hebrew speakers.

Materials, Design, Apparatus and Procedure: The materials and procedure in Experiment 7 were the same as in Experiment 1, except that the instructions did not refer to the depth perspective of the images, but rather to the words themselves. Specifically, after viewing the exemplar image, participants were informed that they would see similar images, all with a target word printed on a green arrow. The participants were asked to respond to the presented word by pressing the key that was allocated to represent that word. Participants were informed that the spatial location of the words was irrelevant to the task at hand. The design and apparatus were the same as in Experiment 1. Experiment 8 was identical to Experiment 7, with the exception that the words were “nail” and “screw.”

Results and Discussion

Experiment 7: The interaction of Word and Distance, $F(1, 9) = 8.55$, $p < .05$, $\eta^2 = .49$, documented the presence of an appreciable Stroop effect in the data². Our participants classified the words “near” and “far” faster when the word’s meaning matched its spatial distance (mean of 685 ms for congruent trials) than when word’s meaning and distance mismatched (mean of 713 ms for incongruent trials). This Stroop effect amounted to 28 ms.

Experiment 8: The critical effect to examine was again the interaction of Word x Distance. This interaction was not present in the data ($F < 1$). We did not detect differences in performance with word identification as a function of distance. Therefore, there was absolutely no effect when the words “nail and “screw” were presented.

²Main effects of word and spatial location are irrelevant to the present research, and we do not report them in detail. We found a main effect of word in Experiments 7-9, indicating faster response to the words “near” than to the words “far” (Experiment 7), to the word “nail” than to the word “screw” (Experiment 8) and to the word “year” than to the word “tomorrow” (Experiment 9). There was no main effect for word in Experiments 10-13. No main effect for spatial location was found in the Experiment 7-13, excluding Experiment 8, in which faster response was documented when the word was spatially near.

Experiment 7 demonstrated that the irrelevant location of distance words affected the speed with which they were classified for content. When the arrow pointed to a relatively proximal location, participants classified the word “near” faster than the word “far.” When the arrow pointed to a relatively distal location, participants classified the word “far” faster than the word “near.” In Experiment 8, classification of words unrelated to distance was not affected by their distance.

These experiments set the stage for the experiments that would test our question of interest: Does the spatial position of words conveying psychological distance (temporal, social and level of hypothetically) affect their classification?

Experiments 9-13—In the final 5 experiments, we tested whether spatial distance affects the classification of words that denote proximity or distance on temporal, social, or hypothetical dimensions. In each pair, one of the words denoted psychological proximity, whereas the other denoted psychological distance. Experiment 9-12 used the same stimuli as Experiments 3-6. Experiment 13 used new stimuli words, related to hypotheticality. We predicted that in each of these experiments, participants will respond faster to congruent trials (when the word’s meaning and its distance match) than to incongruent trials (when the word’s meaning and its distance mismatch).

Method

Participants: Sixteen introductory psychology undergraduates participated in Experiment 9 (12 women, 4 men), 13 (9 women, 4 men) participated in Experiment 10, 14 in Experiment 11 (8 women, 6 men), 10 (9 women, 1 men) in Experiment 12, and 14 participants (7 women, 7 men) participated in Experiment 13. All participants participated in exchange for course credit. All were native Hebrew speakers.

Materials, Design, Apparatus and Procedure: The materials were the same as in Experiment 1, except for the two printed words in each experiment. The words were all in Hebrew. The words were “tomorrow” and “year” (Experiment 9), “friend” and “enemy” (Experiment 10), “we” and “others” (Experiment 11), “sure” and “maybe” (Experiment 12), and “certainly” and “possibly” (Experiment 13). The apparatus, procedure and design were the same as in Experiment 7.

Results and Discussion

Experiment 9: The results revealed a Stroop effect engendered by the distance of the words associated with temporal distance. The Word x Distance interaction, $F(1, 15) = 5.21$, $p < .05$, $\eta^2 = .26$, documented faster response to congruent (mean of 655 msec) than to incongruent (mean of 671 msec) combinations.

