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Content Differences for Abstract and Concrete Concepts

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Abstract

Concept properties are an integral part of theories of conceptual representation and processing. To date, little is known about conceptual properties of abstract concepts, such as *idea*. This experiment systematically compared the content of 18 abstract and 18 concrete concepts, using a feature generation task. Thirty-one participants listed characteristics of the concepts (i.e., item properties) or their relevant context (i.e., context properties). Abstract concepts had significantly fewer intrinsic item properties and more properties expressing subjective experiences than concrete concepts. Situation components generated for abstract and concrete concepts differed in kind, but not in number. Abstract concepts were predominantly related to social aspects of situations. Properties were significantly less specific for abstract than for concrete concepts. Thus, abstractness emerged as a function of several, both qualitative and quantitative, factors.

Keywords: Abstract concepts; Concreteness; Feature analysis; Concept representation

1. Introduction

Abstract words, such as *indecision* and *difference,* are abundant in daily conversation. They refer to diverse concepts such as personality traits, emotions, cognitive processes, and events. Very little is known about their representation to date, owing to their elusiveness to sensory experience, as well as to the considerable variability of their manifestations across situations (Galbraith & Underwood, 1973). For example, *difference* can refer to a sensory difference, such as the result of adding a bit of salt to a soup, or to mental differences such as between two opinions. In this article, superordinate categories of concrete items (such as *furniture*) are not used as abstract concepts; only situation-embedded instances of events, traits, actions, thoughts, and other abstract entities are used; these may involve objects, but are inherently abstract. This study systematically compares abstract and concrete concepts to identify their representational differences and the aspects that influence individuals' perceptions of concrete-

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ness. Features generated by participants for abstract and concrete concepts were compared with respect to their kinds and quantity, and these measures were related to ratings of perceived concreteness and associated variables, such as imagery.

At first glance, abstract concepts (e.g., *difference*) are easily distinguished from concrete concepts (e.g., *bucket*). Only concrete concepts represent physical entities, defined by spatial boundaries and perceivable attributes. However, physicality as the distinguishing factor is unsatisfying: It characterizes abstract concepts only by exclusion (i.e., "not physical"), and it does not account for graded differences in concreteness. For example, most people perceive *scientist* to be more abstract than *milk bottle,* but both are perceivable physical entities. Likewise, most people perceive *notion* as more abstract than *ambiance,* but neither is a perceivable physical entity. These gradual variations have been associated with differences in processing and are thus important to consider in an account of concept representation.

2. Variables associated with concreteness

It is more difficult to process abstract concepts such as *idea* than concrete concepts such as *table*. Such differences are known as concreteness effects, and span a variety of tasks, including studies of learning, memory retrieval, comprehension, lexical decision, translation, and semantic deficits. Most accounts for concreteness effects aim to quantify differences between abstract and concrete concepts (e.g., Jones, 1985; Kieras, 1978). However, there is currently no convincing explanation for concreteness effects that is based on conceptual content. The *associate set size* hypothesis (or connectivity) proposed larger sets of associates for abstract concepts, making them more confusable during recall processes. However, associate set size is only weakly correlated with concreteness and has independent effects on memory measures (Nelson & Schreiber, 1992). The *context availability* theory attributes concreteness effects to differences in the amount of context information available in memory for concrete than for abstract concepts (Bransford & Johnson, 1972; Kieras, 1978). Indeed, context availability tends to be highly correlated with concreteness ratings (e.g., Schwanenflugel, Harnishfeger, & Stowe, 1988). However, the postulated differences in the availability of context information in memory are neither well understood, nor have they received a satisfactory explanation. Finally, the *ease of predication* account assumes that predicates of concrete or highly imageable words are easier to generate (Jones, 1985). However, correlations of these variables are inconclusive because it is possible that concreteness or imageability considerations enter into the processes of rating ease of predication (cf. de Mornay Davies & Funnel, 2000).

The dual-code theory assumes a *qualitative* difference between abstract and concrete concepts and holds that concreteness effects are due to abstract concepts lacking a perceptual representation (Paivio, 1971, 1986). Imageability ratings are highly correlated with concreteness (Paivio, 1986; Rubin, 1980). However, imageability itself requires explanation. Imageability is likely associated with conceptual characteristics that afford imagery. Recent studies have furthermore shown that concreteness and imageability, and concreteness and context availability, are not consistently correlated for the entire range of concreteness (Altarriba, Bauer, & Benvenuto, 1999; Wiemer-Hastings, Krug, & Xu, 2001). Although high correlations were found for word samples that vary in concreteness from very abstract to very concrete, the correlation patterns differed when calculated separately for concrete versus abstract words. The findings suggest a more complex difference between abstract and concrete concepts. This study aimed to identify some representational factors that may underlie ratings of abstractness, imageability, and context availability.

