

The More Things Change . . . : Metamorphoses and Conceptual Structure*

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Given that mythmakers must construct stories that are comprehensible to their audience, it is reasonable to expect stories to be conceptually natural even when their topics deal with the supernatural. Thus, as stories are adapted to human conceptual structure, they should reflect characteristics of that structure. An examination of the types of magical transformations in Ovid's *Metamorphoses* and Grimms' Fairy Tales suggests that this is the case. It was possible to predict the patterns of transformations on the basis of structural properties of ontological knowledge, which is knowledge of the basic categories of existence (e.g., conscious beings, animals, plants, events). Other characteristics of the transformations seem to reflect the conceptual distinction between animates and inanimates as well as the relative prototypicality of various taxonomic classes of animals. It appears that aspects of conceptual structure can constrain patterns of thinking even during "the willing suspension of disbelief."

Now shall I tell of things that change, new being
Out of old; since you, O Gods, created
Mutable arts and gifts, give me the voice
To tell the shifting story of the world
From its beginning to the present hour.

With this prayer for divine assistance, the Roman poet Ovid embarks on a fabulous journey of depicting the classical myths of change and mutability. The invocation answered, Ovid exhibits a menagerie of metamorphoses: Men and women are recast in the forms of lions and birds, fish and streams, trees, constellations, animals of all sorts, and even echos. The issue ad-

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dressed here is the manner by which the song poured forth from Parnassus is shaped by the vessel of human cognition. In particular, must the guidance of the muse conform to organizational principles of the human mind? We will argue that, even in the realm of seemingly unconstrained fantasy, not everything is equally likely. In fantasy, any transformation of one kind into another can be imagined. Still, some transformations may be favored over others as they adapt to, and hence reflect, properties of conceptual structure.

How could conceptual structure affect mythical metamorphoses? Ovid and his fellow mythmakers and story tellers certainly did not create metamorphoses with the purpose of mirroring conceptual structure. Rather, they constructed tales in order to fulfill some social goal, such as edification and entertainment of citizens, socialization of children, and veneration (or, in Ovid's case, possibly deprecation) of the gods. Any metamorphoses portrayed in stories were designed to advance these other goals.

Though these social concerns received more immediate attention by story tellers than conceptual structure or other aspects of human cognition, the latter factors may still indirectly affect the structure of stories and metamorphoses. For example, in order to entertain an audience, a tale must clearly be interesting and comprehensible. In addition, using tales for education and socialization requires that they be memorable. General characteristics of human cognition may partially determine what is memorable, interesting, and comprehensible, and so may indirectly influence the way metamorphoses and stories are composed. Mandler's investigations of story structure (Mandler, 1978; Mandler & Johnson, 1977), for example, demonstrate that stories from oral traditions tend to be structured so as to aid their encoding in and retrieval from memory. Analogously, metamorphoses may be structured so that they do not detract from the comprehensibility of a story. Comprehensibility may be aided if some characteristics of an object remain invariant across a transformation. This condition would provide a way for an audience to follow particular characters despite transformations and also remember details of a transformation at a later time. The types of characteristics kept invariant may indicate the levels of conceptual structure influencing the transformations. While many of the transformations in the *Metamorphoses* are quite radical, as when Juno turns a monster's eyes into stars in the tail feathers of a peacock (her favorite bird), we wondered whether very basic properties of objects might be maintained through a transformation. One set of basic properties that may be involved in the transformations immortalized by Ovid concerns our knowledge of ontological categories.¹

¹ Parts of the discussion in the preceding paragraphs are based on comments on an earlier version of this paper that were provided by an anonymous reviewer. We gratefully acknowledge these contributions.

Ontology concerns the basic categories of existence, such as conscious beings, plants, nonliving inanimate objects, and events. Philosophers since Aristotle (Ackrill, 1963) and on through Russell (1924) and Ryle (1938) have been intrigued by these types of categories because of their fundamental nature. Sommers (1959, 1965) represents the interrelations among this set of categories through a hierarchical structure based on predicability. Predicability is the knowledge of the predicates that can be sensibly (though not necessarily truthfully) combined with a set of terms. For example, the sentence "Milk is red" is sensible (though false) since milk is a type of thing that can have color. However, "The idea is red" is not only false, it is also nonsensical since, literally speaking, ideas cannot be red or any other color. Sommers distinguishes ontological categories by the predicates that apply uniquely to sets of terms.