Experiment 10: As predicted, distance engendered a Stroop effect also for classification of words associated with social distance. The Word x Distance interaction, $F(1, 12) = 6.77$, $p < .05$, $\eta^2 = .36$, documented faster response to congruent (mean of 637 msec) than to incongruent (mean of 657 msec) combinations.

Experiment 11: Again, the results revealed a Stroop effect engendered by the distance of words associated with social distance. The Word x Distance interaction, $F(1, 13) = 9.77$, $p < .001$, $\eta^2 = .43$, documented faster response to congruent (mean of 657 msec) than to incongruent (mean of 671 msec) combinations.

Experiment 12: Contrary to our prediction, there was no interaction, $F(1, 9) = 1.88$, $p = .22$. Classification speed of the words “sure” and “maybe” did not interact with the words’

distance. Congruent trials (a spatially proximal “sure”, or spatially distal “maybe”) were slower (mean of 649 msec) than incongruent trials (mean of 640 msec). This difference was opposite to our prediction and not significant.

One possible explanation for the surprising results of Experiment 12 is that the words “sure” and “maybe” have activated another meaning, in addition to psychological distance. This additional meaning might have blocked or weakened the activation of psychological distance meanings. The word “sure” in Hebrew (BATUAH) has the additional, frequently used meaning of “safe.” This explanation, however, is challenged by the results of Experiment 6, which used the same two words and yielded the predicted results. Possibly, in Experiment 6 psychological distance was more accessible than in Experiment 12, because in Experiment 6 the task explicitly referred to judgment of distance (classifying spatial proximity vs. distance), whereas in Experiment 12 participants discriminated between two words, and no explicit reference to distance was made. Perhaps, in order to obtain the predicted effect in a task of words classification, the words have to be associated with psychological distance more strongly than in Experiment 6. We therefore conducted Experiment 13, which used two other words that denote hypotheticality and do not have any additional meaning (“certain” as the proximal entity and “probable” as the distal entity).

Experiment 13: This time, the results revealed a Stroop effect engendered by the distance of words associated with hypotheticality. The Word x Distance interaction, $F(1, 13) = 10.11$, $p < .001$, $\eta^2 = .44$, documented faster response to congruent (mean of 650 msec) than to incongruent (mean of 685 msec) combinations.

Experiments 9-13 demonstrated that classification of words that denote different meanings of psychological distance was facilitated or impaired depending on the distance at which they were presented. Participants were faster to respond to congruent trials (when the word's spatial distance matched the psychological distance conveyed by the word's meaning), than in incongruent trials (when the word's spatial distance mismatched the psychological distance conveyed by its meaning). The results are consistent with our hypothesis that psychological distance is a common meaning that temporal distance, social distance and hypotheticality share with spatial distance.

General Discussion—Nine experiment examined performance in a Stroop-like task with word and spatial distance as dimensions. In Experiments 3-6, spatial distance (near, far) was the relevant dimension: Participants decided the distance of the words, ignoring their meaning. The words were related to temporal distance (Experiment 3), social distance (Experiments 4-5) and hypotheticality (Experiment 6), but did not have direct explicit relation to spatial distance. However, CLT contends that they are all different types of psychological distance, and therefore they are closely related to spatial distance, which is another manifestation of psychological distance. This prediction was supported by the Stroop-like effects that emerged in these experiments. Participants could not ignore the psychological distance that was conveyed by words: Performance was facilitated when the words and spatial location matched by CLT, and was impaired when words' meaning and distance mismatched by CLT.