3. Knowledge basis for abstract concepts: Predictions

Property generation tasks tap into conceptual knowledge and allow for an unbiased exploration of the knowledge and structure associated with concepts (e.g., Rosch & Mervis, 1975). This task instructs participants to list all characteristics of items that they can think of. Participant-generated features unlikely reflect exact conceptual content. Other important aspects are relations among features, or organizations of features according to individuals' theories about entities based on their world knowledge, which play an important role for concept processing (Murphy & Medin, 1985). However, properties generated by participants should reflect differences in the types of properties that underlie abstract versus concrete concepts. The experiment tested a few predictions for these differences.

Although concreteness is not a binary variable, there is some indication that a few factors should broadly distinguish the two groups. Concreteness ratings obtained for large samples of nouns tend to form a bimodal distribution (Nelson & Schreiber, 1992; Wiemer-Hastings et al., 2001), with each mode centered in one of the two halves of the concreteness scale. Consistent with this bimodality, which coincides with the physicality distinction, the first prediction was that qualitatively different features can be found in abstract and concrete concepts. Specifically, only concrete items should have *perceptual features.* In contrast, *introspective features,* such as emotions, are likely a central property of *abstract* concepts (Barsalou, 1999). Research shows that the proportion of introspective properties is correlated with perceived abstractness (Wiemer-Hastings et al., 2001).

Many abstract concepts are relational concepts (Gentner, 1981; Markman & Stilwell, 2001) that are characterized by their links to external concepts rather than by intrinsic properties, unlike most concrete concepts. Accordingly, abstract item properties may include frequent mention of *contextually related entities.* For example, Hampton (1981) observed that many properties generated for abstract concepts describe a social situation involving an agent, and suggested that abstract concepts would commonly involve behaviors, agent characteristics (such as goals), and other aspects of a situation. Similar situation elements have been suggested in the personality literature (Cantor, Mischel, & Schwartz, 1982; Chaplin, John, & Goldberg, 1988). Thus, the second prediction was that abstract item descriptions would mention *agents and agent-related properties,* including subjective experiences, behaviors, and social states, more often than concrete item descriptions.

Third, it was predicted that abstract concepts have properties that are relatively unspecified in comparison to concrete concepts because relational concepts vary widely across situations (Galbraith & Underwood, 1973). For example, an intuitive analysis suggests that *difference* refers to contexts that contain *any* two or more items that can be compared on some dimension. Unspecific properties may act like slots in a script or schema (Minsky, 1975; Schank & Abelson, 1977), which allow for different specific fillers. Perhaps the most abstract concepts can be described as so-called *content-free* schemata (Fiske & Taylor, 1991), which specify abstract entities and relations between them, but allow for a fairly unconstrained range of situations that can fit the schema.

4. Method

4.1. Participants

Thirty-one undergraduate students at Northern Illinois University participated in this experiment for course credit. All participants were native speakers of English.

4.2. Materials

Thirty-six nouns along with familiarity and concreteness ratings from published word norms were sampled from 1993 nouns retrieved from the MRC2 database (Coltheart, 1981; Wilson, 1988). The concreteness range was divided into six subsections through percentiles based on the MRC2 abstractness ratings. From each, six nouns were sampled randomly. Nouns were matched in familiarity across the concreteness levels, again using the MRC2 ratings. Items deliberately represented a variety of categories, including plants, animals, objects, substances, actions, emotions, states, and communication (see Appendix A) to average differences across abstract versus concrete items, rather than to limit the discussion to specific categories.

4.3. Design

Three lists of 12 items were constructed from the 36 items. Each set contained two words from each concreteness level. Sets were presented to participants in one of three tasks: (a) generation of item properties, (b) generation of context elements always occurring with the item, and (c) imagination of a specific context. Results from the first and second tasks were compared to test the extent to which contextual properties were named automatically versus on explicit instruction. The third task measured context availability through manual response times. These data were not analyzed because of accuracy problems.

The independent variables were word type (with six concreteness levels) and instruction (item properties, context features, context activation); both varied within participants. Each of the tasks was presented with a different 12-item set. The order of tasks and word sets were counterbalanced. Items within a set were presented in three different random orders. Analyses averaged effects across the word sets. At least 10 participants generated features for each item in each condition.

4.4. Procedure

Data were collected in individual sessions. For each task, the experimenter first read the instructions aloud. Examples varying in concreteness were presented that were not used in the study. A practice trial with one abstract, one concrete, and one intermediate item followed. After clarifying questions, participants received the first experimental item for the block. Part of the instructions was repeated before every new item to remind participants of the main task, and thus to limit carryover of processing strategies to subsequent items. The instructions for the item feature generation task read as follows: "Please describe as exhaustively as you can what aspects characterize this object: (item)." The instructions for contextual features were: "Please describe as exhaustively as you can aspects of a situation that MUST be true for this object to occur in it: (item)."

A previously prepared list of near synonyms was used to "translate" items that were unfamiliar to participants, to provide consistent information, and to not bias their answers through feature descriptions. Data were tape recorded with the participants' consent. Following the main tasks, each participant rated all 36 items for concreteness, context availability, and imagery. These ratings were provided in counterbalanced order, with items presented in different random orders. The experiment took about 30 min to complete.