The structure that results by grouping together predicates that span the same set of terms is known as a predicability tree, which is shown in Figure 1. In the tree, predicates dominate terms (i.e., are above them on the tree) if they are sensibly predicable of them, even if some predications are

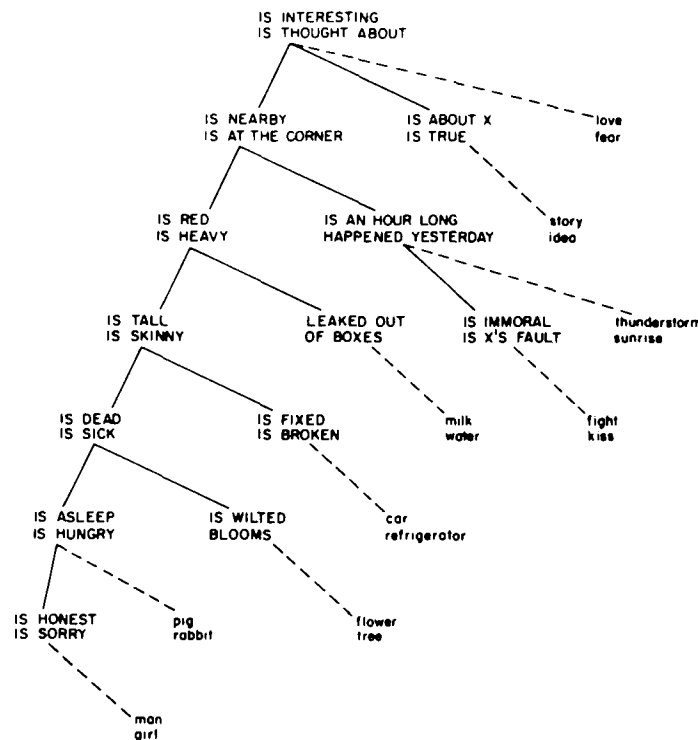


Figure 1. Predicability Tree. (From Keil, F. C. (1979). *Semantic and Conceptual Development: An Ontological Perspective*. Cambridge, MA: Harvard University Press. Reprinted by permission.)

false. Each node in the tree represents an indefinitely large class of predicates or terms, not just the few shown here. The tree illustrates how the predicates and terms are sorted into classes that have hierarchically arranged co-occurrence privileges with each other. The relevance of the predicability tree to the structure of ontological knowledge derives from the correspondence between each node in the tree and a particular ontological category. Thus, the node containing “is asleep” and “is hungry” stands for the ontological category of animals. Using the predicability tree as a guide, then, an underlying ontological tree can be constructed that represents the interrelations among ontological categories (see Figure 2).

Keil (1979, 1983) has predominantly relied on adult and child intuitions regarding predicability to demonstrate the importance of ontology as a framework for representing knowledge. Given recent critiques of results obtained through this method (Carey, 1983; Gerard & Mandler, 1983; but for reply, see Keil & Kelly, in press), it is essential to extend investigations of an ontological level of conceptual structure beyond linguistics judgments.

Keil (in press) has explored in greater detail the development of ontological categories by examining children’s intuitions about surgical opera-

