

FAMILIARITY, ABSTRACTNESS, AND THE INTERPRETIVE STRATEGIES OF NOUN-NOUN COMBINATIONS

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ABSTRACT

Conceptual combination refers to the cognitive process by which people combine two or more concepts to represent a new conceptual entity. Literature has studied the primary interpretive strategies of a conceptual combination denoted by two nouns (e.g., *robin snake*): relation-linking (e.g., *a robin snake is a snake that eats robins*) and property-mapping (e.g., *a robin snake is a snake that has red breast*). This study examined two factors in relation to the choice of interpretive strategies in human cognition: familiarity with the combination and abstractness of the two constituent concepts. A total of 49 participants evaluated 240 noun-noun combinations. Both familiarity and the abstractness of the constituent concepts were found positively associated with the likelihood of the choice of relation-linking

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strategy. In addition, the abstractness of the modifiers was more predictive of the likelihood than the abstractness of the head nouns, suggesting that the cognitive process of combining concepts is largely influenced by the characteristics of component concepts.

Key Words: noun-noun combinations; familiarity; abstract concepts; relation-linking; property-mapping

1. INTRODUCTION

Conceptual combination refers to the cognitive process by which people combine two or more concepts to represent a new conceptual entity that a single concept is insufficient to describe. Among many types of conceptual combinations, researchers have paid special attention to noun-noun combinations – a combination of two concepts denoted by two nouns (e.g., Downing, 1977; Medin and Shoben, 1988; Murphy, 1990; Ran and Duimering 2009). Some theories have been proposed to explain the cognitive process of combining two noun concepts. For example, the Dual Process theory (Wisniewski, 1997, 1999) proposes that interpreting a noun-noun combination may involve either of these two processes: a relation-linking process by which the two nouns are integrated through a thematic relation, or a property-mapping process by which the two concepts denoted by the two nouns are compared, and then one or more properties of one concept are transferred to the other. That is, the relation-linking interpretation creates a plausible scenario involving the two constituent concepts. For example, a *truck soap* can be interpreted as a soap for cleaning a truck, in which *truck* is the object of the cleaning action, while *soap* is what is used to do the cleaning (Wisniewski, 1997). In contrast, the property-mapping understanding starts from comparing commonalities and differences between the two constituent concepts, and ends with selecting and transferring one or more properties from one concept to the other. For example, to understand *fork spoon*, people could compare the two concepts and identify an important feature of *fork*, “has prong”, that can be incorporated on the *end* of a *spoon* (Wisniewski, 1997).

Another theory, the Competition Among Relations In Nominals (CARIN) theory (Gagné, 2000, 2001; Gagné and Shoben, 1997, 2002) stresses the psychological significance of the relation-linking process. Gagné (2000) argued that people mainly use their prior experience about the thematic relations that the constituent nouns are often involved in to construct the interpretation of a noun-noun combination. For example, a *mountain* is often a location of other things.

Therefore, a *mountain stream* can be aptly interpreted as a stream found or located in the mountain. Furthermore, Gagné argued that people possess distributional knowledge about how often particular relations have been used with particular nouns, and the most frequent and typical relation of a noun (e.g., *locative* relation as to the noun *mountain*) is often the one being selected for interpretation (Gagné and Shoben, 1997).

According to these theories about noun-noun combinations, there appear to be mainly two strategies people use to construct or interpret the meaning of a noun-noun combination, the relation-linking strategy and the property-mapping strategy. Empirical research including corpus studies has provided evidence for both strategies (e.g., Gagné, 2000; Wisniewski, 1997). In addition, the relation-linking strategy seemed more prominent compared to the property-mapping strategy among natural-occurring instances for noun-noun combinations. Corpus studies have found that the majority of the natural-occurring noun-noun combinations are constructed through thematic relations as opposed to property comparison and transference (e.g., Gagné, 2000; Wisniewski and Love, 1998). The purpose of the present study was to investigate the factors that might be associated with people's choice of strategies for constructing and interpreting noun-noun combinations.

