High-level construal mindset promotes categorizing information based on thematic relations

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Abstract

The present study examined whether a high-level construal mindset promotes categorizing information according to thematic relations. In two experiments, the construal-level priming task was used to initiate a high-level versus low-level construal mindset, and then all participants were asked to complete the triad task which is the task of measuring the preference to classify. The research findings demonstrated that irrespective of whether the objects being classified were artifacts (Experiment 1) or natural objects (Experiment 2), the high-level construal mindset group exhibited a higher percentage of thematic responses in the triad task. The findings suggest that a high-level construal mindset promotes categorizing information based on thematic relations.

Full Text

Preamble

High-level construal mindset promotes categorizing information based on thematic relations

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Abstract

The present study examined whether a high-level construal mindset promotes categorizing information according to thematic relations. In two experiments, we used a construal-level priming task to induce either a high-level or low-level

construal mindset, after which all participants completed a triad task measuring classification preferences. The findings demonstrated that regardless of whether the objects being classified were artifacts (Experiment 1) or natural objects (Experiment 2), participants in the high-level construal mindset group exhibited a higher percentage of thematic responses in the triad task. These results suggest that a high-level construal mindset promotes categorizing information based on thematic relations.

Keywords: Categorization, Level of construal, High-level construal mindset, Thematic relations

Statements and Declarations

Conflict of Interest: The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Research Involving Human Participants: The study was conducted after obtaining Institutional Review Board approval from the Department of Psychology at Northwest Normal University. We received written consent from all participants before testing began. All procedures performed in studies involving human participants complied with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent to Participate: Informed consent was obtained from all individual participants included in the study.

Consent for Publication: All participants signed informed consent regarding publishing their data.

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RUNNING HEAD: CONSTRUAL LEVEL AND CATEGORIZATION

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Categorizing our understanding of the world into meaningful classifications is a fundamental cognitive process. Categories represent groups or classes of items that share similarities or meaningful connections (Lawson, Chang, & Wills, 2017). The organization of semantic knowledge for concrete object categories is based on two primary types of relations: taxonomic and thematic (Lawson et al., 2017). Thematic relations are complementary relations between objects that co-occur or interact in space and time (Mirman, Landrigan, & Britt, 2017). In contrast, taxonomic relationships entail membership in a common category based on shared features (Mirman et al., 2017). Categorizing information using thematic relations requires focusing on the complementary functions or roles of entities, thereby integrating them within a shared scenario or event (Estes et

al., 2011; Li, Shi, Wei, & Xia, 2023). For instance, “cow” and “milk” exhibit a thematic relationship through a production theme, as cows serve as producers and their milk is the resulting product, with each object performing complementary thematic roles. Conversely, categorizing information using taxonomic relations requires directing attention toward the shared detailed characteristics of entities, thereby grouping them within the same category (Li, Guo, Shi, Sun, & Wang, 2022; Mirman et al., 2017). For example, “whales” and “horses” share significant characteristics such as being warm-blooded and giving birth to live offspring, thus placing them within the category of “mammals.” Similarly, “pizza” and “chips” both belong to the “food” category as they share the property of being edible.

Research has demonstrated that categorizing information according to thematic or taxonomic relationships produces distinctly different effects on cognitive processing. Studies show that thematic categorization enhances subjectively perceived similarity (Mman & Graziano, 2012b), facilitates the organization and encoding of experiential knowledge in memory representations (Borghi & Caramelli, 2003), and improves comprehension of both local content (words) and overall content (paragraph sketches) in textual stories (Jones & Estes, 2012). Additionally, this process influences linguistic intuitive coherence judgments (Maldei, Baumann, & Koole, 2020) and specific reasoning processes such as analogical reasoning (Doumas, Hummel, & Sandhofer, 2008). In contrast, taxonomic categorization enhances memory for conceptual knowledge (Estes et al., 2011), increases perception of novelty between a brand and extension product (De Groote, Mendini, & Gibbert, 2019), and facilitates the generalization of fear emotions (Lei, Mei, Dai, & Peng, 2020).

