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Generics as reflecting conceptual knowledge

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## Abstract

Generics are proposed to reflect the content of the conceptual system, whose prototype structure and vague boundaries make an unreliable basis for traditional treatments of truth and logic. Examples from the psychological literature are used to illustrate the relation between generics, similarity-based reasoning and concepts.

Statements that we make about the world are generic statements (including this one). Although we may state them with confidence, and we may be taken to be telling the truth by our listeners, yet if interpreted as expressing a universal truth, then they may very likely be false. Our knowledge of the world depends on an informational structure that is constructed from individual concept representations. These representations themselves contain or point to information that is considered germane and relevant to an understanding and familiarity with that concept. Such information includes fundamental or ontological features, such as that water is H<sub>2</sub>O and a liquid, but also information about the common or typical form that exemplars of the concept may take (ice, steam, fog), and any other information that it is important for someone to know (water freezes at zero degrees Celsius).

One method that psychologists have used to explore conceptual contents is the “feature listing” task. Hampton (1979) developed an elaborated version of this task, aimed at making explicit the conceptual content underlying the meaning of some familiar category names such as Fruits, Sports and Vehicles. Participants were interviewed and asked seven different

questions aimed at eliciting generic properties of these concepts. As well as asking people what properties or features made something a fruit or not a fruit, following Lakoff (1972) people were also asked to consider why something might only loosely speaking count as a fruit, or why something might be considered technically speaking a fruit. Participants were also asked to consider what properties might make particular exemplars typical or atypical members of the category (following Rosch, 1975). More streamlined feature elicitation methods have since been used in many studies, with extensive feature norms being published by De Deyne et al., 200x, in Leuven, and McRae et al., 2005 in Canada). As an illustration, Table 1 shows the features that people generated to two of the categories in Hampton (1979).

Further work by Wu and Barsalou, 2009 provided a detailed qualitative analysis of the information that people generate. They divided the properties generated into four main categories: taxonomic (for example mentioning superordinate categories), entity (parts and appearance, functions), situational (contexts of use and associated actions) and introspective (people's mental states when interacting with the concept, including emotional, evaluative judgments).

It would appear at first sight that a large majority of the properties generated in this fashion will provide the basis for generic sentences. "Furniture is found in the home" or "Fruit is sweet" are statements that have the classic properties of generics. People will judge them true, in spite of possible or real counterexamples, such as park benches, or lemons.

Table 1: Features generated for two of the categories in Hampton (1979), in decreasing order of production frequency

Furniture	Fruit
- Has a specific function, used by humans	- Is a plant, organic, vegetation
- Is found in buildings	- Is edible, is eaten
- Is made of wood	- Contains seeds
- Is for sitting on or in	- Grows above ground, on bushes or trees
- Is attractive	- Is juicy, thirst quenching
- Is for comfort, convenience or satisfaction	- Is brightly coloured
- Is found in the home	- Is sweet
- Is man-made, manufactured	- Has an outer layer of skin or peel
- Is for putting things on or in	- Is round
- Is not just decorative	- Is eaten as a dessert, snack or on its own
- Has legs	- Is a protection for seeds

As a first hypothesis, one source of generic statements results from a read-out from this conceptual/ knowledge database, without concern for the degree to which statements are universally or even most commonly true. In this paper, I will review studies that demonstrate the degree to which this lack of concern for quantification is evidenced across a range of tasks. It appears that when discussing and describing their knowledge of things in the world, the main determinant of what is taken as true (or false) has to do with the relevance and usefulness of

the information, rather than traditional views of truth taken from logic. As a consequence people are led to make apparently inconsistent or fallacious judgments.

### **Intensional reasoning**

Over the last thirty years, a common theme in research on adult conceptual reasoning has been the demonstration of effects of what Tversky and Kahneman called *intuitive* as opposed to *extensional* reasoning. The principle characteristic of this form of reasoning is that it is based on the intensional contents of conceptual representations, rather than the logical relations of sets in the external world. “Intensional” and “extensional” are used here to distinguish two ways of individuating concepts at the level of individual concept possessors. The intensional content concerns the representation of the concept in the mind, through knowledge of the features and properties associated with it, whereas the extensional content of a concept concerns the set of things in the world that a person would consider fall under the concept term. Both are to be understood in a psychological sense (as reflecting a person’s belief) rather than a semantic sense (as reflecting the contribution of a word’s meaning to the truth conditions of propositions expressed by statements or utterances).