Some noun-noun combinations can be understood both through relational integration and through property comparison. A repeatedly used example in the literature is *robin snake* (e.g., Gagné, 2000, Wisniewski, 1997). A *robin snake* can be understood as *a snake that eats robins* by relating the two concepts, or as *a snake that has red breast* by comparing them and mapping one key property from robin to snake. Even though both meanings are plausible, we rarely reach both simultaneously. In fact, one meaning always seems easier to derive than the other, and people often prefer one to the other. As discussed earlier, research has shown that the majority of natural-occurring noun-noun combinations are constructed through relation-linking. Gagné (2000) further argued that relation-linking strategy is more psychologically significant. To evaluate the status of the relation-linking strategy, the present study examined how the level of familiarity with a noun-noun combination might be associated with one's choice of the relation-linking strategy over the property-mapping strategy. It is tentatively hypothesized that the more familiar a noun-noun combination is, the more likely it is interpreted through a relation-linking strategy. Familiarity has been identified in the literature about noun-noun combinations as a factor that affects the ease of understanding noun-noun combinations (Tagalakakis and Keane, 2006; Wisniewski and Murphy, 2005). However, researchers have not directly evaluated whether there could be a linear correlation between the degree of familiarity with a noun-noun combination

and the preference for a relational strategy, which could potentially test the claim about the psychological significance of the relation-linking strategy.

Another factor examined in this study was the abstractness/concreteness of the constituent concepts, the modifier and the head noun, of noun-noun combinations. This factor has been given little attention so far. In the literature, study materials were overwhelmingly noun-noun phrases consisting of concrete concepts. A couple of exceptions are Gagné (2000) and Maquire, Wisniewski, and Storm (2006). Gagné (2000) examined a large number of abstract concepts. However, abstractness was not a factor explicitly studied. Maquire et al. (2006) compared the productivities of abstract nouns and concrete nouns in noun-noun combinations. That is, they compared abstract concepts versus concrete concepts in terms of how frequent each type of concepts appear in the modifier position versus the head noun position in natural English language. Their analysis showed that there were more abstract head nouns than abstract modifiers, whereas there was no such difference found for concrete concepts.

Abstract concepts and concrete concepts are represented and processed differently. Concrete concepts usually have core physical referents, such as *table*, *bird*, or *person*, whereas abstract concepts, such as *justice*, *civilization*, or *consultation*, are usually represented as situations or scenarios with a number of key elements (Barsalou, 1999; Barsalou and Wiemer-Hastings, 2005). For instance, the representation of *consultation* is a situation in which elements such as a subject matter, a communication process, and at least two agents must be involved. It would not be proper to denote it as a *consultation* if a situation is missing any of these elements. More relevant to the current study is the fact that studies have shown that abstract concepts do not readily evoke features such as color, shape, or texture as do concrete concepts (Graesser and Clark, 1985; Markman and Gentner, 1993). More importantly, when asked to evaluate the similarity of two abstract concepts, people sometimes integrate them through thematic relations such as causal relation, temporal contingency, or spatial proximity (Wiemer-Hastings and Xu, 2003). For example, while evaluating the similarity between *sadness* and *surprise*, some participants mentioned the potential causal relationship between the two: *a bad surprise can lead to a feeling of sadness*. In contrast, for two concrete concepts, e.g., *giraffe* and *horse*, people were more likely to analyze and align features of the two, e.g., *both have four legs and a tail*. Given these differences between abstract and concrete concepts, what happens when one or both of the nouns of a noun-noun combination are abstract concepts? How might this affect the strategy people use to make sense of the combination?