In Experiments 9-13, the meaning of the same words was the target dimension to respond: Participants classified the words, ignoring their spatial location. In these experiments, again, the Stroop-like effects observed supported CLT's hypothesis. Performance was facilitated when meaning and spatial distance matched, and impaired when meaning and spatial distance mismatched. We interpret the results of the 9 experiments as providing initial evidence for the claim that temporal distance, social distance, hypotheticality, and spatial distance form different types of the core concept of psychological distance. Moreover,

psychological distance is activated in an automatic fashion (to affect perception and action) upon exposure to any one of these types.

The results of Experiments 3-6 suggest that psychological distance denoted by each word was accessed although it was irrelevant to the spatial discrimination task (despite the fact that the participants were instructed to ignore the meaning of the words). In our design, words were uncorrelated with the spatial location of the target stimuli, hence participants could not benefit from reading the words or processing their meaning. The fact that meaning did affect performance attests to an involuntary activation of psychological distance denoted by the words. The meaning of the words interfered with performance on incongruent trials, but facilitated performance on congruent trials. Note that the very terms, congruent incongruent (with the words used), are only sensible by CLT analysis. The results validate this analysis.

Similarly, the spatial distance of the word was accessed involuntarily in Experiments 9, 10, 11, and 13, when the task required response to the word itself (and performance could not benefit from attending to the spatial distance of the words). Participants were instructed to attend to words and the entire spatial layout was not mentioned at all. According to Bargh et al., (1996), concepts are defined as chronically accessible if they affect behavior or cognition even when intentional thought and attention are focused on aspects that do not relate to these concepts. On this view, the activation of the psychological distance of the words in Experiments 3-6 and of both words and arrow-locations in Experiments 9, 10, 11 and 13 suggests that psychological distance is a chronically accessible aspect of meaning. In other words, we suggest that the participant's failure to ignore the psychological distance of the stimuli in our experiments attests to the fact that the psychological distance of objects is accessed automatically. This suggests that psychological distance is an important determinant of perception and action.

We think that the importance of psychological distance stems from its effect on construal. Specifically, people tend to construe psychologically distant targets in relatively abstract, high level terms and proximal targets in more concrete, low level terms. CLT contends that higher levels of construal are engendered by distance from direct experience, and that level of construal is consequential for a variety of outcomes. Indeed, research conducted within the framework of CLT demonstrated many important consequences of distancing on evaluation, decision-making, confidence, self control and creativity, all of which were hypothesized to be mediated by the effect of distancing on level of construal (see Liberman, Trope & Stephan, in press, for a review). Conceptually similar effects of distancing have been demonstrated with temporal distancing (Liberman & Trope, 1998; Trope and Liberman 2000; Nussbaum et al., 2006) spatial distancing (Fujita et al., 2006; Henderson et al., in press), hypotheticality (Wakslak, Trope, Liberman & Trope, in press) and social distance (for a review, see Pronin, Gilovich & Ross, 2004). These lines of research suggest that distancing on all the psychological distance dimensions produce similar outcomes, due to their similar effects on construal.

For example, recent studies on self control conceptualize a self-control dilemma as a conflict between behavioral implications of high level construal of the situation (the alternative that requires self-control) and low level behavioral implications of the same situation (the temptation). This perspective has been validated by research that found that higher construal level enhanced self-control (Fujita, Trope, Liberman & Levi-Sagi, 2006). In addition, CLT predicts that distancing on any dimension would produce similar effects. Indeed, the literature on self-control finds that temporal distancing (e.g. Ainslie & Haslam, 1992; Frederick et al., 2002) and physical distancing (Mischel & Ebbesen, 1970; Vohs & Heatherton, 2000) improve self-control. We believe that important consequences of

construal level, such as success at self-control, make psychological distance a highly accessible concept that accounts for the automatic activation demonstrated in our study.