5. Results

5.1. Analysis of transcripts

The data were manually transcribed and coded. Data from 5 participants were unusable due to failure to follow instructions, experimenter error, and omissions of particularly highly abstract items, such as *aspect* and *exception.* Thus, only 26 transcripts entered the analyses.

5.1.1. Coding of transcripts

The transcripts were parsed into features, which consisted of individual words or short phrases. All features were coded using a coding schema developed for concrete object features (Wu & Barsalou, 2004) and that has been shown to cover relevant aspects of conceptual knowledge (e.g., Cree & McRae, 2003; McRae & Cree, 2002). A previous exploratory study shows that these codes can be applied to abstract feature protocols (Barsalou & Wiemer-Hastings, 2005). This coding schema accommodates features for both abstract and concrete concepts because, besides *entity properties,* it also covers *situation properties,* and *introspective properties* (which we refer to as *subjective experience*), both of which we predicted to be relevant for abstract concepts.

Entity properties are intrinsic properties (Barr & Caplan, 1987; Gentner, 1981) that describe the structure and appearance of objects and express properties of the items themselves. For example, a *tree*'s entity properties include branches, green color, wood, and growing. Introspective or experience-related properties are personal experiences related to an item. This can include emotional or evaluative responses, negation, representational states, and more complex features such as contingencies and causal relations. Experiential features for *tree* may include evaluations such as *beautiful.* Some experiential properties are intrinsic item features, meaning that they describe the item itself. In other cases, they are *relational* (or extrinsic, Barr & Caplan, 1987) properties and describe relations of the item to other items or actions (Gentner, 1981).

Situation properties are relational properties, which describe the item's relations to other entities in context, such as animate beings, physical and social states, functions, and locations. Situation properties generated for *tree* typically include animate beings such as *birds,* objects such as *soil,* actions such as *climbing,* and functions such as *offering shade.* Situation properties reflect knowledge about an item's context and usually do not express characteristics of the item itself (Barr & Caplan, 1987). It may be argued that this is not necessarily true for abstract items. For example, a *person* is not a "property" of an emotion but a related entity; yet, the person is essential to an emotion in that without a person, there could not be an emotion. The same holds for most cognitions, traits, and actions.

The coding schema also includes taxonomic properties such as superordinates and synonyms. Taxonomic properties were not included in the analyses because they do not reflect item content. Taxonomic properties were analyzed separately. Slightly more taxonomic properties were mentioned for abstract items than for concrete items, but this difference was only marginally significant in a subject analysis, $F_1(1, 25) = 4.21$, mean square error [*MSE*] = 0.19, $p = .051$. Analyses of the individual taxonomic code categories reveal that this is mostly due to more coordinate terms and synonyms being listed for abstract items.

The feature lists for all words were coded by one of the authors so that the codes would be used consistently. Beforehand, a subset of features was coded by both authors to establish clear coding guidelines. Many features were coded by assigning a code to individual words; in other cases, a code was applied to a proposition. Examples for one coded concrete and one coded abstract item are shown in Appendixes B and C, respectively.

5.1.2. Feature scores

Differences between abstract and concrete conceptual content were analyzed, using type and token scores of entity, experience, and situation properties. The type scores show how many kinds of entity, experiential, and situation properties were named for an item, but not how often. This score is useful in evaluating the complexity of an item's features in each of the domains. For example, a situation-type score of "1" indicates that an item elicits one situation property (e.g., an action), whereas "3" or higher indicates a more complex scenario (e.g., a person, an action, and an object). Tokens refer to the total number of instances mentioned for these features. Token scores show the proportion of all features generated for an item that falls into the different domains. For example, an item that elicits five parts may have a type score of "1" for entity properties, but a token score of "5." Properties that were mentioned repeatedly were counted only once in an item's token score; for example, "an object" and "it" may refer to the same object.

5.2. Type analysis by domains

The first analysis compared the number of feature types generated for abstract and concrete concepts. The mean type scores are listed in Table 1. These scores are absolute scores rather than proportions. For comparison purposes, a weighted type score was also calculated that divided all scores by the total number of feature types available in the respective property domains (see Table 1). Participants altogether generated 16 types of situation properties, 11 types of entity properties, and only 6 types of experience-related properties. The weighted scores in-

Table 1
Average number of types of each property domain

Instruction	Item	Situations		Entities		Experience	
		Types	Weighed	Types	Weighed	Types	Weighed
Features	Abstract	3.44	0.22	0.33	0.03	1.09	0.18
	Concrete	3.62	0.23	2.09	0.19	0.33	0.06
Context	Abstract	3.81	0.24	0.25	0.02	1.47	0.25
	Concrete	4.19	0.26	0.93	0.08	0.54	0.09

dicate what proportion of feature types in a given domain were generated for items. Analyses were performed on the original type scores.