In summary, the study reported here examined two factors, the familiarity with the noun-noun combinations and the abstractness of the constituent concepts, in relation to the interpretive strategies for noun-noun combinations. In this study, participants indicated which strategy, relation-linking or property-mapping, they used to interpret each of the noun-noun combinations presented to them. Previous studies have shown that relation-linking is more prevalent than property mapping. If this is the case, it is likely that more familiar combinations should be judged and interpreted through a relational approach. In addition, if relation-linking is more of psychological significance (Gagné, 2000), the likelihood of choosing a relation-linking strategy might be positively associated with the level of familiarity of the phrase. As of abstractness of the constituent concepts, abstract concepts rarely contain readily available, specific features, and it seems to be a natural strategy to relationally link an abstract concept with another concept. Therefore, it was hypothesized that abstractness of the constituent concepts, both the modifier and the head noun, would increase the chance for the choice of relation-linking strategy.

METHOD

Participants

Forty-nine undergraduate students from introductory psychology classes participated in this study. All considered themselves the native speakers of English. They received course credits for participation.

Materials

Two hundred and forty noun-noun combinations were randomly sampled from among the stimuli used by Gagné and colleagues (e.g., Gagné, 2000; Gagné and Shoben, 1997) and by Wisniewski and colleagues (e.g., Wisniewski, 1997; Wisniewski and Love, 1998; Wisniewski and Middleton, 2002; Storms and Wisniewski, 2005). Among these stimuli items, many could be interpreted through both the relation-linking strategy and the property-mapping strategy. Example stimuli include *farm community*, *goose duck*, *government operation*, and *olive area*. To increase the representativeness of the sampled stimuli, care was taken to ensure that as few combinations as possible share the same head nouns or the same modifiers. As a result, no words but two (*box* and *equipment*) appeared

as head noun more than twice. *Box* and *equipment* appeared as head noun three times each. No words but four (*family*, *spear*, *state*, and *home*) appeared as modifier more than three times. *Family*, *spear*, and *state* appeared as modifier four times, and *home* appeared as modifier five times. The 240 noun-noun combinations were divided into four even groups. Each participant received one list of 60 combinations.

Procedure

The noun-noun combinations were presented to the participants on computer screen, one at a time, in random order. Participants needed to judge whether the meaning of each noun-noun combination was derived from comparing the properties of the two concepts denoted by the nouns or relating the two concepts. A repeatedly-used example, *robin snake*, from the literature was included in the instruction to help participants understand the task. In this example, a robin snake can be understood as "a snake that has red breast," or as "a snake that eats robins." That is, the first meaning is derived from comparing the properties of the two animals, whereas the second meaning is derived from relating the two nouns. Approximately half of the participants read the two meanings of this example combination in the order they were presented here, whereas the other half of the participants read the two meanings in the opposite order.

Following the instruction, participants needed to press one of two labeled keys, *comparing properties* versus *relating the two nouns*, on the keyboard to indicate their interpretation of each combination. The positions of the two labeled keys were counterbalanced among participants. They were also told that, when they felt that a combination had two equally plausible meanings, they should still press only one of the two keys to indicate which meaning jumped to the mind first. Finally, participants indicated how familiar they felt about each noun-noun combination using a 5.0 scale, with "1" as "not familiar at all" and "5" as "extremely familiar".

RESULTS

For each of the 240 noun-noun combinations, the probability of being judged as a relation-linking combination (Pr, henceforward) was represented by the number of participants who chose the relational interpretation divided by the number of participants who had judged on this combination. The probability of

being judged as a property-mapping combination was therefore equal to 1 minus the probability of being judged as a relation-linking combination ($1 - Pr$). The value of Pr ranged from 0 to 1, with a mean of 0.55. That is, among the 240 combinations, some (e.g., *coat shirt*) were judged by all participants as property-mapping combinations, some (e.g., *state court*) were judged by all participants as relation-linking combinations, yet some (e.g., *olive area*) were disputed among participants.