The current research examined the interrelations between spatial distance and three other psychological distance dimensions: temporal distance, social distance and hypotheticality. We chose spatial distance because it was easier to create stimuli that combined variable spatial distance and printed words than to design a similar task that combines stimuli that vary in other psychological distance dimension. Nevertheless, we believe that with suitable tasks similar interrelations can be found among temporal distance, social distance, and hypotheticality. Such tasks might include the discrimination between in-group and out-group faces (i.e., social distance discrimination), whose foreheads are tattooed with words that denote psychological distance or proximity on other dimensions, or the discrimination between pictures of real vs. imaginary creatures (i.e., discrimination of hypotheticality), with words printed on their backs.

The interrelations among different dimensions of psychological distance can also be examined by using methods that require more complex cognitive functions and that take place in a more natural social context. Such interrelations have been demonstrated in studies that measured how people's estimations of the distance of a target on one psychological distance dimension changes as a function of the distance of the same target on other psychological distance dimensions. For instance, Stephan (2006) requested participants to imagine meeting their roommate either on the following day or six months later, and to describe that roommate (e.g., what kind of person she is, what she likes to do). Participants then indicated how familiar (i.e., how socially proximal) the roommate seemed to them. It was found that expecting to meet the roommate sooner enhanced her perceived familiarity. This study demonstrates the effect of temporal distance on social distance.

Another study (Stephan, Liberman & Trope, 2006) examined the effect of spatial distance on social distance. Participants were adults, meeting for the first time in a SAT preparation course. They were asked to write two notes (one explaining how to use the course web site, and the other asking for advice on how to prepare for an exam) to either a random student sitting next to them, to a student sitting in another class in the same building, or to a student in a similar class in another town. After writing the notes, participants rated whether they addressed the other person in a familiar or a formal way (the researchers assumed that a formal way of addressing a person indicates social distance). It was found that participants addressed spatially distant others in a more formal way (i.e., expressed more social distance). Notably, temporal distance in the first study and spatial distance in the second study were unrelated to the social distance of the targets. That is, there was no reason to believe that a roommate who would arrive the next day would be more familiar than a roommate who would arrive in six months; nor was there any difference in social distance between students who sat in the same SAT class and students who happened to sit in the adjacent class-room. These findings as well as the findings of the present research demonstrate a certain degree of interchangeability among the different distance dimensions and suggest that all of these distances have in common a single dimension of psychological distance.

Is it possible that some dimensions of distance are more primary than other dimensions? In other words, is it possible that concepts of some distances (e.g., temporal distance) are developed on the basis of and understood as a metaphor to other distances (e.g., spatial distance). Such hierarchy is suggested by the findings of Boroditsky and her colleagues (Boroditsky, 2000; Boroditsky, 2001; Boroditsky & Ramscar, 2002). Boroditsky suggests that the domain of time is shaped by metaphorical mappings from the domain of space (2000). Boroditsky has found spatial supremacy that support this view (Boroditsky, 2000,

Experiments 2 & 3): thinking about space before answering questions about time influenced the participants' responses, but thinking about time before answering questions about space did not have any effect on participants' responses. It is important to note that our results cannot speak to a hierarchy between the different dimensions of distance, nor were our studies designed to detect such hierarchy. The results of Experiment 3 show that concepts related to time **can** affect the processing of spatial distance. The fact that the temporal domain interferes with the processing of the spatial domain does not rule out, however, the possibility that the spatial domain is superior to the temporal domain, or other domains of distance.

Conclusions: The current research demonstrates that people process stimuli comprised of spatial location (with respect to the observer) and a word that denotes temporal distance, social distance, or hypotheticality more easily if the stimuli are identical (rather than different) in their relative psychological distance. This was found despite the fact that the tasks required response to only one of the dimensions. The results are interpreted as reflecting a tendency to access psychological distance of stimuli automatically, even when it is not directly related to nor instrumental for people's current goals. These findings implicate psychological distance as an important dimension of meaning, reflecting the commonality of the four different dimensions.