As expected, significant differences were observed between abstract and concrete concepts both in the number of types of entity and experiential features. First, participants generated significantly more kinds of entity properties for concrete than for abstract concepts, $F_1(1, 25) = 27.67$, $MSE = 0.36$, $p < .001$; $F_2(1, 34) = 21.31$, $MSE = 1.16$, $p < .001$; F_1 designates subject and F_2 item analyses, respectively). This reflects that only concrete concepts represent physical items. Instructions to generate context features decreased the number of kinds of entity properties, but significantly only for concrete items. This interaction was significant, $F_1(1, 25) = 22.90$, $MSE = 0.33$, $p < .001$; $F_2(1, 34) = 8.97$, $MSE = 0.51$, $p < .005$. There was still significantly more mention of entity properties for concrete concepts when asked to describe the context, suggesting that objects are processed as part of their context.

This result is of course consistent with the definition of abstract items as nonmaterial entities. In fact, it is surprising that any entity properties are listed for abstract concepts at all. A closer look at the kinds of entity properties shows that such properties were only listed for items of the "somewhat abstract" group. For many of these, one may argue that the features coded as entity properties may be coded as situation properties more appropriately. These include "parts" listed for *story* and *saga,* such as beginning, climax and ending, plot, and so forth, all of which could alternatively be considered *social artifacts.* Clearly, these are no more physical in nature than the targets themselves. This suggests that even if similar types of properties are generated for an abstract and a concrete item, the nature of the specific properties as well as their relation to the item may be qualitatively different.

A reverse pattern of differences was obtained for experience-related features. Participants listed significantly more different introspective features for abstract than for concrete items, $F_1(1, 25) = 76.99$, $MSE = 0.24$, $p < .001$; $F_2(1, 34) = 20.09$, $MSE = 0.64$, $p < .001$. This difference was robust across instructions. The proportion of experience-related features was increased significantly when participants were instructed to generate context features, $F_1(1, 25) = 4.72$, $MSE = 0.48$, $p < .05$; $F_2(1, 34) = 10.58$, $MSE = 0.17$, $p < .005$. Thus, as participants focus on an item's context, they describe more differentiated mental processes and states, such as goals, emotions, and so on.

An average of one experience-related property was generated for each abstract target. This suggests that subjective experiences are regular aspects of such concepts, rather than activated for specific abstract concepts. We also examined more closely what kinds of experience-related properties were generated by participants for concrete items. Such properties were listed predominantly for a few specific targets, most notably, for *labyrinth* and *prize.* A mental state such as *confusion* was listed quite regularly for *labyrinth;* likewise, positive emotions were frequently mentioned for *prize.* About half of the concrete item features coded as introspective expressed feature contingencies (e.g., *if, because*) or negation (e.g., *does not move*), rather than being either relational or intrinsic properties.

5.2.1. Entity and experiential properties across the concreteness scale

Do different property domains apply dichotomously either to abstract or to concrete concepts, as suggested by simplified definitions along the physical–not physical dimension, or are there gradual differences that may account for the large variation in perceived concreteness? In previous work, it was found that the proportion of experiential properties is significantly correlated with rated concreteness of abstract items, suggesting that abstract items vary gradually on this dimension. Similarly, an object with many intrinsic entity features may be perceived as more concrete. If true, there should be an increase in the proportion of experience features within the abstract target sample as items get more abstract, and an increase in the proportion of entity features for concrete items as these get more concrete. In the middle of the abstractness scale, items may involve a mix of entity and experiential features.

We plotted the *proportions* of entity and introspective features across the six concreteness levels for easier comparison. They are displayed in Fig. 1. There does not appear to be a dichotomous break in the types of features predominantly activated for abstract versus concrete concepts. Rather, only concepts at the most concrete and most abstract levels have clearly distinctive conceptual content. Very concrete concepts contain a large amount of item properties and evoke few if any experiential properties. In contrast, experiential features are regularly part of very abstract concepts, for which few if any *concrete* item properties are produced.

The correlation between the entity tokens ($r = .74$) and experiential tokens ($r = -.69$) and concreteness ratings was significant ($p < .01$ for both). That is, the more concrete a concept is, the more entity properties and the fewer experience properties are generated. The concepts rated as somewhat concrete and somewhat abstract have a lower proportion of both entity and experiential features. By exclusion, this means that their conceptual content may be dominated by situation properties. Further, the amount of experiential and entity features is almost bal-

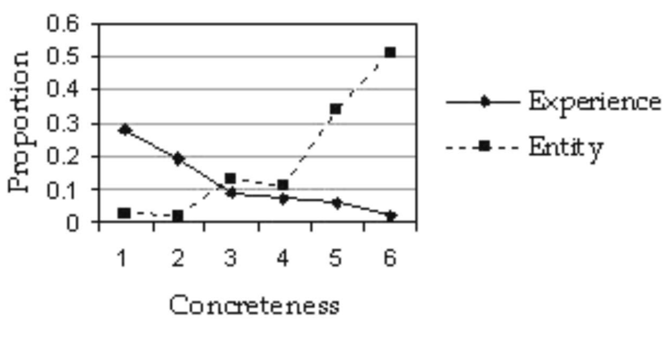

Fig. 1. Proportions of entity and experiential properties generated for items of six concreteness levels (numbers increase with higher concreteness).

anced for these concepts: They contain a few concrete properties, but are also associated with subjective experiences. This finding highlights the importance to sample items from the extreme poles of the concreteness scale in studies comparing abstract and concrete concepts.