Various factors influence individuals’ preferences for categorizing information based on thematic or taxonomic relations. Research has shown that generating solutions to distant analogies promotes thematic categorization (Li et al., 2023). In that study, Li et al. initially assigned one group to solve distant analogies while another group tackled near analogies; following this, both groups completed the triad task. In this task, participants received sets of triads consisting of a base item (such as a dog) and two comparison items, deciding whether an item that was thematically related (such as a bone) or taxonomically similar (such as a cat) should be placed in the same category as the base item. The results showed that the group solving distant analogies demonstrated more thematic responses in the triad task than the group solving near analogies. Furthermore, prior research has highlighted that factors including global-local processing, knowledge and educational background, thought patterns, age, and the level of abstractness in material can shape individuals’ bias toward thematic or taxonomic categorization. For instance, initiating global rather than local processing causes individuals to organize information according to thematic relationships (Guest et al., 2016). Li et al. observed that unconscious thinking tends to categorize information based on thematic relations (Li, Guo, Shi, Sun, & Wang, 2022). In sorting and induction tasks involving marine creatures, Shafto et al. found that commercial fishermen (experts) were more influenced

by thematic constraints such as commercial and ecological factors, whereas university undergraduates (novices) were primarily influenced by taxonomic constraints such as visual features (Shafto & Coley, 2003). Li et al. also discovered that bilingual participants made more thematically related responses than taxonomically related responses in their first language but equally frequent thematic and taxonomic responses in their second language (Li, Zhang, & Wang, 2011). Berger et al. found that adults tend to categorize information based on thematic relations, while children and the elderly rely more on taxonomic relations (Berger & Donnadieu, 2006; Mman & Graziano, 2012b). Finally, Papagno et al. observed that categorizing concrete concepts seemingly relies on taxonomic relations, whereas categorizing abstract concepts relies on thematic relations (Papagno, Martello, & Mattavelli, 2013).

Among these factors, both global processing and abstract concepts appear closely related to a high-level construal mindset (abstract processing) (e.g., Darwent, Fujita, & Wakslak, 2010; Papagno, Martello, & Mattavelli, 2013). Darwent et al. (2010) found that when global processing is initiated at the perceptual level, abstract and superordinate concepts in the semantic network are activated, and people tend to integrate new information into existing knowledge structures. Papagno et al. (2013) found that when organizing and categorizing abstract concepts, people attempt to integrate them into a higher level of abstraction. However, to date, no studies have directly explored whether levels of construal, especially a high-level construal mindset, affect individuals' classification preferences.

Construal level theory (CLT; Trope & Liberman, 2010) posits that individuals can perceive or "construe" stimuli at a high or low level. A high-level construal mindset involves creating abstract mental representations that extract the essential core characteristics of an item and emphasize its global perceptual elements. By contrast, a low-level construal mindset concentrates on rich and specific details that highlight the perceptual features of an item. Research has shown that high construal levels facilitate information aggregation (Hadar, Glickman, Trope, Liberman & Usher, 2022). In that study, all participants completed a construal-level priming manipulation task where the high-level construal group contemplated the "why" aspect of engaging in a specific activity (e.g., "Why maintain good physical health?") while the low-level construal group considered the "how" aspect (e.g., "How to maintain good physical health"). All participants then completed a numerical averaging task, and the findings revealed that inducing a high-level construal mindset improved aggregation accuracy compared with a low-level construal mindset. Numerous studies have investigated how construal levels affect cognitive processing across domains, demonstrating that a high-level construal mindset confers benefits in areas such as self-control, recognition of human faces, creative processing, mitigation of retrieval-induced forgetting, facilitation of goal-consistent evaluations, influence on emotional preferences, reduction of over-optimistic predictions, cross-sensory effects of visual information on taste perception, and augmentation of moral concern (Fujita, Trope, Liberman & Levin-Sagi, 2006; Yan, Hou & Unger, 2014;

Hansen, 2019; Agerström & Björklund, 2013; Wyer, Hollins, Pahl & Roper, 2015; Zhbanova & Rule, 2014; Ikeda, Hattori & Kobayashi, 2016; Rees, Fujita, Han, Sherman & Sklar, 2018; Schwartz, Eyal & Tamir, 2018). This raises the question of whether a high-level construal mindset promotes the categorization of information according to thematic relations.