References

- Ainslie, G.; Haslam, N. Self-control. In: Loewenstein, G.; Elster, J., editors. *Choice over time*. Russell Sage Foundation; New York: 1992. p. 177-209.
- Algom D, Dekel A, Pansky A. The perception of number from the separability of the stimulus: The Stroop effect revisited. *Memory & Cognition*. 1996; 24:557-572.
- Arieh Y, Algom D. Processing picture-word stimuli: The contingent nature of picture and of word superiority. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. 2002; 28:221-232.
- Bargh J, A. Chaiken S, Raymond P, Hymens C. The Automatic Evaluation Effect: Unconditional Automatic Attitude Activation with a Pronunciation Task. *Journal of Experimental Social Psychology*. 1996; 32:104-128.
- Boroditsky L. Metaphoric structuring: Understanding time through spatial metaphors. *Cognition*. 2000; 75:1-28. [PubMed: 10815775]
- Boroditsky L. Does language shape thought? Mandarin and English speakers' conceptions of time. *Cognitive Psychology*. 2001; 43:1-22. [PubMed: 11487292]
- Boroditsky L, Ramscar M. The roles of body and mind in abstract thought. *Psychological Science*. 2002; 13:185-188. [PubMed: 11934006]
- Brewer M, B. Lui L. Categorization of the elderly by the elderly: Effects of perceiver's category membership. *Personality and Social Psychology Bulletin*. 1984; 10(4):585-595.
- Eyal T, Liberman N, Walther E, Trope y. The Pros and Cons of Temporally Near and Distant Action. *Journal of Personality and Social Psychology*. 2004; 86(6):781-795. [PubMed: 15149255]
- Frederick S, Loewenstein G, O'Donoghue T. Time discounting and time preference: A critical review. *Journal of Economic Literature*. 2002; 40:351-401.
- Fiedler K, Semin G, R. Finkenauer C. The battle of words between gender groups: A language-based approach to intergroup processes. *Human Communication Research*. 1993; 19(3):409-441.
- Fiedler K, Semin GR, Finkenauer C, Berkel I. Actor observer bias in close relationships: The role of self-knowledge and self-related language. *Personality and Social Psychology Bulletin*. 1995; 21:525-538.
- Frank MG, Gilovich T. Effect of memory perspective on retrospective causal attributions. *Journal of Personality and Social Psychology*. 1989; 5:399-403. [PubMed: 2778630]
- Fujita K, Henderson M, Eng J, Trope Y, Liberman N. Spatial Distance and Mental Construal of Social Events. *Psychological Science*. 2005; 17:278-282. [PubMed: 16623682]