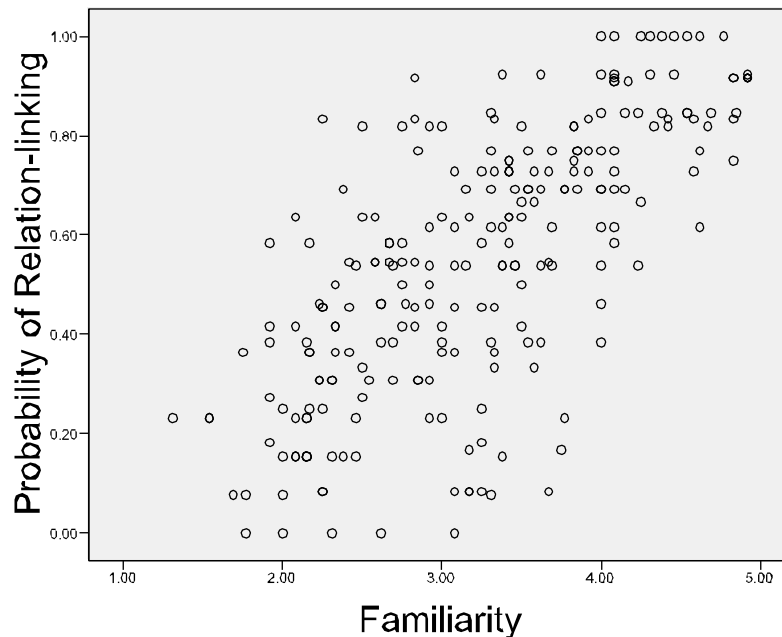


Figure 1: Correlation between familiarity and probability of relation-linking judgments.

Participants' familiarity ratings were first evaluated in terms of agreement. Cronbach's *alphas* were 0.88, 0.90, 0.84, and 0.90 for the four lists of stimuli items, respectively, indicating a high level of agreement on familiarity among participants. Therefore, for each noun-noun combination, the familiarity rating was averaged across participants. The average familiarity rating ranged from 1.31 to 4.92, with a mean of 3.24. A scatterplot (Figure 1) suggested that there was a positive association between Pr and familiarity rating. Pearson's $r(240) = 0.70$ ($p < 0.001$) indicated that this was indeed a strong positive correlation. That is, the more familiar a noun-noun combination was, the more likely it was judged as a

relation-linking combination. Conversely, the less familiar a noun-noun combination was, the more likely it was judged as a property-mapping combination.

Considering the fact that the stimuli combinations were sampled from materials including both natural-occurring instances (potentially more familiar instances) and instances constructed for research purposes (potentially less familiar instances), it might be possible that the correlation between Pr and familiarity was inflated because previous studies had shown that the majority of natural-occurring, hence potentially familiar, instances are relational by nature. To further elucidate the relationship between Pr and familiarity, correlational analysis was conducted for the items that could be surely identified as natural-occurring instances based on the material descriptions in the original studies and for the rest of the items, separately. Correlation coefficient was found $r(101) = 0.75$ ($p < 0.001$) between Pr and familiarity for natural-occurring items, whereas correlation coefficient was $r(139) = 0.69$ ($p < 0.001$) for the rest of the items. These results further supported the validity of the relationship between Pr and familiarity.

To examine the relation of Pr with the abstractness/concreteness of the head nouns and the modifiers, the concreteness ratings of the head nouns and the modifiers were retrieved from the MRC Linguistic Database (cf. Coltheart, 1981; Wilson, 1988). The database provides concreteness ratings of both the head nouns and the modifiers for 100 out of the 240 noun-noun combinations. For these 100 combinations, the concreteness ratings for the head nouns ranged from 267 to 637 on a 700-point scale, and the concreteness ratings for the modifiers ranged from 280 to 648 on the same scale. Therefore, the 100 combinations can be considered representative in terms of the ranges of the concreteness levels of both the head nouns and the modifiers. Due to skewed distribution of these ratings, a cubing transformation was performed before further analysis.

Bivariate correlational analysis showed that Pr was negatively correlated to both the concreteness of head nouns, $r(100) = -0.42$, $p < 0.001$, and the concreteness of the modifiers, $r(100) = -0.53$, $p < 0.001$ (Figures 2 and 3). That is, the more concrete the head noun or the modifier was, the more likely a combination was judged as a property-mapping combination. Conversely, the more abstract the head noun or the modifier was, the more likely a combination was judged as a relation-linking combination.

