Construal Level Theory: Testing the Association of Abstraction Level and Object Distance with Experimentally Induced Distances

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Abstract

Construal Level Theory (CLT) suggests that we represent objects close to us in a concrete and modal fashion, and that representations become more abstract and amodal with increasing distance from ourselves. Evidence for such an association of abstraction level and distance comes from the Implicit Association Test (IAT), where participants are faster when pressing one key for "near" and "concrete" and another key for "far" and "abstract" targets (congruent), than when "near" is paired with "abstract" and "far" with "concrete" (incongruent). However, previous experiments might have confounded distance and abstraction by employing inherently near and far targets (e.g., CHAIR vs. SUN) that might also differ in their abstractness. Here, we thus experimentally induced different distances in a learning phase before a subsequent IAT task. Even with this controlled distance manipulation, a pronounced congruency effect emerged, providing further support for an association of distance and abstraction level as suggested by CLT.

Keywords: thinking; abstraction; distance-dependent representation; construal level; modal and amodal cognition

Evidence for an Association of Abstraction Level and Object Distance

Imagine meeting a friend for coffee – what comes to your mind? You might conceive this cup of coffee as a chance to relax, refresh, and have a good conversation in a pleasant atmosphere. But what color and size did the mug have in your imagination of the upcoming situation? Likely, the mere idea of meeting over coffee did not evoke a clear imagination of the visual properties of the mug. This might be different if you try to find a mug on your crowded kitchen shelf – in vista space, such properties suddenly become relevant, and we need a clear representation of what we are looking for. Once you find the mug and want to pick it up (within reaching distance), its weight, orientation, and handle position are crucial to planning and controlling the grasping movement of your arm and hand.

The example above shows that different formats of mental representations may coexist and serve different functions (for a recent overview, see Kaup, Ulrich, Bausenhart, et al., 2023), and how this representational format may depend on distance: various aspects of an entity are relevant for different behavioral and cognitive operations, and distance mediates which operations are applicable to the entity. For things that are far away from ourselves, abstract and amodal aspects such as linguistic labels or conceptual knowledge organized within a semantic network are more useful than specific and potentially context-dependent object details, because they allow for communication and thinking about remote objects – that is, they allow to transcend one's immediate context and extend the scope of cognition towards unknown and unspecified situations (e.g., Trope & Liberman, 2010). For things in our close vicinity (e.g., in vista or peripersonal space), more concrete and modal aspects related to sensory and motor processing, are relevant.

A theoretical framework that addresses this relationship of distance and cognitive representations is Construal Level Theory (CLT, Trope & Liberman, 2003; Trope & Liberman, 2010). It suggests that we activate different aspects of objects or events depending on their distance from ourselves. Accordingly, things that are close to us should be represented rather concretely, modally, in more detail, and anchored within their specific context (that is, on a so-called low level of construal). In contrast, things far from us should be

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represented in a more global, schematic, abstract, or amodal fashion (i.e., on a high level of construal). CLT gains support from a large number of studies investigating the relation between construal level and various dimensions of distance (e.g., spatial distance, temporal distance, social distance, or the mere likelihood of an event or outcome; for overviews, see Trope & Liberman, 2010; Soderberg Callahan, Kochersberger, Amit, & Ledgerwood, 2015). For example, subjects use more abstract language when describing spatially distant events compared to spatially close events (Fujita, Henderson, Eng, Trope & Liberman, 2006; Semin & Fiedler, 1988). Likewise, with increasing temporal distance to an imagined future event, participants tend to categorize objects associated with the event into fewer and broader categories (Liberman, Sagristano, & Trope, 2002). Also, they describe activities taking place in the far rather than the near future in terms of more abstract and superordinate goals (Liberman & Trope, 1998).

In another line of research, Bar-Anan, Liberman and Trope (2006) more implicitly investigated the relationship between distance and construal level. Specifically, they used the Implicit Association Test (IAT, Greenwald, McGhee, & Schwarz, 1998) which was originally developed to investigate implicit attitudes without the influence of social desirability. This task was used to assess whether and how the poles of a specific target dimension (e.g., female vs. male) are associated with the poles of a particular dimension of attitude (e.g., weak vs. strong). The task is based on the assumption that participants who bear a certain attitude (e.g., associating the concept "female" with weakness and "male" with strength) will be faster in a reaction time task when the two associated concepts are assigned to the response keys in a congruent rather than incongruent fashion. For the assumption described above, a congruent mapping would consist of pressing one key for female names and synonyms of the term "weak", and another one for male names and for synonyms of the term "strong", while an incongruent mapping would mean pressing one key for female names and "strong" words, and another key for male names and "weak" words.