Finally, there were no concreteness effects on situation properties. Participants mentioned roughly the same number of different types of situation properties for abstract and concrete concepts. Instructions to generate relevant context features (as opposed to item features) increased the number of different kinds of situation properties only marginally (subject analysis only): $F_1(1, 25) = 3.51$, $MSE = 1.66$, $p = .07$. Thus, the complexity of the described situations did not seem to increase as participants shifted focus from item to context.

5.3. *Token analysis by domain*

The token means for entity, situation, and experience features are summarized in Table 2. The results for tokens were consistent with the type results; thus, they are only briefly summarized here. There were the same significant main effects for concreteness on entity and experiential token scores by items and subjects, and the same interaction between concreteness and instruction on entity properties. Again, there were no effects of concreteness on the number of situation properties. Instructions to describe the context increased this count (significant by items).

5.4. *Analysis of situation features*

Abstract versus concrete items evoked an equal number of different situation properties. Thus, both concept types are embedded in knowledge about their situation context. However, differences may be revealed at the level of individual situation properties. Specifically, frequent mention of persons, actions, events, and social categories were expected for abstract items. In contrast, more concrete situation elements, such as objects, buildings, locations, physical states, and functions were expected for concrete items.

5.4.1. *Types*

Table 3 shows the type scores obtained for concrete and abstract concepts for the situation properties. All these scores vary between 0 and 1 and indicate the proportion of participants generating each property. (Two feature types were not included in this analysis: quantity, because it is not readily interpretable, and *manner* because of zero occurrences.) The pattern was largely consistent with the predictions. In particular, abstract items involve a person most of

Table 2
Average number of features (tokens) generated for each property domain

Instruction	Item	Situations	Entities	Experience
Features	Abstract	3.95	0.22	1.28
	Concrete	3.88	2.02	0.36
Context	Abstract	4.49	0.19	1.65
	Concrete	4.29	1.01	0.62

Table 3
Type scores of situation properties for abstract and concrete concepts

	Item Features		Context Features	
Situation Property	Concrete	Abstract	Concrete	Abstract
More for abstract				
Person*	0.34	0.71	0.38	0.96
Social state*	0.01	0.19	0.02	0.26
Social artifact**	0.01	0.18	0.02	0.13
More for concrete				
Object**	0.61	0.48	0.92	0.43
Location**	0.41	0.19	0.39	0.22
Living thing*	0.35	0.01	0.44	0.03
Function**	0.18	0.04	0.08	0.01
No difference				
Action	0.65	0.83	0.65	0.84
Event	0.26	0.24	0.32	0.39
Time	0.24	0.13	0.23	0.11
Physical state	0.21	0.14	0.32	0.19
Building	0.01	0.00	0.04	0.02
Social organization	0.03	0.10	0.02	0.02
Spatial relation	0.1	0.06	0.10	0.03

Note. Situation properties for which a significant main effect of concreteness was obtained are marked with *($p < .05$) or **($p < .01$).

the time, whereas concrete concepts only mention an agent a third of the time, $F_1(1, 25) = 37.03$, $MSE = 0.11$, $p < .001$; $F_2(1, 34) = 14.13$, $MSE = 0.29$, $p < .01$. Actions and a person are the most frequently mentioned situation features for abstract concepts ($M = 0.84$, averaged across instructions). Thus, on average, participants mentioned an agent and an action for 8 out of 10 abstract items.

Actions were also mentioned considerably more often for abstract than for concrete concepts, but this difference only approached significance in the subject analysis ($p = .11$, or $p = .07$ for item and subject analysis, respectively). Other properties mentioned more often for abstract concepts were social states ($M = 0.23$) and social artifacts ($M = 0.16$). Social states were mentioned close to never for concrete concepts, $M = 0.02$; $F_1(1, 25) = 46.23$, $MSE = 0.03$, $p < .001$; $F_2(1, 34) = 11.63$, $MSE = 0.07$, $p < .005$; neither were social artifacts, $M = 0.02$; $F_1(1, 25) = 25.24$, $MSE = 0.02$, $p < .001$; $F_2(1, 34) = 6.52$, $MSE = 0.05$, $p < .05$. Thus, social concepts can be considered quite distinctly associated with abstract concepts. All these situation elements are consistent with suggestions made in previous research (e.g., Hampton, 1981) on the content of abstract concepts, such as agents, behaviors, and social aspects.