An early demonstration of intensional reasoning was a study of the transitivity of category statements (Hampton, 1982). Based on earlier work in folk taxonomy (Kempton, 1978; Randall, 1976) the study provided participants with a set of category statements to judge as true or false. While property statements have always been understood as generic (birds fly, fruit grows on tree) and expressing general rather than universal truth, category statements had been thought to convey a different kind of information. Being of a given kind carries with it an assumption of universal quantification – if a poodle is a kind of dog, then all poodles must be

dogs. This sense that categorisation carries additional epistemological weight is supported by category learning experiments where category and property information are treated differently, and in the developmental literature by studies showing that children consider a category statement to carry greater inductive potential (Heyman & Gelman, 20ss). For example “he is a tomato-eater” appears to say more about a person than “he eats a lot of tomatoes”.

Statements in Study 1 in Hampton (1982) related to three levels of a concept hierarchy. The top level superordinate of Furniture was taken, together with two typical subsets (Bed and Chair), two atypical subsets (Lamp and Shelf), and a related concept (Case). For each subset, 16 items were created that shared the common function of the set, so that for Bed they were all things to lie on, for Lamp they were all sources of light. Participants judged the items as members of the subset (e.g. Chair), and as members of the superordinate (Furniture), and also judged whether the subset was a member of the superordinate. Analysis focused on individual patterns of responding to the three elements in a transitive chain – A is a B, B is a C, and A is a C. If the response to the first two was positive, but to the last was negative, then the pattern showed intransitivity. Remarkably, some 25% of responses were of this kind, and they were as frequent in the typical subsets of Chair and Bed as in the atypical subsets. For example a majority of participants all said that chair-lifts, sedan chairs and car seats were chairs but were not furniture, even though chairs were very typical furniture. Looking at the examples of intransitivity it is clear that when people agree to a statement of the kind “A is a type of B”, or “As are Bs”, they do not intend this to imply that the set of As is fully included within the set of Bs. This point was made clear in the second study in Hampton (1982). The key issue concerned why people say that “chairs are furniture” even when they acknowledge that there are

counterexamples. In the second study, these statements were presented twice, once at the start of the experiment, and then again at the end, after participants had experienced the counterexamples. There was no evidence for any reduction in the confidence with which people asserted the truth of these statements as a consequence of processing counterexamples. Chairs are furniture regardless of the existence of sedans or ski-lift chairs.

How does intensional reasoning account for this result? It appears that a categorical statement such as “chairs are furniture” is understood as a generic statement in just the same way as a property attribution such as “birds fly”. They both reflect important and useful facts to know about chairs or birds, which help a person to operate with the concept in an efficient way. The fact that category statements can suffer counterexamples was demonstrated further in a set of studies on the conjunction, disjunction and negation of concepts (see Hampton, 1997, 2011 for reviews). People were asked to categorize a list of words three times. First, for example whether the words named Sports, then whether they named Games, and finally whether they named Sports that are also Games. Extensional reasoning would require that people decide on the final classification by taking the two individual categorizations and using a simple conjunctive rule. An item is in the category “Sports that are also Games” only if is both a sport and a game. For disjunction and negation, similar experiments were run looking at the relation of individual categorization in a pair of categories to categorization in complex phrases such as “Hobbies or Games” for disjunction, of “Sports that are not Games” for negation. In all three kinds of conceptual combination, there was a systematic deviation from the predictions of extensional reasoning. Chess, for example, was not considered a sport, but because it was such a clear example of a game, it was judged to belong to the conjunctive category “Sports



that are also Games". Mushrooms were considered poor examples of Vegetables, and were never called Fruit, but they had high membership in the disjunction "Fruit or Vegetables".

Briefly summarizing a series of studies, the conclusion can be drawn that category statements are indeed often generic, and survive counterexamples. In the case of conjunction it seems that even the transparently true statement "Sports that are also games are sports" can have counterexamples, with chess being in the conjunction but not in the conjunct.

### **The modifier effect in generics**

A more recent series of studies, conducted with Martin Jönsson, has looked at another interesting aspect of generic sentences. Following Connolly et al. (2007), we investigated a phenomenon that we dubbed the modifier effect. Connolly et al, were concerned with the compositionality of conceptual combination, and showed how the application of a modifier to the subject noun of a generic sentence has a general tendency to reduce the rated likelihood that the sentence is true. For example "Lithuanian strawberries are red" was judged less true than "Strawberries are red". The effect was more pronounced when the modifier was atypical or unfamiliar in combination with the noun, as in this case. However it was also seen with a typical modifier, such as "Round strawberries are red". This paper has led to an interesting debate on the issue of prototypes and compositionality (Gleitman et al, 2011; Jönsson & Hampton, 2008, 2011). For the present purpose, the effect is interesting because it provides a further chance to test whether categorical statements are in fact categorical or just generic.