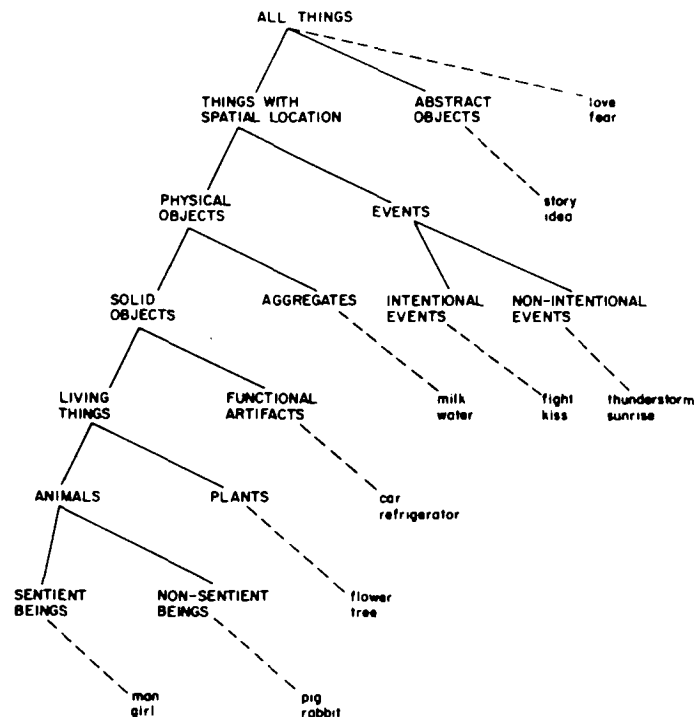


Figure 2. Ontological Tree. (From Keil, F. C. (1979). *Semantic and Conceptual Development: An Ontological Perspective*. Cambridge, MA: Harvard University Press. Reprinted by permission.)

tions that transform (not as “magically” as in fairy tales) one object into another. Thus, a raccoon is said to be altered so that it looks (and smells) like a skunk. After hearing the story, the child is asked to decide what the object really is. Two types of operations are presented to the children: those involving members of the same ontological category (e.g., an animal into an animal) and those involving members of different categories (e.g., an animal into a plant). Children tend to reject across category changes earlier in development than within category changes. While permitting superficial changes, children believe that the ontological identity of an object must remain invariant across the operations.

Adults react much differently to these operations. No matter how similar two objects are ontologically, they invariably claim that the identity of an object cannot change through “plastic surgery.” Adults apparently rely a great deal on more detailed information in making judgments about category membership, object properties, etc. Despite these observations, the ontological skeleton may continue to guide the structure of conceptual knowledge, perhaps most clearly in the “willing suspension of disbelief.” In order to test this view, the pattern of transformations portrayed by Ovid in the *Metamorphoses* was examined. If ontological status is treated as an important property of an object’s identity, the mythmaker may resist changing it across a metamorphosis. If this is the case, one would predict that the likelihood of a transformation from one thing into another should decrease as the distance on the ontological tree between the categories of these two things increases. Thus, certain categorical distinctions may be more sacred than others, and despite his frequent irreverence to the “gods,” perhaps Ovid genuflects to the “cognitive sciences.”

EXAMINATION OF THE *METAMORPHOSES*

Method and Scoring

The text used was the translation of the *Metamorphoses* by Gregory (1958). All transformations that occurred were transcribed and coded in terms of the ontological categories implicated in each metamorphosis. The unit of analysis in the scoring was usually the transformation of a single entity. However, when a group of objects was changed in an identical manner through the action of a single causal force, these multiple transformations were recorded as a single metamorphosis. Examples are Jason using the Gorgon’s head to change a throng of assailants into stone statues and Jupiter changing the inhabitants of a town into monkeys. Two raters performed the coding and agreed on 98% of the classifications. Disagreements were easily resolved by considering the text. One transformation, a conscious being

into a rainbow, was not included because its location on the ontological tree was unclear.²

The transformations were sorted into two categories: Those in which conscious beings (gods or humans) are transformed and those involving members of other ontological categories. This division seemed reasonable given the large number of transformations in the former set. Gods and humans are combined into one category because the ontological tree does not distinguish between the two. In addition, throughout the *Metamorphoses*, Ovid depicts the gods in very physical terms. Thus, they eat, sleep, and mate just like human beings.³

Transformations of Conscious Beings

It is proposed that the number of transformations of conscious beings into members of other ontological categories will decrease as the distance between the ontological categories increases. In terms of the ontological tree, transformations of conscious beings should decrease as one moves up the tree. The predicted order from most to least number of metamorphoses is: Conscious beings into (1) conscious beings, (2) animals, (3) plants, (4) non-living inanimate objects, (5) liquids or other aggregates, (6) events, (7) abstract objects.