Bar-Anan, Liberman, and Trope (2006) adopted this task to test the assumptions of CLT in the following manner: participants had to react to words describing either small or large distances and to words representing either a low or high level of construal. In eight experiments, all combinations of the four distance dimensions (spatial, temporal, social distance, and hypotheticality) and two instances of construal level (synonyms for "concrete" or "abstract", and lower-level exemplars such as "hammer" or superordinate category labels such as "animal") were tested. In all experiments, Bar-Anan, Liberman, and Trope consistently showed that reaction times were shorter in the congruent condition (i.e., the condition associating close distance and low construal level with one key, and far distance and high construal level with another key) than in the incongruent condition (see also Bausenhart, Ulrich, & Kaup, 2023, for a recent conceptual replication of the IAT effect for temporal distance). These results were interpreted as support for the basic claim of CLT that distance and abstractness are cognitively related.

However, there is a caveat to interpreting these word-based IAT studies. Consider, for example, Experiment 2A in Bar-Anan, Liberman, and Trope (2006), in which the (Hebrew) words for airplane, north pole, sun, and clouds were used as instances of the far condition, and the (Hebrew) words for hair, chair, door, and shoes were used as instances of the near condition. The referents of these words likely not only differ in spatial distance, but also in their degree of abstraction/concreteness. For example, participants have more direct and concrete sensory-motor experiences with objects such as chairs or shoes than with clouds or airplanes. Moreover, while there are many different variants or exemplars of the former examples (e.g., different chairs or hair colors and styles), presumably requiring more detailed and specific representations, especially the sun and the north pole are singular entities and thus may be more efficiently represented in a rather abstract format. Finally, the north pole is not a manipulable object but rather a geographical concept, and thus is per se more abstract than all instances of the "near" category. Therefore, the observed reaction time benefit in the abovementioned IAT might be due to the concreteness/abstractness rather than the implied distance of the stimulus material used in the distance category. A similar reasoning might also apply to other experiments in Bar-Anan's study. For example, in Experiment 2B, spatial distance was manipulated by using adverbial expressions such as "here" and "besides" in the close condition and "there" or "far away" in the far condition, and one might argue that the former descriptions are more deterministic and concrete (e.g., there is only one "here" and it is well-known to us) than the latter descriptions (e.g., "there" describes a more remote, but unspecified location).

In the present study, we thus tested whether an association of distance and construal level would also emerge in the IAT for objects that differ in distance but not in abstractness. To this end, rather than relying on the inherent spatial distance of different objects, we experimentally induced near or far distance for a constant set of everyday objects by including a learning phase prior to the IAT. Suppose the association of distance and construal level, as postulated within CLT, also holds under these conditions. In this case, we again expect shorter reaction times for the congruent than the incongruent mapping of categories to response keys.

Methods

Participants

Participants were recruited via a circular email to the university mailing list of the University of Tübingen and all participants gave informed consent before participation. A

total of 187 people took part in this online experiment. From this sample, 9 participants were first excluded from the analysis due to a high error rate (>25% of errors). As participants were randomly assigned to the four different experimental versions created for counterbalancing (see below), different participant numbers resulted in the four versions (ranging between n = 33 and n = 64). Thus, to achieve perfect counterbalancing, a subset of 33 participants was chosen randomly from each of the four conditions. The resulting sample consisted of 132 participants (100 female, 32 male, 120 right-handed, 12 left-handed), aged 18-36 years (M = 23.72, SD = 3.03). Please note that an alternative data analysis based on data of all eligible participants yields comparable results to those reported below, that is, all statistical tests exhibit the same pattern of significance. Please also note that our final sample size by far exceeds the sample sizes (ranging from 12-25 participants) in Bar-Anan et al.'s original experiments and is sufficient to detect a small effect (Cohen's d = 0.30) in a paired-samples t-test with α = .05 and a power (1-β) > .90.

Stimuli

The two images depicted in Figure 1 were employed in a first learning phase, locating the target object either in near or far spatial distance relative to the participant. German words were used as stimuli in the subsequent IAT task.

Figure 1: Images employed in the learning phase to induce different levels of distance for a set of everyday objects. Left: Bear, mug, clock, and wine bottle are within peripersonal space (near condition), while globe, lamp, books, and plant are located outside peripersonal space (distant condition). Right: The assignment of objects to distance conditions is reversed.