While taxonomic categorization involves identifying common and detailed characteristics, thematic categorization emphasizes discovering overall connections among objects (Guest et al., 2016; Maldei, Baumann, & Koole, 2020). Previous studies have indicated that a high-level construal mindset promotes holistic and integrative thinking (Liberman & Förster, 2009; Smith & Trope, 2006). Smith et al. (2006) found that increasing psychological distance by assuming a high-power position caused individuals to tend toward perceiving global structure to extract the gist. Liberman et al. (2009) found that thinking about more distant future, spatial location, or social relationships enhanced individuals' ability to recognize Navon global letters faster. Additionally, previous studies have indicated that a high-level construal mindset enhances relational processing (e.g., Ikeda et al., 2016). Ikeda et al. (2016) found that a high-level construal mindset can reduce retrieval-induced forgetting by promoting relational processing. Based on these findings, this study hypothesizes that a high-level construal mindset promotes the categorization of information according to thematic relations.

In the current study, we used the construal-level priming manipulation task developed by Freitas et al. (2004) to manipulate high-level versus low-level construal mindset via the "why/how" manipulation. After the construal-level priming task, participants completed the triad task (e.g., Li et al., 2023; Lin et al., 2001). If a high-level construal mindset promotes thematic categorization, we anticipated that the proportion of thematic responses within the high-level construal mindset group would be higher in the triad task, regardless of whether the objects being classified were natural (Experiment 2) or artificial (Experiment 1).

Experiment 1

Methods

Participants and design. We determined the sample size based on effect sizes from related research. For example, Markowitz (2010, Exp. 1) reported an effect size of f = 0.34 (equivalent to d = 0.78), and Maldei et al. (2020, Study 1) found an effect size of f = 0.28 (equivalent to d = 0.56). By averaging these effect sizes (d = 0.67) and aiming for a power of 0.80 with an alpha level of $\alpha = 0.05$ using G*Power (Faul et al., 2009), the calculated total sample size was 72, indicating a minimum of 36 participants per experimental condition. In pursuit of higher power, we recruited 131 undergraduate students (63 male and 68 female, mean age = 21.55 years, SD = 1.11 years). Among them, 66 participants (32 males and 34 females) were allocated to the high-level construal mindset group, while 65 participants (31 males and 34 females) were assigned to

the low-level construal mindset group. All participants received corresponding course credits.

The study employed a between-subjects single-factor design, with thinking type (high-level construal mindset or low-level construal mindset) serving as the between-subjects variable. The dependent variable was the proportion of theme-related responses in the triad task, with higher proportions indicating greater inclination to categorize information based on thematic relationships.

Materials and procedure. We first asked both groups to complete the construal-level priming task developed by Freitas et al. (2004). In the high-level construal mindset group, participants responded to four consecutive "why" questions, starting with queries like "Why maintain good physical health?" and then referring to their responses. Conversely, in the low-level construal mindset group, participants responded to four consecutive "how" questions beginning with the same behavior, such as "How to maintain good physical health," and subsequently referred to their answers (see Fig. 1).

Fig 1. Mindset induction manipulation: Participants complete the high-level construal mindset manipulation ("why?") or the low-level construal mindset manipulation ("how?").

After completing the construal-level priming task, all participants completed the Behavioral Identification Form (BIF; Vallacher & Wegner, 1989). The BIF is a widely adopted measure of construal level (Hansen & Trope, 2013; Shaeffer, Libby, & Eibach, 2015). On this form, participants were presented with 25 target behaviors that they could redescribe in either narrow, discrete terms or global, superordinate terms. Participants received a score of 1 for abstract descriptions and 0 for concrete descriptions, with higher scores out of 25 indicating greater tendency toward abstract construal.