The results are presented in Table I. The Spearman rank-order correlation between the predicted order and the observed is .93, which is significant ($p < .01$). Though caution should be used in interpreting this significance value given the small number of categories involved, the correspondence between the two orders supports the claim that ontology constrains transformations.

TABLE I
Transformations of Conscious Beings in Ovid and Grimm

	Number (and %) of Conscious Beings Transformed Into...						
	Cons.	Animal	Plant	Inan.	Liquid	Event	Abs.
Ovid	36 (20)	93 (51)	19 (10)	21 (12)	9 (5)	3 (2)	0 (0)
Grimm	23 (23)	53 (52)	10 (10)	11 (11)	4 (4)	0 (0)	0 (0)

Note. Cons. = Conscious Being, Inan. = Non-living inanimate, Abs. = Abstract Object.

² A list of all recorded transformations and the ontological categories involved in each may be obtained from the authors.

³ The patterns of transformations do not change if the gods are dropped from the analysis and the data include only human being transformations.

Transformations Involving Other Ontological Categories

Because of the relatively small number of transformations of objects other than conscious beings, it was difficult to determine strong patterns of transformations consistent with the ontological tree within individual categories. The modal number of transformations were within the same category only for nonliving inanimates. For animals, plants, and liquids, within-category transformations were the second most frequent occurrence. Though these results do not support a strong version of the ontological hypothesis since within-category transformations are not the most frequent, firm conclusions cannot be drawn from the few transformations in each category (e.g., 4 transformations of plants, 6 for liquids).

A weaker version of the ontological hypothesis would predict that, even when the ontological status of an object is changed in a metamorphosis, the alteration will not be very severe. That is, objects may become members of neighboring ontological categories more frequently than distant categories. Thus, a horse would be changed into a plant or conscious being more readily than a nonliving inanimate or liquid. In order to test this hypothesis, we determined the percentage of transformations that produced a member of each ontological category as an outcome. Thus, 20% of the transformations produced conscious beings as outcomes, 12% produced animals, 10% produced plants, 56% produced inanimates, and 2% produced liquids. These percentages provide a general measure of the likelihood that an object will be transformed into a member of a particular ontological category. Based on these proportions, we determined the mean number of nodes on the ontological tree that an object of each category would be expected to cross, given that the general patterns of change are present within the individual categories. For example, of the ten transformations of animals, one would expect from the above percentages that 2 of the 10 transformations should produce conscious beings as an outcome, 1.2 should produce animals, 1 should produce a plant, 5.6 should result in inanimates, and .2 should result in liquids. Each of these expected outcomes was multiplied by the number of nodes on the ontological tree separating each category from animals. Thus, 3 transformations should be one node away since animals are separated from conscious beings and plants by one node on the tree, 1.2 transformations should be zero nodes away since the animal category is not separated from itself, 5.6 should be two nodes away, and .2 transformations should be three nodes away. Summing these values and dividing by the total number of transformations involving animals produces 1.5 as the mean expected number of nodes crossed in animal transformations. An identical procedure was performed on the plant, inanimate, and liquid categories. Events and abstract objects were not included since no members of these categories were ever transformed. If the ontological cate-

gory of an object has no impact on the outcomes of transformations, the mean observed number of nodes crossed in transformations should not differ from expected values. However, if the outcomes of transformations cluster around the ontological category of the original object rather than more distant categories, the mean observed number of nodes crossed should be less than expected values. Table II shows that in three of the ontological categories is represented, transformations tended to be confined to an object's own category and those relatively close to its own category, and the fourth did not differ from expected values. Given the small number of transformations in some of the categories, differences between expected and observed values were collapsed across the categories in the statistical analysis. However, although the results were in the predicted direction, they were not significant, $t(49) = 0.82, p > .40$.