For the distance dimension, eight nouns referring to the depicted everyday objects were employed: BÄR (bear), TASSE (cup), FLASCHE (bottle), UHR (clock), PFLANZE (plant), GLOBUS (globe), LAMPE (lamp), BÜCHER (books). For the abstraction dimension, as in the study of Bar-Anan, Liberman, and Trope (2006), four adjectives (synonyms of concrete) referred to low abstraction level: DETAILLIERT (detailed), SPEZIFISCH (specific), GENAU (exact), BESTIMMT (determined/defined), and four adjectives (synonyms for abstract) referred to high abstraction level: ALLGEMEIN (general), UNIVERSELL (universal), SCHEMATISCH (schematic), GENERELL (general). Please note that the adjectives ALLGEMEIN and GENERELL are both commonly used German adjectives with different etymologies, which synonymously translate to the English term "general". In this task, the "E" and "I" keys served as response keys for the left and right index fingers, respectively.

Procedure

The experiment was programmed in jspych (De Leeuw, 2015) and run as an online experiment. First, participants saw an image depicting eight everyday objects distributed on two tables in a room. Four of the objects were located on a table depicted in the peripersonal space of the participants (near condition) and four objects were located on a table against the back wall of the room, outside of peripersonal space (distant condition). For half of the participants, the assignment of objects to distance condition was reversed by creating two versions of this image (cf. left and right side of Figure 1).

Then, participants were asked to memorize which of the objects were located close and which were located far from them. In a subsequent recall phase, it was tested whether they learned the position of each object correctly. In case of errors, the room image with the objects was presented again and the testing phase was repeated until all locations were remembered correctly.

In the subsequent IAT phase, words referring to the objects and synonyms for concrete and abstract were presented. These words had to be categorized per keypress as either near or far and concrete or abstract, respectively. Half of the participants started with a congruent assignment (i.e., near and concrete words were assigned to one response key, and far and abstract words were assigned to the other response key). In contrast, the other half of the participants started with the incongruent assignment (far and concrete assigned to one key, and near and abstract assigned to the other key).

As is customary in the typical IAT design (cf. Greenwald, Brendl, Cai, et al., 2022), both word types and their key assignment were first practiced in isolation (Blocks 1 & 2), and then randomly intermixed (Block 3), with 16 trials each. In Block 4, 32 experimental trials were presented; again, both word types were randomly intermixed. Then, the assignment of distance condition to response keys was reversed. Consequently, participants who had started with the congruent key assignment now proceeded with the incongruent assignment and vice versa. The new assignment was practiced for distance words in isolation (Block 5) and then for both word types randomly intermixed (Block 6), with 16 trials per block. Finally, again 32 experimental trials with both word types randomly intermixed were run in Block 7. The experiment took around 10-15 minutes to complete.

Design

The main factor of interest in this study was the congruency (congruent vs. incongruent) of the mapping of stimulus categories to response keys (manipulated within-subjects). The order of congruency conditions (congruent first vs. incongruent first) and the assignment of the everyday objects to distances (Image Versions A and B) were counterbalanced across participants. Reaction times and the percentage of correct responses were assessed as dependent variables.

Results

Trials with reaction times <200 ms or >3000 ms were considered outliers and excluded from analyses (3.29%). These cutoff values were based on visual inspection of the distribution of all recorded reaction time values irrespective of their experimental condition (M = 1270 ms, SD = 778 ms, range = [3 ms; 16.4 sec]), and the cutoff values were chosen such that the most extreme outlier values would be discarded whilst conservatively retaining a large proportion of the original data. In contrast to some typical IAT studies (e.g., Bar-Anan et al., 2003; Greenwald, Nosek, & Banaji, 2003), reaction times from outlier trials were not recoded to the cutoff values, as we suspect that these rare and extreme values reflect premature responding, lapses of attention, or distraction, and are thus not informative with respect to our experimental question. However, an alternative analysis in which no outliers were discarded yielded a comparable pattern of statistical results. Only correct responses entered the analysis of reaction times.

For statistical analysis, first, repeated-measures analyses of variance were conducted with Congruency as a within-subjects factor and Congruency Order and Image Version as between-subjects factors for the percentage of correct responses and reaction times.

Since these analyses yielded neither significant main effects of Congruency Order and Image Version nor any interaction involving these two factors, data were aggregated across these two counterbalancing factors, and paired-samples t-tests were conducted to test the effect of Congruency on the dependent variables.

As can be seen in Figure 2A, the mean percentage of correct responses was similar in the congruent (M = 95.16, SD = 5.79) and the incongruent condition (M = 94.49, SD = 5.50). The t-test showed no significant effect of congruency on the percentage of correct responses, $t(131) = 1.31$, Cohen's d = 0.11, $p = .19$.