To compare the relative importance of the familiarity of the noun-noun combination, the concreteness of the head noun, and the concreteness of the modifier, a multiple regression analysis with backward approach was conducted. Both the familiarity rating, $\beta = 0.63$, $t = 8.59$, $p < 0.001$, and the concreteness rating of the modifier, $\beta = 0.24$, $t = 3.24$, $p < 0.005$, emerged as significant

predictors for the likelihood of a noun-noun combination to be judged as a relation-linking combination versus a property-mapping combination. They accounted for 59% of the variance in the likelihood of the judgments. The concre-

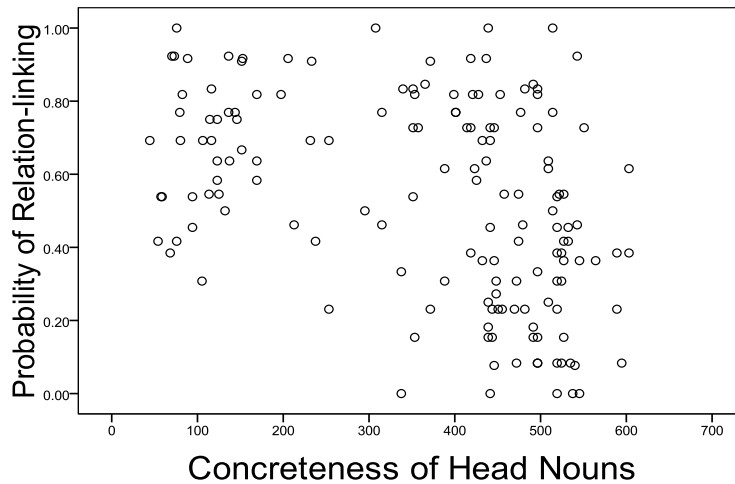


Figure 2: Correlation between concreteness of head nouns and probability of relation-linking judgments.

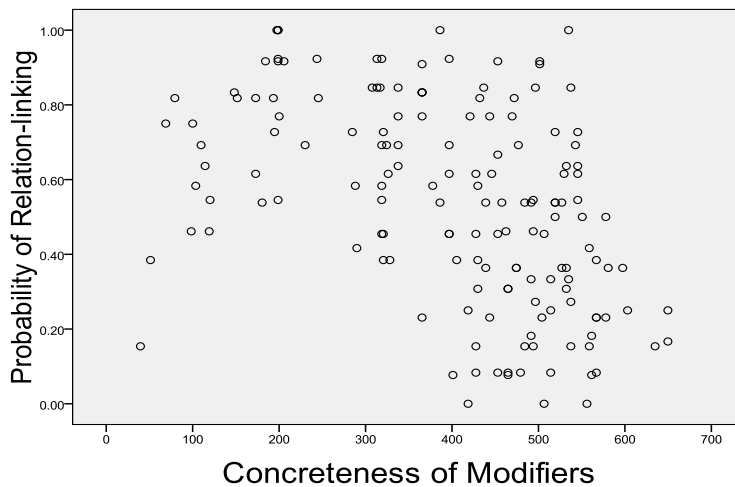


Figure 3: Correlation between concreteness of modifiers and probability of relation-linking judgments.

teness rating of the head noun did not reach the significance criterion, and was therefore removed from the model. The results suggest that familiarity rating was the most important predictor among the three factors, and that concreteness rating of the modifier appeared more predictive of the judgment decision than the concreteness rating of the head noun.