Given the lack of significance of the final analysis, a replication was attempted to determine the generality of the patterns of transformations beyond Ovid and the Roman culture. The subjects of this analysis collected stories 1800 years after Ovid: The brothers Grimm.

TABLE II
Transformations of Objects other than Conscious Beings

	Mean Expected Nodes Crossed	Mean Observed Nodes Crossed
Ovid		
Animals	1.5	1.2
Plants	1.1	0.8
Inanimates	1.0	1.0
Liquids	1.9	1.5
Grimm		
Animals	1.6	0.8
Plants	1.1	0.8
Inanimates	0.7	0.1
Liquids	1.7	0.0

EXAMINATION OF GRIMMS' GERMAN FOLK TALES

Method and Scoring

The English translation of the tales by Magoun and Krappe (1960) was scored in the same manner as the *Metamorphoses* with the following additions. First, transformed objects are often disenchanting by the end of the story so that they assume their original forms. Because transformations and their inverses are clearly not independent, the reversals were not included in the scoring. Second, in many stories the original metamorphosis is not men-

tioned in the narrative. Rather, one discovers that an entity in the story is "really" some different object that has been enchanted into its current form (e.g., a frog is really a handsome prince under a spell). In these cases, the transformation from the original ontological category was counted in the scoring, rather than the disenchantment. Third, for cases in which a conscious being is transformed into one object, "A", and then, while apparently in this new form (the text is not explicit about this) changed to a second object, "B", the following case-by-case scoring procedure was adopted. The metamorphosis was scored "object A into object B" if the text said something like, "... and then object A became object B." The metamorphosis was scored as "conscious being into object B" if the text stated something to the effect of, "... then conscious being became object B."

The metamorphoses were again classified into those involving conscious beings and those involving members of other ontological categories. The results for the former set are shown in Table I. The spearman rank-order correlation between the predicted and observed orders is .92, which is significant ($p < .02$). Of the transformations implicating categories other than conscious beings, nonliving inanimates and liquids were changed most often into members of their own categories. Among animals, within-category changes were the second most common transformation whereas among plants, they were third most common. To determine whether transformations tended to be confined to categories identical or close to that of the transformed object, the mean expected number of nodes crossed for transformations in each category was compared with the mean-observed value. These results are presented in Table II. The pattern was similar to that found in the *Metamorphoses*, though much stronger. In all four of the relevant categories, objects tended to be transformed into members of their own or neighboring categories rather than more distant categories. These results were highly significant, ($t[45] = 8.64, p < .001$). Collapsing across Ovid and Grimm, this pattern was obtained in seven of the individual analyses, with the eighth showing no difference. Thus, the patterns of transformations within Grimms' fairy tales replicate those portrayed by Ovid.

DISCUSSION

Perhaps the patterns of transformations in Ovid and Grimm are due not to conceptual structure, but rather to the interest a metamorphosis evokes in an audience, and this interest may be entirely specific to the story in which the metamorphosis is placed. By examining a story in detail, one can determine exactly what metamorphosis would maximize interest and fit the story. Thus, interest in the relation between predator and prey can explain the transformation of the hunter Actaeon into a deer, who is then pursued by

his own hunting dogs. Similarly, as Gregory notes in his introduction to the *Metamorphoses*, "What could be more appropriate than placid, yielding Io changed to a cow? Or matronly, slow-thinking Niobe, still weeping, into monumental stone?" (p. xiii). These metamorphoses seem fully determined by the theme and characters of a particular myth, and could not have been predicted with as great accuracy by ontological or other conceptual principles. Each transformation possesses a unique personality, and an idiographic approach to myth might be far more revealing than any nomothetic analysis.

While not denying the importance of focused exegesis of each myth, or that general conceptual principles underdetermine the outcome of a particular transformation, we still propose that generalizations can be made across broad samples of mythical metamorphoses. This conclusion arises not only from correspondences between the patterns of transformations and the posited structure of ontological knowledge, but also from the high degree of similarity between the patterns found in Ovid and Grimm themselves. In Table I, when the raw tallies of transformations in each ontological category are converted into proportions of the total number of transformations found in each of the two texts, the similarity between the distributions for Ovid and Grimm is striking. Indeed, they do not differ significantly ($\chi^2(5) = 2.38$, $p > .50$, with the abstract object category dropped since no transformations involved that category).