- Fujita K, Trope Y, Liberman N, Levin-Sagi M. Construal Levels and Self-Control. *Journal of Personality and Social Psychology*. 2006; 90:351–367. [PubMed: 16594824]
- Hayduk LA. Personal space: Where we now stand. *Psychological Bulletin*. 1983; 94:293–335.
- Henderson M, Fujita K, Trope Y, Liberman. Transcending the “here”: The effect of spatial distance on social judgment. *Journal of Personality and Social Psychology*. (in press).
- Jones EE. The rocky road from acts to dispositions. *American Psychologist*. 1979; 34:107–117. [PubMed: 484919]
- Jones, EE.; Nisbett, RE. The actor and the observer: Divergent perceptions of the causes of behavior. In: Jones, EE.; Kanouse, DE.; Kelley, HH.; Nisbett, RE.; Valins, S.; Weiner, B., editors. *Attribution: Perceiving the causes of behavior*. General Learning Press; Morristown, NJ: 1972. p. 79-94.
- Jones EE, Wood GC, Quattrone GA. Perceived variability of personal characteristics in ingroups and outgroups: The role of knowledge and evaluation. *Personality and Social Psychology Bulletin*. 1981; 7:523–528.
- Liberman, N.; Macrae, S.; Sherman, S.; Trope, Y. Tel Aviv University; Israel: 2005. The effect of level of construal on temporal distance. A manuscript in preparation
- Liberman N, Sagristano M, Trope Y. The effect of temporal distance on level of construal. *Journal of Experimental Social Psychology*. 2002; 38:523–535.
- Liberman N, Trope Y. The role of feasibility and desirability considerations in near and distant future decisions: A test of temporal construal theory. *Journal of Personality and Social Psychology*. 1998; 75:5–18.
- Liberman, N.; Trope, Y.; Stefan, E. Psychological distance. In: Higgins, ET.; Kruglanski, AW., editors. *Social psychology: Handbook of basic principles*. Vol. 2. Guilford Press; New York: (in press)
- Linville PW. The complexity-extremity effect and age-based stereotyping. *Journal of Personality and Social Psychology*. 1982; 42:193–211.
- Linville PW, Fischer GW, Yoon C. Perceived covariation among the features of ingroup and outgroup members: The outgroup covariation effect. *Journal of Personality and Social Psychology*. 1996; 70:421–436.
- MacLeod C, M. Half a Century of Research on the Stroop Effect : An Integrative Review. *Psychological Bulletin*. 1991; 109:163–203. [PubMed: 2034749]
- Melara RD, Algom D. Driven by Information: A Tectonic Theory of Stroop Effects. *Psychological Review*. 2003; 110:422–471. [PubMed: 12885110]
- Melara R, D. Mounts J, R. Selective attention to Stroop dimensions: Effects of baseline discriminability, response mode, and practice. *Memory & Cognition*. 1993; 21:627–645.
- Mischel W, Ebbesen E, B. Attention in delay of gratification. *Journal of Personality and Social Psychology*. 1970; 16:329–337.
- Nigro G, Neisser U. Point of view in personal memories. *Cognitive Psychology*. 1983; 15:467–482.
- Nussbaum S, Liberman N, Trope Y. Predicting the near and distant future. *Journal of Experimental Psychology: General*. 2006; 135:152–161. [PubMed: 16719648]
- Nussbaum S, Trope Y, Liberman N. Creeping dispositionism: The temporal dynamics of behavior prediction. *Journal of Personality and Social Psychology*. 2003; 84:485–497. [PubMed: 12635911]
- Park B, Judd CM. Measures and models of perceived group variability. *Journal of Personality and Social Psychology*. 1990; 59:173–191.
- Park B, Rothbart M. Perception of out-group homogeneity and levels of social categorization: Memory for the subordinate attributes of in-group and out-group members. *Journal of Personality and Social Psychology*. 1982; 42:1051–1068.
- Park B, Ryan CS, Judd CM. Role of meaningful subgroups in explaining differences in perceived variability for in-groups and out-groups. *Journal of Personality and Social Psychology*. 1992; 63:553–567. [PubMed: 1447686]
- Pronin E, Gilovich T, Ross L. Objectivity in the Eye of the Beholder: Divergent Perceptions of Bias in Self Versus Others. *Psychological Review*. 2004; 111:781–799. [PubMed: 15250784]