Situation properties that were mentioned significantly more often for concrete concepts were objects, $F_1(1, 25) = 29.56$, $MSE = 0.09$, $p < .001$; $F_2(1, 34) = 5.09$, $MSE = 0.33$, $p < .05$; location, $F_1(1, 25) = 16.19$, $MSE = 0.05$, $p < .001$; $F_2(1, 34) = 4.92$, $MSE = 0.14$, $p < .05$; living things, $F_1(1, 25) = 56.81$, $MSE = 0.08$, $p < .001$; $F_2(1, 34) = 10.27$, $MSE = 0.24$, $p < .005$); and function, $F_1(1, 25) = 12.10$, $MSE = 0.02$, $p < .005$; $F_2(1, 34) = 4.05$, $MSE = 0.05$, $p = .05$. These results are consistent with a related study for concrete items in which function and location also emerged as central aspects (Cree & McRae, 2003). In sum, 7 out of the 14 situation properties were mentioned significantly more often for either abstract or for concrete items. Three of the remaining items, *actions, social organizations,* and *spatial relations* approached significance. Buildings were mentioned so rarely that no differences emerged.

5.4.2. Tokens

The differences in situation properties were more pronounced in the token analysis and involved more situation properties. The effects were consistent with the type analysis, except for actions, for which token scores were significantly higher for abstract ($M = 0.90$) than for concrete items ($M = 0.68$), $F_1(1, 23) = 5.36$, $MSE = 0.22$, $p < .05$; F_2 was a marginal effect, $p = .08$. Also, two further situation properties had significantly higher tokens for *concrete* items in the subject analysis. These were time, $F_1(1, 23) = 26.09$, $MSE = 0.02$, $p < .001$, and physical state, $F_1(1, 23) = 6.24$, $MSE = 0.04$, $p < .05$. Given that abstract items more commonly have *temporal* characteristics than concrete ones, it is somewhat surprising that time properties were mentioned more often for concrete items. We explain this effect by the effects of random sampling of our word materials, which put two time concepts (*day, daybreak*) into the low-concrete sample. *Day* especially evoked a lot of *time* features such as *week, 24 hr,* and so on. Meanwhile, many temporal aspects of abstract items were expressed indirectly, such as in the mention of actions, events, or emotions.

Thus, both abstract and concrete concepts are described in terms of situations, but some of these properties are, at least to some extent, concreteness specific. Abstract item-specific situation properties are socially relevant aspects, whereas those for concrete items tend to be concrete entities and actions in a situation. Thus, abstract and concrete conceptual content does not seem to converge on the level of situations, but instead, they tend to be associated with different aspects of situations.

So far, the analyses have shown that abstract and concrete concepts both evoke relevant relational properties (i.e., situation properties). Further, intrinsic entity properties are predominantly part of concrete concepts, whereas intrinsic and relational experiential properties are mostly found in abstract concepts. Given the relatively higher proportion of situation properties in abstract items, our analysis suggests that abstract concepts have a weak internal structure but a large proportion of relational properties, which is consistent with posited characteristics of relational concepts (Gentner, 1981). Abstract concepts seem to activate situations and related subjective experiences, as if the situation were mentally experienced (or *simulated* as in a process of dynamic mental imagery; Barsalou, 1999).

5.5. Features versus associations

Participants may have generated some features that they do not really think of as the target's properties. In particular, features listed first may trigger associations, which may be predominantly situation properties. Such associations may be related to the first-mentioned features rather than to the target itself (comparable problems arise in associative sets; cf. Nelson & Schreiber, 1992). Because our participants were free to end their feature generation anytime, this is not a strong concern here. Still, in a few cases feature lists were quite extensive. To control for the influence of associative processes in the data, the token analysis was repeated for only the first

Table 4
Property domain proportions among first five features

	Situation	Entity	Experience
Abstract	0.66	0.02	0.19
Concrete	0.42	0.40	0.04

five coded properties for each target and for each participant. If relational properties are mostly activated through associations, then intrinsic entity and experiential features may emerge as more central sources of conceptual knowledge relative to relational situation properties.

Only features generated under feature instructions were entered into the analysis. Table 4 shows that indeed the differences between abstract and concrete items emerge more strongly in the first features. Abstract items had close to no entity properties, and concrete items had close to no experiential features. Both differences were highly significant; entity: $F_1(1, 24) = 141.25$, $MSE = 0.01$, $p < .001$; $t(34) = 4.97$, $p < .001$; experience: $F_1(1, 24) = 45.45$, $MSE = 0.01$, $p < .001$; $t(34) = 4.69$, $p < .001$. Also, abstract items evoked more situation properties early on than concrete concepts, $F_1(1, 24) = 34.86$, $MSE = 0.02$, $p < .001$; t approaching significance, $p < 0.1$. Thus, even though participants tend to mention fewer situation properties early, it generally seems to be the case that relational properties are a central part of conceptual knowledge. It also appears to be relatively more central in abstract than in concrete concepts.