Finally, after completing the BIF, all participants completed the triad task used in previous studies by Guest et al. (2016) and Lin et al. (2001) with the same stimuli (the full list appears in Appendix A). To ensure cross-cultural validity, we adopted the methodology suggested by Ember et al. (2001) and undertook translation and back-translation of the word materials to create the Chinese version used in the experiment. During this task, items were sequentially presented on a computer screen with random order generated by the computer. Each item consisted of a benchmark word (e.g., "lamp") along with two comparison words: one taxonomically related (e.g., "flashlight," indicating shared luminous lighting attributes) and one thematically related (e.g., "desk," indicating complementary roles in a "learning" or "handling official business" scenario) (see Fig. 2). Participants determined which comparison word should be grouped with the benchmark word. The proportion of thematically related choices served as the measure of classification tendency, with thematically related words presented on the left for half the items and on the right for the other half.

Fig 2. Example of the triad items.

Results and Discussion

First, the manipulation check revealed successful construal level manipulation. Participants in the high-level mindset group (M = 17.88, SD = 2.34) chose a higher proportion of high-level alternatives on the BIF than the low-level mindset group (M = 13.17, SD = 2.71), t(129) = 10.66, p < 0.001, Cohen's d = 1.86, 95% CI [3.836, 5.583], BF10 = 1.76$×10^{16}$ in favor of an effect (Default prior).

Subsequently, we conducted a correlation analysis to explore the relationship between BIF scores and the proportion of theme-related responses in the triad task. The results revealed a significant positive correlation between BIF scores and thematic response proportions, r(131) = 0.44, p < 0.001, BF10 = 10.98$×10^{4}$, favoring an effect (Default prior). Furthermore, regression analysis demonstrated that BIF scores significantly and positively predicted thematic response proportions, β = 0.44, t(131) = 5.60, p < 0.01, BF10 = 9.71$×10^{4}$, favoring an effect (Default prior).

Finally, we calculated the percentage of thematic responses in both groups (see Fig. 3). An independent samples t-test revealed that the high-level mindset group (M = 0.70, SD = 0.17) exhibited a significantly higher percentage of thematic responses than the low-level mindset group (M = 0.46, SD = 0.17), t(129) = 8.20, p < 0.001, Cohen's d = 1.43, 95% CI [0.184, 0.301], BF10 = 2.73$×10^{10}$ in favor of an effect (Default prior). These results indicate that a high-level construal mindset promotes categorizing information based on thematic relations.

Fig 3. The percentage of thematic responses in high-level and low-level mindset groups (error bars represent standard errors).

Experiment 2

Previous research has found that individuals tend to classify natural objects based on taxonomic relationships (e.g., Kalénine et al., 2009; Kalénine & Buxbaum, 2016). In Experiment 1, we employed a real-world version of the triad task using only artifacts (e.g., cars). In Experiment 2, we expanded our investigation to examine whether a high-level construal mindset still promotes thematic categorization when the objects are natural kinds (e.g., cats). Additionally, we introduced a non-priming control group for comparison. If a high-level construal mindset promotes thematic categorization, we anticipated that participants primed with a high-level mindset would exhibit a higher proportion of thematic responses compared to both those primed with a low-level mindset and those in the control group.

Methods

Participants and design. Consistent with Experiment 1, we determined sample size based on effect sizes from related research. For example, Estes (2012,

Study 3) reported an effect size of f = 0.13, and Li et al. (2023, Exp. 2) found an effect size of f = 0.41. By averaging these effect sizes (f = 0.27) and targeting a power of 0.80 with $\alpha = 0.05$ in G*Power (Faul et al., 2009), specifying three groups resulted in a required sample size of 138. Aiming for higher power, we recruited 200 undergraduate students (101 male and 99 female, mean age = 21.15 years, SD = 0.94 years). Of these, 66 (34 male and 32 female) were assigned to the high-level construal mindset group, 67 (36 male and 31 female) to the low-level construal mindset group, and 67 (31 male and 36 female) to the control group. All participants received corresponding course credits.