Perhaps the similarity between the transformations in Ovid and Grimm can be accounted for by general principles of interest. For example, stories typically center around animate beings: Gods, humans, and animals. Animate beings are certainly more interesting story topics than inanimate objects since they create and respond to the events in a story. The great attention devoted to animate objects probably accounts for the fact that conscious beings are transformed far more often than weeds, urns, rocks, and other dull lumps of matter. The latter also have less occasion to offend gods or parents.

General interest in conscious beings might also explain more detailed aspects of the transformations. It is probably easier for a main character to continue participating in a story after being transformed into a conscious being or animal rather than an inanimate object. This need for continuity of action leads to conscious beings being changed into other conscious beings and animals more often than plants, liquids, or other inanimate objects. Besides being interesting because they can act, animate beings are also interesting because they inspire empathy more easily than inanimate objects. The audience might empathize more readily with a character who is changed into a deer rather than one changed to a rock.

To determine whether conceptual principles may still be needed to explain the metamorphoses, we compared the proportion of transformations

among animate beings in which an animate object (conscious being or animal) was changed into an inanimate object (plant, liquid, or other inanimate) with the proportion of transformations among inanimate objects in which an inanimate object was changed to an animate object. Since general interest in animate objects should cause them to be favored as the outcome of a transformation, an asymmetry should be present in the transformations across the animate/inanimate boundary. The proportion of inanimate objects changed to animate objects should be higher than the proportion of animate to inanimate changes. However, the results were opposite to what the interest hypothesis would predict. Collapsing across the metamorphoses in Ovid and Grimm, animate beings were transformed into inanimate objects 27% of the time, whereas 19% of the inanimate objects were transformed into animate objects. The proportions do not differ significantly since the 95% confidence intervals around the proportions for animates (.22 to .32) and inanimates (.10 to .27) overlap. As a more detailed analysis of the interest explanation, we examined the number of nodes on the ontological tree separating the objects participating in each transformation. If general interest in animate objects underlies the transformations, inanimate objects should on the average cross more nodes in a transformation than animate objects. This prediction follows from the greater number of nodes that an inanimate, compared with an animate, must cross to become animate. Once again, however, the results were not in accord with the proposal that interest alone could account for the transformations. The mean number of nodes crossed in transforming an inanimate object was 0.7, compared with 1.3 for transformations of animate objects. Despite the generally greater interest in animate beings, they do not stand out as attractive outcomes of metamorphoses among objects that are very different from animate beings.

We do not deny through this analysis that the desire to stimulate interest in a story plays no role in the transformations. However, recourse to conceptual principles may still be needed to explain the source of the interest. For instance, if empathy provides a proximal explanation for changing persons into animals more often than plants or other inanimates, one must still identify the cause of this greater empathy, which could be due to some fundamental similarities between conscious beings and animals, such as their animacy or ontological relatedness. In addition, the act of violating conceptual categories could arouse interest in an audience. However, excessively radical violations may sacrifice comprehensibility and, hence, decrease interest. Thus, the story teller may be motivated to alter an object's identity, but not very severely. The degree of severity may indicate the types of conceptual categories involved in transformations. Ontological knowledge appears to be implicated in the transformations because objects are transformed into members of their own or neighboring categories rather

than more distant ontological categories. Such a pattern may instill interest in a story, but the interest itself must be explained through recourse to conceptual structure.