Both parties to the debate agree that the modifier probably reduces statement likelihood because it changes the prototype that is associated with the subject noun concept. Adding in additional features (such as being Lithuanian) to the prototype has the effect of reducing

confidence in the value of other associated features. Thus being susceptible to the modifier effect should be an index of a generic sentence. As the conceptual content changes, so the relevance or importance of properties situated within that content become reduced.

Hampton, Passanisi & Jönsson (2011) investigated whether this modifier effect would be more pronounced for generic properties of a kind that were mutable, rather than necessary or categorical. A mutable property is one that one can easily imagine being different, without serious consequences for the concept itself. For example there is a possible world in which swans are pink rather than white, but otherwise everything about them is the same. The same is not true of necessary or categorical properties. In a world where swans had no heart, or where swans were not birds, there would have to be some parallel shifts in the concepts of just what a swan (or a bird) actually is. Removing the heart would require adjustments to the biological theory of how swans function that would lead to other important changes in their make-up and properties. In the case that swans were not birds, either they would have to be changed so as not to have feathers, two legs, beaks and wings, and so forth, or the naïve theory of biological kinds would have to undergo major reorganization. We hypothesized therefore that generic statements about mutable properties would show stronger effects of a modifier than generic statements about necessary or categorical features.

Surprisingly, it proved very hard to show any differential effect of the modifier on sentences of different mutability. Four studies were run comparing either central or categorical statements with mutable statements, and in every case the modifier reduced the likelihood of all statements to the same degree. The effect was strangely insensitive to whether the statements were about easily changed properties (Striped catfish have whiskers), central

properties (Striped catfish have bones) or categorical properties (Striped catfish are fish). The conclusion reached by Hampton et al. (2011) was that the modifier effect is probably largely driven by pragmatic considerations. Thus when a brief textual context was provided prior to the judgments then only the mutable statements were affected by the modifier.

Leslie, Khemlani and Glucksberg (2011) have shown that generics are often considered true, even when universally quantified, an effect they call the Generic Overgeneralization Effect. Our data on the modifier effect also support this result. Jönsson & Hampton (2006) investigated how modifiers would affect the judged likelihood of universally quantified generic sentences, such as “All sofas have backrests” as opposed to “All uncomfortable handmade sofas have backrests”. If the statements are taken as truly reflecting a universal truth, then there should be no reduction in likelihood when the modifier is added. If all sofas do in fact have backrests, then that should be true of comfortable, uncomfortable, factory made and handmade sofas alike. As might be expected however, the results showed the modifier reducing likelihood, leading to what we termed the Inverse Conjunction Fallacy. There is a logical connection to the Conjunction Fallacy reported by Tversky and Kahneman (1983). While their fallacy concerns subjective probabilities of individuals belonging in conjunctions, our fallacy concerns subjective probabilities of properties being universally true in conjunctions. Once again we conducted an extensive set of studies before we were able to find conditions in which this robust effect could be made to disappear. Emphasizing the universal quantification (e.g., “All sofas always...”, “Every single sofa...” or “100% of sofas...”) had no significant effect, and nor did placing the sentences side by side and asking participants to choose the more likely. As Leslie et al. (2011) also reported, it is very hard to convince people of the unacceptability of

applying universal quantifiers to generic statements that are subject to counterexamples.

An unpublished study by Hampton and Lan (2006) examined how the modifier effect was influenced by the presence or absence of a universal quantifier. Sentences could be either modified or not, and could also be generic, or quantified with “All”. Each statement occurred in only one condition for each participant, but each participant saw a random mixture of all four kinds of sentence. The presence of universal quantifiers for just half the sentences should therefore have given the manipulation some prominence, through contrast with the rest.