DISCUSSION

The organization of knowledge in human cognition is largely semantic and based on the meaning of the information. When people process conceptual combinations, the semantic memory of the components is often under the influence of many factors. This study examined two such factors: familiarity and abstractness. We asked participants to evaluate noun-noun combinations that were sampled from the materials used in past research including natural-occurring instances of noun-noun combinations and novel combinations constructed for controlled experiments. The positive correlation found in this study between the probability of noun-noun combinations being understood through relation-linking and the level of familiarity with the combinations suggests that many combinations that people are very familiar with appear to be relational combinations, or at least readily understood by the majority as relational combinations. This seems to be in line with previous findings that most natural-occurring noun-noun combinations were relational in nature, whereas a relatively small portion of them evoked property comparison and transference (e.g., Gagné, 2000; Wisniewski and Love, 1998). Furthermore, the linear correlation between the probability of relation-linking and familiarity indicated that the increase of familiarity was associated with the increase of the likelihood for a combination being judged as relational. Considering familiarity was a subjective, self-report measure based on participants' experience and perception, its association with the probability of relational judgments seems to suggest psychological significance of the relation-linking approach. However, it should be noted that Gagné's (2000) claim was that the relation-linking approach was more psychologically significant in that people tended to first resort to this approach rather than the property-mapping approach to derive the meaning of a noun-noun combination. The finding about familiarity in this study does not provide evidence for this first-resort argument, but it may imply that relational interpretation is psychologically significant in that the more apt a noun-noun combination is to be understood as a relational phrase, the more likely it is to be accepted or added to people's mental lexicon.

A second finding of this study was the relationship between the abstractness of the constituent concepts and the choice of interpretive approaches for noun-noun combinations. More specifically, the abstractness of both constituent concepts was positively associated with the choice for relation-linking strategy. Abstract concepts are represented as situations or scenarios, and their properties are significantly less specific (Wiemer-Hastings and Xu, 2005). Therefore, it appeared to be natural for one to engage in a thematic relational linking strategy when reading or hearing a noun-noun combination consisting of abstract concepts. As discussed earlier, abstractness of concepts has not seemed to be thoroughly examined in the context of conceptual combination. This study is an attempt to fill this void. Maquire et al. (2006) argued that abstractness of a concept could be either due to the range of its representation (e.g., A *unit* can have a large range of possible representations) or due to the intangibility of the referent (e.g., *requirement*). Future research should look into different types of abstract concepts, and examine their roles in the interpretive process of noun-noun combinations.

In addition, the results of this study showed that the abstractness of the modifiers appeared to be more predictive of the interpretive strategies than the abstractness of the head nouns. Possibly, it is due to the position and the syntactic role of a modifier in a noun-noun combination that one's interpretive strategy is first and foremost prompted and even determined by the characteristics of the modifiers as opposed to the characteristics of the head nouns. Gagné and colleague also found that the characteristics of the modifier seemed more influential to the interpretation process of noun-noun combinations. More specifically, a particular noun often appears in some particular relations with other nouns. For example, a *mountain* is often a *location of* other things, whereas a *tool* is often *used for* certain tasks. Gagné and Shoben (1997) found that the typical relation that the modifier entails could affect the ease of the interpretation of a noun-noun combination, whereas the typical relation that the head noun entails did not have such an effect. In addition, Gagné (1999) found that the typical relation of the modifier, but not the typical relation of the head noun, had a priming effect on how a noun-noun combination was interpreted.

In summary, the present study examined two factors in the interpretive process of noun-noun combinations: familiarity with the combinations and abstractness of the constituent concepts. Both factors appeared to be associated with the choice between two interpretive strategies: relation-linking versus property mapping, which are often studied in the literature of conceptual combination. Future studies in this lab will attempt to address a number of issues left by this study. For example, the abstractness of concepts was evaluated based

on ratings obtained from a database, which only provided information for a limited number of combinations. Human ratings for more combination items are necessary to further examine the role of this factor in the context of conceptual combination. In addition, participants were forced to make a choice between relation-linking and property-mapping in this study. Research has shown, though rare, some combinations cannot be interpreted through either approach. Therefore, a forced choice task might have overlooked some other options, and an open-ended task may be a useful addition to this task.

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