Given that general interest in particular objects cannot completely account for the transformations, the types of characteristics kept invariant across metamorphoses can reasonably be said to reflect the levels of conceptual structure influencing the transformations. The analysis presented here suggests that the ontological category of an object tends to remain constant throughout transformations, and when ontology is altered, the violation is not severe. However, the violations might be drastic enough to indicate that ontological knowledge is not reflected through the transformations, but rather more general conceptual distinctions. The examination of the interest hypothesis suggests that the distinction between animacy and inanimacy might be more immediately reflected in the transformations than ontology. When animate beings were transformed, 73% were changed into other animate beings. On the other hand, when inanimate objects were transformed, 81% were turned into other inanimate objects. The 95% confidence intervals around these proportions is .68 to .78 for animate objects and .72 to .90 for inanimate objects. Hence, both proportions are significantly greater than .50. Thus, the animacy or inanimacy of a target is generally maintained across transformations. The sharp boundary between animacy and inanimacy appeared not only in the overall analysis, but also within each of the specific ontological categories examined, as Table III shows.

Perhaps the patterns of transformations can be more readily accounted for by animacy rather than ontology. For example, the large number of transformations of conscious beings into animals (Table I) poses a problem for the ontology explanation since this view predicts other conscious beings as the predominant outcome of such transformations. However, this pattern of results fits easily within an animacy account. Still, some aspects of the transformations indicate that ontological categories might be relevant.

TABLE III
Percentage of Changes for Each Ontological Category
That Did Not Cross the Animate/Inanimate Boundary

<i>Animate to Animate Changes</i>	
Animate Objects	(%)
Conscious Beings	73
Animals	67
<i>Inanimate to Inanimate Changes</i>	
Inanimate Objects	(%)
Plants	78
Nonliving Inanimates	81
Liquids	86

Among transformations of inanimate objects alone, which never cross the animate/inanimate boundary, plants are turned into plants more than liquids, whereas liquids are turned into liquids more than plants, as an ontological account would predict. In addition, as Table III shows, the closer a particular ontological category is to the animate/inanimate boundary, the greater the likelihood of transformations across that boundary. An ontological account of the transformations would predict this ordering since objects should be transformed into members of ontological categories close to those of the original objects. Ontological categories close to the animate/inanimate boundary should, thus, have a greater chance of crossing that boundary in a transformation. The obtained pattern is marginally significant, since a pattern exactly corresponding to that predicted by an ontology account would be observed by chance with a probability of .08 (2 arrangements of animate categories by three arrangements of inanimate categories yield 12 possible patterns, only one of which corresponds to the ontology explanation). Since ontological knowledge not only captures the animate/inanimate distinction, but also these other patterns within the transformations, it possibly provides a more encompassing explanation than does knowledge of animacy. More extensive analyses of tales would be needed to fully evaluate the role of ontology and animacy in the transformations.

In the present set of transformations, conceptual structures finer than those related to ontology or animacy are also reflected. An analysis of the many transformations of conscious beings into animals provides support for Carey's (in press) proposal that the concept of "animal" for young children follows a typicality pattern in which humans are most central, followed by decreasingly similar taxonomic classes. If metamorphoses are constructed with enough features of the transformed object kept invariant so that its original form can be recovered, then conscious beings should tend to be transformed into animals that are relatively close to the central concept of "human being." Based on Carey's work, we predicted that transformations of conscious beings into mammals should dominate, followed by birds, reptiles/amphibians, fish, and insects. These predictions were generally supported in the *Metamorphoses*, 37 conscious beings were transformed into mammals, 40 were changes into birds, 10 into reptiles/amphibians, 5 into fish, and 1 into an insect. The results were almost identical in Grimms' fairy tales: 19 conscious beings were changed into mammals, 20 into birds, 6 into reptiles/amphibians and fish, and 2 into insects.

CONCLUSION

In conclusion, we believe that the transformational patterns, as well as their consistency across the two texts analyzed, were partially determined by the nature of conceptual organization at some or all of the levels of ontology,

animacy, and the more specific knowledge domain of animal. The existence of these patterns in myth and fantasy seems particularly important if, with Levi-Strauss, one believes that, "if it were possible to show . . . that the apparent arbitrariness of myths, the supposed freedom of inspiration, the seemingly uncontrolled process of invention, implied the existence of laws at a deeper level, then the conclusion would be inescapable. . . . If the human mind is determined even in its creation of myths, a fortiori it is determined in other spheres as well" (1964/1969, p. 18).

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