5.6. *Feature specificity*

It was predicted that abstract item features are less specific than concrete item features. To test this prediction, all 3,120 features generated under the feature instructions were coded for specificity. Features were sorted by feature type and coded blindly by one of the authors. Features were coded as specific if they identified a particular property, and unspecific if they identified a property type without a specific property. This distinction is analogous to the difference between a *slot* and *filler* within a frame (Minsky, 1975). Examples from the data for unspecific and specific features pairs are, respectively, *a creature* versus *birds, area* versus *forest, someone* versus *a kid, something* versus *a sign,* and *doing something* versus *collect.* As predicted, there were more specific features for concrete (84.4%) than for abstract items (57.2%), $t(34) = 7.11$, $p < .001$. The correlation between the proportion of specific features and concreteness was significant, $r = .73$, $p < .001$. Follow-up analyses by domain show that abstract items had more unspecific features than concrete items in all domains, particularly in situation properties. The finding is consistent with the contextual variety hypothesis. The unspecific situation properties of abstract items permit representation of a larger variety of situations, whereas concrete items are associated with specific contexts.

5.7. *Concreteness-related variables and conceptual content*

Correlation analyses were performed to test the relation of type, token, and specificity measures to ratings of context availability and imageability. Rated context availability significantly increased with the number of entity tokens generated for a concept ($r = .55$, $p < .01$), but not with any other feature scores. Context availability ratings were also weakly correlated with the specificity of features ($r = .34$, $p < .05$). Unspecific properties probably pose little constraint on the activation of context, so it takes more effort to recall or generate specific contexts. Rated imageability increased significantly with the number of entity tokens ($r = .62$, $p < .01$) and decreased with the number of experience properties ($r = –.42$, $p < .05$). Imageability was also significantly associated with specificity of properties overall, particularly with the specificity of entity ($r = .36$, $p < .05$) and situation properties ($r = .49$, $p < .01$). Clearly, one can imagine specific parts of a truck more easily than "the pieces of some object."

5.8. Complexity

The property scores were used to run a preliminary test of the hypothesis that abstract concepts are more complex than concrete concepts (Barsalou, 1999). Assuming that complex concepts contain a larger variety of features, the type score presents a ready estimate of complexity; it indicates the number of *different* concept features that individuals list, on average, for a given concept. If abstract concepts are more complex than concrete concepts, then this complexity measure should correlate negatively with concreteness. This was supported marginally across domains, $r = –.32$, $p < .06$. With respect to the individual domains, only the number of different situation properties was correlated, marginally, with concreteness, $r = –.32$, $p < .06$. Thus, abstractness tends to increase with situation complexity. This relation was only moderate, as estimated by our measure. However, this measure ignores other factors of complexity, such as the complexity of individual properties. For instance, a *person* is less complex than a *social state.* Taking such factors into account may result in a higher correlation.

6. Discussion

This study identified a number of factors that contribute to perceived abstractness. We have presented evidence that abstract concepts involve qualitatively different types of properties from concrete concepts. Abstract concepts are anchored in situations and regularly involve subjective experiences, such as cognitive processes and emotion. Unlike concrete concepts, abstract concepts have fewer intrinsic and proportionally more relational properties. Consistent with their relational character, the analysis of taxonomic properties indicated that participants listed more coordinate terms for abstract than for concrete items.

Also, abstract concepts resemble frames or schemata in that many of their properties are unspecific, which allows for the representation of a diversity of situations or events. At the same time, this renders abstract concepts less imaginable, and perhaps less memorable, and may play a central role in the processing disadvantages reported for abstract concepts (e.g., for comprehension and memory). It is also of interest in this context that a few participants had extreme difficulty generating properties for abstract items. This suggests that considerable parts of our conceptual knowledge of abstract entities may be difficult to express verbally. This may in part be due to highly unspecific features and the need to construct or remember specific situations.

6.1. Perceptual representations of abstract concepts

Many characteristics of abstract concepts are just as abstract as the concepts themselves (e.g., "liberty" for *emancipation*). Thus, it is difficult to imagine how abstract concepts may be formed from purely perceptual sources, for example, as perceptual symbols (Barsalou, 1999). The main challenge lies in the properties related to subjective experience. Mental processes in particular are triggered by perceptions, but are not themselves perceived. Many abstract concepts seem to require mental processes or emotions that specify relevant situation aspects and unite them into coherent concepts. The influence of theories (Murphy & Medin, 1985), particularly of social world knowledge, may be more pronounced in abstract concepts than in concrete concepts. Thus, situational aspects of abstract concepts may be *simulated* perceptually (Barsalou, 1999), but this would be an incomplete representation without the associated emotional and cognitive processes.

6.2. Situating abstract and concrete concepts: Difference in focus

In related work, Barsalou and Wiemer-Hastings (in press) suggested that although both abstract and concrete concepts are embedded in knowledge about typical situations, they may differ in focus. The presented findings are consistent with such a view. The center of focus for concrete concepts is the represented object, along with its attributes, parts and functions, actions performed on or with the object, relations to other objects, and perhaps specific locations. Consistent with this proposed object focus, participants still produced many item features for concrete items when instructed to describe *context* rather than *item* characteristics.