The study utilized a between-subjects single-factor design with cognitive type (high-level construal mindset, low-level construal mindset, and control) as the between-subjects variable. The dependent variable was the proportion of theme-related responses in the triad task, with higher proportions indicating greater tendency to categorize information based on thematic relationships.

Materials and procedure. As in Experiment 1, we primed high-level and low-level construal mindsets using the construal-level priming task developed by Freitas et al. (2004). The control group received no induction.

After completing the priming task, all participants completed a natural-world version of the triad task using only natural objects (the full stimulus list appears in Appendix A). Stimuli were presented identically to Experiment 1, using the same items employed in previous studies by Guest et al. (2016) and Lin et al. (2001). To ensure cross-cultural validity, we again used translation and back-translation (Ember et al., 2001) to create Chinese versions of the materials.

Results and Discussion

First, the manipulation check revealed successful construal level manipulation. The main effect of construal level was significant, F(2, 197) = 38.33, p < 0.001, ^{2} = 0.28, BF10 = 7.45$×10^{11}$ in favor of an effect. Post-hoc tests with Bonferroni corrections indicated that the high-level mindset group (M = 18.77, SD = 4.03) chose a higher proportion of high-level alternatives on the BIF than both the low-level mindset group (M = 12.73, SD = 3.81), p < 0.001, 95% CI [4.373, 7.679], BF10 = 1.17$×10^{12}$, and the control group (M = 15.81, SD = 4.10), p < 0.001, 95% CI [1.284, 4.589], BF10 = 423.56. Additionally, the control group chose a higher proportion of high-level alternatives than the low-level mindset group, p < 0.001, 95% CI [1.443, 4.736], BF10 = 1207.06.

Subsequently, we conducted a correlation analysis examining the relationship between BIF scores and thematic response proportions. The results revealed a significant positive correlation, r(198) = 0.27, p < 0.001, BF10 = 167.13 in favor of an effect (Default prior). Regression analysis further demonstrated that BIF scores significantly and positively predicted thematic response proportions, $\beta = 0.27$, t(198) = 3.98, p < 0.01, BF10 = 208.83 in favor of an effect (Default prior).

Finally, we calculated the percentage of thematic responses across all three groups (see Fig. 4). A one-way ANOVA revealed a significant main effect of construal level, $F(2, 197) = 24.70$, $p < 0.001$, $^{2} = 0.20$, BF10 = 3.67$×10^{7}$ in favor of an effect. Post-hoc tests with Bonferroni corrections indicated that the high-level mindset group ($M = 0.64$, $SD = 0.22$) exhibited a significantly higher percentage of thematic responses than both the low-level mindset group ($M = 0.38$, $SD = 0.18$), $p < 0.001$, 95% CI [0.171, 0.352], BF10 = 1.08$×10^{9}$, and the control group ($M = 0.49$, $SD = 0.24$), $p < 0.001$, 95% CI [0.063, 0.243], BF10 = 119.41. These results demonstrate that even when categorizing natural objects, a high-level construal mindset promotes thematic categorization.

Fig 4. The percentage of thematic responses in high-level mindset, low-level mindset, and control groups (error bars represent standard errors).

General Discussion

This study investigated whether a high-level construal mindset promotes categorizing information based on thematic relations. The findings demonstrated that regardless of whether the classification objects were artifacts (Experiment 1) or natural objects (Experiment 2), participants who initiated a high-level mindset exhibited a higher proportion of thematic responses in the triad task. These results suggest that a high-level construal mindset promotes thematic categorization.

This study builds upon previous research examining when individuals tend to categorize information based on thematic relations. Prior studies have provided evidence that various factors—including generating solutions to distant analogies, unconscious thought, increasing age, and East Asian culture—influence individuals' propensity for thematic categorization (Berger et al., 2006; Li et al., 2022; Li et al., 2023; Nisbett et al., 2003). Extending these findings, the present study further demonstrates that a high-level construal mindset promotes thematic categorization.