- Reichman; Ben, Arie. Tel Aviv University; 2004. The effect of spatial distance on politeness: Evidence for the effect of special distance on social distance. An unpublished manuscript
- Robins R, W. Spranca M, D. Mendelsohn G, A. The actor-observer effect revisited: Effects of individual differences and repeated social interactions on actor and observer attributions. *Journal of Personality and Social Psychology*. 1996; 71(2):375–389. [PubMed: 8765487]
- Shaki S, Algom D. The locus and nature of semantic congruity in symbolic comparison: Evidence from the Stroop effect. *Memory & Cognition*. 2002; 30:3–17.
- Sherman SJ, Zehner KS, Johnson J, Hirt ER. Social explanation: The role of timing, set, and recall on subjective likelihood estimates. *Journal of Personality and Social Psychology*. 1983; 44:1127–1143.
- Sherman SJ, Cialdini RB, Schwartzman DF, Reynolds KD. Imagining can heighten or lower the perceived likelihood of contracting a disease: The mediating effect of ease of imagery. *Personality and Social Psychology Bulletin*. 1985; 11:118–127.
- Smith M, C. Magee L, E. Tracing the time course of picture-word processing. *Journal of Experimental Psychology: General*. 1980; 109:373–392. [PubMed: 6449530]
- Stephan, E. Tel Aviv University; 2006. Social Distance and its Relation to Level of Construal, Temporal Distance and Physical Distance. Unpublished manuscript
- Stroop JR. Studies of interference in serial-verbal reaction. *Journal of Experimental Psychology*. 1935; 18:643–662.
- Trope Y, Liberman N. Temporal construal and time-dependent changes in preference. *Journal of Personality and Social Psychology*. 2000; 79:876–889. [PubMed: 11138758]
- Trope Y, Liberman N. Temporal Construal. *Psychological Review*. 2003; 110(3):403–421. [PubMed: 12885109]
- Vohs K, Heatherton TF. Self-regulatory failure: A resource-depletion approach. *Psychological Science*. 2000; 11:249–254. [PubMed: 11273412]
- Wakslak C, J. Trope Y, Liberman N, Alony R. Seeing the Forest When Entry is Unlikely: Probability and the Mental Representation of Events. *Journal of Experimental Psychology: General*. (in press).
- Werkman WM, Wigboldus DH, Semin GR. Children's communication of the linguistic intergroup bias and its impact upon cognitive inferences. *European Journal of Social Psychology*. 1999; 29:95–104.

Figure 1.

The four panels illustrate the four possible spatial-location X word-meaning combinations in each of the experiments. The four conditions are: a word of proximity located near the observer (a congruent condition, Panel A), a word of distance located near the observer (an incongruent condition, Panel B), a word of proximity located far from the observer (an incongruent condition, Panel C), and a word of distance located far from the observer (a congruent condition, Panel D). The actual stimuli were color photographs and not drawings. The present illustration demonstrates words related to hypotheticality – “sure” denotes proximity in that domain, and “maybe” denotes distance. These words were used in Experiments 6 and 12.

Figure 2. Incongruent trials were significantly slower than congruent trials in all experiments, excluding Experiments 2, 8 and 12. In the spatial task, participants classified the spatial distance of the words; and in the words task participants classified the words.

Table 1

Mean Reaction Time (in Millisecond) and SD (in Parentheses) for all experiments

	Spatial distance sorting task		Words sorting task	
	Spatially Proximal	Spatially Distal	Spatially Proximal	Spatially Distal
	Experiment 1		Experiment 7	
'NEAR'	706 (29)	775 (29)	669 (22)	707 (33)
'FAR'	726 (33)	724 (26)	719 (33)	701 (36)
	Experiment 2		Experiment 8	
'NAIL'	547 (21)	585 (17)	590 (15)	621 (18)
'SCREW'	547 (21)	590 (14)	629 (15)	654 (25)
	Experiment 3		Experiment 9	
'TOMORROW'	600 (22)	652 (24)	663 (16)	681 (24)
'YEAR'	621 (22)	645 (21)	662 (18)	648 (16)
	Experiment 4		Experiment 10	
'FRIEND'	621 (29)	687 (28)	634 (17)	647 (19)
'ENEMY'	638 (27)	676 (26)	667 (20)	639 (18)
	Experiment 5		Experiment 11	
'WE'	614	675	651 (16)	665 (19)
'OTHERS'	629	667	679 (13)	662 (15)
	Experiment 6		Experiment 12	
'SURE'	603 (18)	677 (30)	649 (27)	627 (30)
'MAYBE'	611 (21)	653 (19)	654 (26)	649 (27)
			Experiment 13	
'CERTAINLY'			659 (16)	679 (24)
'POSSIBLY'			692 (16)	642 (16)

* Congruent cells are written in bold.