However, participants responded considerably faster in the congruent condition (M = 1119 ms, SD = 227 ms) than in the incongruent condition, M = 1238 ms, SD = 236 ms). A paired-samples t-test revealed that this difference was highly significant, $t(131) = 7.41$, Cohen's d = 0.65, $p < .001$ (cf. Figure 2B).

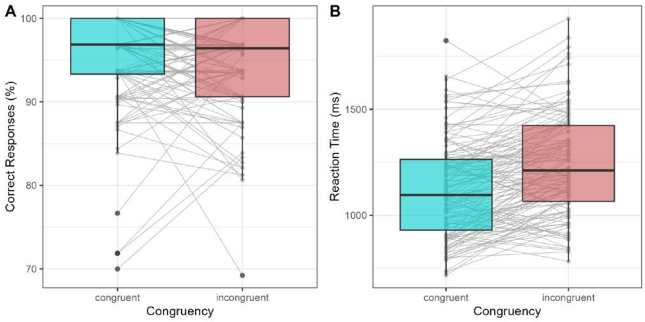

Figure 2: A. Boxplot of the Mean Percentage of Correct Responses depending on Congruency. Grey data points and lines depict individual participants. B. Boxplot of the Mean Reaction Time depending on Congruency. Grey data points and lines depict individual participants.

Discussion

In the present study, we investigated the association of abstraction level and spatial distance. Based on an original study from Bar-Anan, Liberman, and Trope (2006), an IAT task was employed to unravel whether participants tend to associate objects in a small distance with more concrete and objects in a large distance with more abstract verbal expressions. In line with the results of Bar-Anan, Liberman, and Trope (2006), such an association was clearly observed: participants response times were shorter when "concrete" and "near" words were mapped to one key and "abstract" and "far" words were mapped to another key in a reaction time task, compared to when "concrete" and "far" was assigned to one key and "abstract" and "near" to another key.

In contrast to Bar-Anan, Liberman, and Trope (2006), we did not use objects which inherently differ in distance (as "shoe" or "sun"), but we experimentally manipulated the distance of everyday objects (e.g., as "books" or a "lamp"), in such a way that the same object was employed in the near condition for half of the participants and in the far condition for the other half. Therefore, our findings rule out the possibility that the association of distance and abstraction observed by Bar-Anan et al. might be due to differences in the abstractness of the employed stimulus material rather than their implied distance.

Interestingly, a pronounced congruency effect was observed in our study even though our distance manipulation was arguably "weaker" than in the original study. First, the extent of the depicted distances in our study was much smaller, with near objects depicted as being within grasping range and far objects outside this range, but still within the same room (as opposed to a much larger scale of distance implied by "sun" or "north pole" in the original study, for example). Second, while the implied distance in Bar-Anan's study was based on presumably very stable conceptual or semantic knowledge acquired through life-long learning of

the objects' typical locations, in the present study, a very brief learning phase was sufficient to observe a strong association of the (newly acquired knowledge about) object distance with abstraction level.

On the one hand, this conclusion is entirely compatible with a primary claim of CLT, namely that the same object can be flexibly represented either more concretely or abstractly depending on its distance from the self, thus adaptively allowing for those cognitive operations that are applicable and well-suited for the respective situation (e.g., grasping a teddy bear with the correct grip aperture and force, looking for it in a messy playroom, or talking to a friend about how much you loved your former childhood toys). According to such an interpretation, presenting the objects at near or far distances in the present task would automatically have an impact on the content and/or format of their respective cognitive representations (i.e., rendering them more concrete or abstract, respectively), which in turn would have enabled the observed congruency effect to occur. On the other hand, however, the pronounced congruency effect could indicate that merely categorizing an object as "near" or "far" is sufficient to evoke a congruency effect in the IAT task, irrespective of absolute (metric) distance and independent of the specific underlying object representation. In this sense, it is conceivable that the congruency effect does not reflect a difference in the representation or meaning of the particular exemplar stimuli employed in the task but rather an association of the category labels "near" vs. "far" with the category labels "abstract" or "concrete" (see also De Houwer, 2001; Mitchell, Nosek, & Banaji, 1999). Still, in both cases, the major conclusion that distance and abstraction are cognitively related, holds.

In summary, the present results demonstrate an association between distance and abstraction level while experimentally inducing different distances for everyday objects. This research contributes to the growing body of evidence that investigates the format of cognitive representations and their respective functions in various psychological domains (for an overview, see Kaup et al., 2023). In particular, the present results align with the assumption that distance is an essential determinant of whether a particular cognitive representation may be more concrete, specific, and modal, or more abstract, general, and amodal.

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