This study provides more direct evidence for the influence of a high-level construal mindset (abstract thinking) on individuals' classification preferences. Previous research found that initiating global processing leads individuals to classify information based on thematic relations (Guest et al., 2016) and that categorizing abstract concepts relies more strongly on thematic relations (Crutch & Warrington, 2010). Although both global processing at the perceptual level and classification of abstract concepts are closely related to abstract thinking, researchers had not directly explored the relationship between abstract thinking and thematic classification. This study fills that gap by demonstrating that a high-level construal mindset promotes thematic categorization.

The present findings support Construal Level Theory (CLT). From the perspective of CLT, high-level construal mindsets are more inclusive, emphasizing information integration and global processing (e.g., Shapira et al., 2012; Trope et al., 2010). Unlike classifying information based on categorical relationships,

thematic categorization focuses on discovering overall relationships between objects (Guest et al., 2016; Mirman et al., 2017). Our results showing that a high-level construal mindset promotes thematic categorization thus provide empirical support for CLT.

Future research could explore a broader range of classification tasks to investigate whether a high-level construal mindset promotes thematic categorization. This study employed the classic triad task, a forced-choice task with only two options. While widely used to measure tendencies to categorize based on thematic or taxonomic relationships, Honke and Kurtz (2019) recently challenged its validity, suggesting it may not accurately measure such tendencies in some cases. In response, they developed the Ring Task as an alternative. Future research should consider using the Ring Task to further investigate whether a high-level construal mindset promotes thematic categorization.

Future studies should also select participants from diverse cultural backgrounds to investigate whether individuals from varying cultural contexts exhibit thematic categorization when adopting a high-level construal mindset. Among existing studies, Nisbett et al. (2003) discovered that Europeans and Americans lean toward categorizing information using category relations, and Masuda et al. (2001) observed that they tend to process information locally. This local processing tendency could lead individuals to categorize information based on taxonomic relations (Guest et al., 2016). Our participants were Chinese university students from East Asian culture. Future research should include individuals from Euro-American cultures to further explore this phenomenon.

Compliance with Ethical Standards

Conflict of Interest: The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

Research Involving Human Participants: The study was conducted after obtaining Institutional Review Board approval from the Department of Psychology at Northwest Normal University. We received written consent from all participants before testing began. All procedures performed in studies involving human participants complied with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

Data Availability: The data from this study have been uploaded to the OSF sharing platform at the following access link: https://osf.io/78eug/?view_{only}=a9630a70964d42b8916ea2813 None of the experiments was preregistered.

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Appendix A: Items Used in Experiments 1 and 2 (The Triad Task)

Experiment 1

Base item | Taxonomic | Thematic
—|—|—
airplane | flashlight | yacht
sailor | pilot | rabbit
squirrel | eagle | carrot
night | sound | toothbrush
hairbrush | denture | coconut
pineapple | palm tree | Movie theatre
opera house | popcorn | movie
documentary | producer | litter box
French fries | baked potato | ketchup
cactus | willow | dry climate
shirt | hot dog | cookie
jacket | steak | birthday
butterfly | honey | buffalo
mustard | penguin | goose
The Antarctic | police car | sedan
police officer | panda bear | grizzly bear
bamboo | chalk | marker
blackboard | spider | spider web
ambulance | fire truck | stretcher
squirrel | diamond ring | bracelet
engagement | camel | antelope
desert

Experiment 2

Base item | Taxonomic | Thematic
—|—|—
airplane | flashlight | yacht

sailor | pilot | rabbit
squirrel | eagle | carrot
night | sound | toothbrush
hairbrush | denture | coconut
pineapple | palm tree | Movie theatre
opera house | popcorn | movie
documentary | producer | litter box
French fries | baked potato | ketchup
cactus | willow | dry climate
shirt | hot dog | cookie
jacket | steak | birthday
butterfly | honey | buffalo
mustard | penguin | goose
The Antarctic | police car | sedan
police officer | panda bear | grizzly bear
bamboo | chalk | marker
blackboard | spider | spider web
ambulance | fire truck | stretcher
squirrel | diamond ring | bracelet
engagement | camel | antelope
desert

Note: Figure translations are in progress. See original paper for figures.