In contrast, the focus is broader for abstract concepts. Often, the focus encompasses a complex arrangement of entities and processes. For example, *indifference* involves a person, mental state, relation to some state of affairs, and a state of affairs. The center of the focus likely varies across kinds of abstract concepts. For example, personality traits, attitudes, emotions, and beliefs probably focus on a person, whereas interactions and communication concepts probably focus on some action. Consistent with this possibility, both person and action were mentioned very frequently in our analysis.

6.3. Relations among abstract concepts

Abstract concepts are *relational* concepts, which are likely linked to an extensive number of other concepts (Gentner, 1981). In fact, acting and responding intelligently in social situations requires individuals to make connections between abstract concepts. For example, people routinely infer goals or traits from behaviors or utterances. The rich connections between abstract concepts are reflected by the fact that many of their "features" are often abstract concepts themselves, including three experience properties (emotion, representation, evaluation) and situation properties (social state, social artifact, action, event).

Perhaps the description of an abstract concept in terms of other abstract concepts reflects a cognitive economy where more complex abstract concepts are represented by less complex ones. For example, *emancipation* can be described as a transition (process) from one social state to another. The first social state may be described as *oppression,* the second as *liberty.* The transition process is physical or spiritual *liberation.* Notably, these are all abstract concepts. *Oppression* may be represented by a relatively concrete schema of two people, one of who constrains the other's liberty, whereas *emancipation* is a more complex concept that involves two schemata and a transition between them. Schema or frame transition processes have been conceptualized previously, specifically for perceptual changes during object rotation or movement (Minsky, 1975). They may be usefully applied to transitions of social schemata, which may be particularly important in more complex abstract concepts.

To conclude, abstract and concrete concepts are characterized by several qualitative and quantitative differences. Most strikingly, mental experience is a key element to only abstract concepts, whereas intrinsic item features are unique to concrete concepts. Also, abstract concepts tend to be more schematic in nature, involving a larger proportion of unspecific features than concrete concepts. Our results at a more specific property level may of course have been influenced by idiosyncrasies of the limited item sample and may not generalize to larger samples. However, the differences found for the general property domains are likely robust differences. Abstract concepts certainly warrant much deeper attention in the cognitive sciences than they have previously been paid. We have shown that the conceptual characteristics analyzed in this study can be systematically linked to variables associated with abstractness, such as context availability, imageability, and complexity. They may further be linked to processing characteristics of abstract versus concrete items in cognitive tasks, such as recall, comprehension, similarity judgments, categorization, concept formation, and reasoning. For example, memory for abstract concepts may be lower because the unspecific abstract concept characteristics are less distinct. As such, features (defined broadly, i.e., including characteristics of experience and situations) may serve the development of testable models of abstract concept representation and processing, and may reveal stronger explanations for processing differences between concrete and abstract concepts than have been available to date.

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Appendix A

Word materials by concreteness level (concreteness ratings taken from MRC2 database)

	Items	Concreteness
Highly abstract	Aspect, desperation, exception, hope, ingratitude, jeopardy	2.53
Medium abstract	Emancipation, happiness, inaction, mischief, pity, removal	3.13
Little abstract	Formation, morass, possession, saga, story, zone	3.95
Little concrete	Day, daybreak, pest, prize, sedative, venom	4.95
Medium concrete	Bass, blossom, hairpin, labyrinth, lace, nectar	5.62
Highly concrete	Beehive, insect, mackerel, owl, tree, vine	6.08

Note. Ratings are on a 7-point scale, from 1 (*most abstract*) to 7 (*most concrete*).

Appendix B

Excerpt from coded transcript for concrete item: Tree

Features	Domain	Domain Property
wood	Entity	Material
has	\	
branches	Entity	External component
has	\	
different	Entity	Quantity
colored	Entity	External surface feature
leaves	Entity	External component
animals	Situation	Living thing
to_live	Entity	Systemic
in_them	Situation	Spatial
like	Meta	Meta
squirrels	Situation	Living thing
owls	Situation	Living thing
kids	Situation	Person
climb	Situation	Action
them	Meta	Cue repetition
build	Situation	Action
tree	Meta	Cue repetition
houses	Situation	Build

Note. Items belonging to a proposition are marked with a "\"; propositions were coded together as one type of feature.

Appendix C

Excerpt from coded transcripts for abstract item: Hope

Features	Domain	Domain Property
mmm	Meta	Hesitation
um	Meta	Hesitation
maybe		
hope	Meta	Cue repetition
could		
have		
the_hope_that	Meta	Cue repetition
something	/	
will	/	
happen	Situation	Event
good,	Experience	Evaluation
you	Situation	Person
really	Situation	Quantity
want	Experience	Representation
something	/	
to_happen,	Situation	Event

Note. Items belonging to a proposition are marked with a "\"; propositions were coded together as one type of feature.