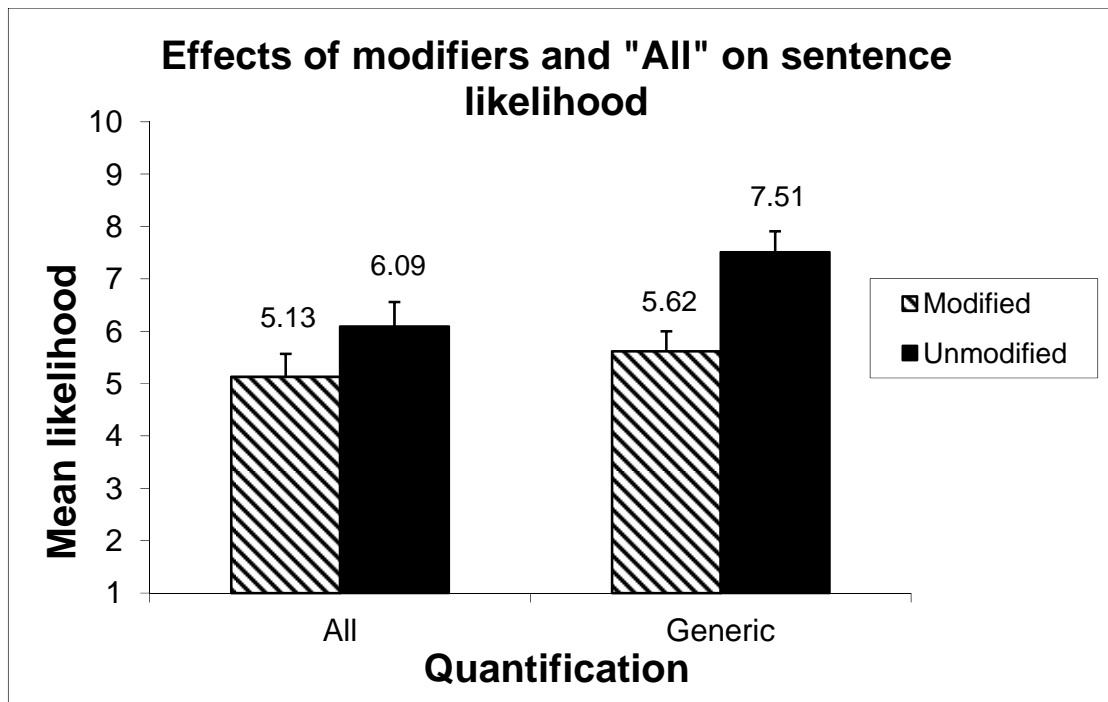


Figure 1 shows the results. For generic sentences the standard modifier effect was seen, with likelihood reducing from 7.5 to 5.6 on a scale from 1 to 10. The effect of “All” was two-fold. First all sentences were judged less likely, consistent with an acknowledgement on the part of the participants that it is in fact more likely that something is true in general than that it

is true in every case. Second, there was a reduction in the modifier effect, from a shift of 1.9 on the scale to a shift of only 0.9. The interaction was significant, confirming that the effect had been moderated by the quantifier. However the modifier effect was still present and highly significant for the “All” statements. People were still happy with the paradoxical belief that a property is more likely to be true of every member of a category than true of every member of a subset of that category.

### **Category-based induction**

There is related evidence in another area of cognitive science where categorical statements turn out to be treated more like generics. For example, Osherson et al. (1990) described the Inclusion Fallacy. They asked people to compare the strength of two inductive arguments with universally quantified premises:

(1) All Robins have property P, therefore all Birds have property P

(2) All Robins have property P, therefore all Ostriches have property P

Logically (if one may be forgiven for pointing this out), if statement (1) is true, and if one accepts that ostriches are in fact all birds, then the validity of the first argument should entail that of the second. Consequently the second should not be rated as weaker than the first, which of course it was. Sloman (1993, 1998) provided two further demonstrations of this type of fallacy. In his case, he showed that people differentiated the strength of two arguments that should both be considered perfectly valid. In the inclusion similarity effect, arguments such as (3) were preferred to (4):

(3) All Birds have property P, therefore all Robins have property P

(4) All Birds have property P, therefore all Ostriches have property P.

Correspondingly in his premise specificity effect, arguments such as (5) were preferred to (6):

(5) All Apples have property P, therefore all McIntosh apples have property P

(6) All Fruit have property P, therefore all McIntosh apples have property P.

There is clearly a close correspondence between all the phenomena described here. Jönsson and Hampton (2006) explain it as follows. As philosophy and logic students are quickly made aware, universally quantified statements can only strictly be verified by an exhaustive search for counterexamples and the failure to find them. “All swans are white” is notoriously much harder to prove true than to prove false. Human language has opted therefore to take a different approach to determining “truth” of such statements, one which frequently leads to judgments that appear fallacious from a logical perspective. Statements are judged true on the basis of the strength and importance of their association with the content of a concept. To say that “All S have property P” in the context of everyday speech is to say something like “An important and relevant fact about the kind S is that the property P is to be found in individuals of that kind.”

Naturally, this formulation shifts the question onto what makes a property important and relevant. Some answers to this question are to be found in recent research by Khemlani, Leslie, Glucksberg, Prasada and others. Having high frequency in the class, being causally linked to the kind’s essential properties, and having important consequences for people are all candidate reasons for representing a property as generically true of a class. The research reviewed in this paper suggests that categorical statements are just as likely to be treated as generics as are property statements.

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