

# How Language Influences the Way We Categorize Hybrids

Yeshayahu Shen<sup>1</sup> and David Gil<sup>2</sup>

<sup>1</sup>Tel Aviv University, Tel Aviv, Israel <sup>2</sup>Max Planck Institute for the Science of Human History, Jena, Germany

## OUTLINE

47.1 Introduction: Visual Hybrids and Their Significance	1178
47.2 The Ontological Hierarchy	1181
47.3 Empirical Studies of the Categorization of Hybrids	1183
47.3.1 <i>The Effect of Grammar</i>	1183
47.3.2 <i>The Effect of More Grammar</i>	1191
47.3.3 <i>The Effect of Verbal Priming</i>	1194
47.4 Discussion	1196
47.4.1 <i>The Distinctiveness of Hybrids</i>	1196
47.4.2 <i>The Ontological Hierarchy and Processes of Categorization</i>	1197
47.5 Conclusion	1198
Acknowledgments	1199
References	1199

## Abstract

A *hybrid* is an entity conceived of as a fusion or inseparable combination of components associated with two or more distinct entities, the hybrid's *parents*. A major subtype is *visual hybrids*, represented in two- or three-dimensional images such as drawings or statues; e.g., the mermaid, combining the top half of a woman with the bottom half of a fish. Visual hybrids are ubiquitous in art, religion, folklore and popular culture world-wide, and have been around since the dawn of civilization.



Whereas the hybrid's parents are typically well-known entities belonging to familiar categories, the hybrid itself is, or at least starts out as, a novel and unfamiliar entity whose categorial membership is not immediately obvious. We address the question whether one of the hybrid's parents is more central to its conceptualization and if so, which one, surveying a series of studies conducted over the past several years investigating the processes involved in the categorization of visual hybrids. Our focus is on the *Ontological Hierarchy: humans > animals > plants > inanimates*. We examine the extent to which there is a tendency for hybrids to be categorized in accordance with the parent that is higher on the Ontological Hierarchy (e.g., man–bird as a kind of man, not a kind of bird). Our main finding is that the Ontological Hierarchy is indeed relevant to the conceptualization of hybrids; however, it is crucially dependent on the medium in which the categorization takes place. Specifically, the verbal medium, when present in various experimental tasks, enhances the Ontological-Hierarchy effect. The results of our studies thus provide support for a cognitive architecture consisting of two major levels, with a basic nonverbal level of conceptualization providing the foundations for a higher level of conceptualization associated with the linguistic medium.

### 47.1 INTRODUCTION: VISUAL HYBRIDS AND THEIR SIGNIFICANCE

---

A *hybrid* is an entity conceived of as a fusion or inseparable combination of components associated with two or more distinct entities, which we shall refer to here as the hybrid's *parents*. A central feature of hybrids is that whereas its parents are typically well-known entities belonging to familiar categories, the hybrid itself is, or at least starts out as, a novel and unfamiliar entity whose categorial membership is not immediately obvious. The notion of hybrid is extremely broad; Wikipedia (accessed on 18 May 2016) provides links to no less than 55 different entries whose titles contain the term hybrid, dealing with a wide array of items from domains as diverse as biology (e.g., hybrid grape), technology (e.g., hybrid vehicle), art (e.g., hybrid genre), and others.

An important subclass of hybrids is that of *visual hybrids*. A visual hybrid is a hybrid that is or may be represented in a visually perceived two- or three-dimensional image such as a drawing or statue. Prototypical and well-known examples of visual hybrids are *centaurs*, part-human part-horse, and *mermaids*, combining the top half of a woman with the bottom half of a fish. Visual hybrids are ubiquitous in art, religion, folklore, and popular culture, and have been around since the dawn of civilization (see Wengrow, 2014). Earliest known examples of visual hybrids are the 40,000-year-old Hohlenstein Stadel *lion man* and the 30,000- to 32,000-year-old Chauvet *bison man*. Ancient Assyrian and Egyptian religion is replete with gods of hybrid form, as is the mythology of the ancient Greeks and Romans. Today, visual hybrids can be found in all corners of the world, ranging from the traditional



cultures of New Guinea and the Amazon all the way to modern pop art. The widespread distribution of visual hybrids across space and time suggests that they may provide a reflection of universal properties of human cognition.

Visual hybrids constitute an interesting boundary case of *categorical ambiguity* which must be accounted for by any adequate theory of categorization. On the one hand, the hybrid's parents are familiar entities; in this respect, the hybrid is far from representing some kind of unfamiliar meaningless image. On the other hand, the hybrid itself, in its entirety, does not map onto any familiar concept, and, at least from the outset, is lacking in conventional lexical representation. For example, the hybrid in Fig. 47.1 below clearly contains the top half of a bird and the bottom half of a man, but the hybrid as a whole does not instantiate any known concept, and there is no simple conventional word for it: it's just a "man-bird," or something along those lines. When faced with such visual hybrids, and attempting to conceptualize them or represent them verbally, the perceiver is placed under *conceptual and linguistic strain* (Gentner & France, 1988). Examination of the conceptual and linguistic processing of visual hybrids under such strain thus stands to reveal fundamental cognitive processes which may not be readily observable in the context of more conventional stimuli, or, alternatively, totally novel ones. It is this that makes the study of visual hybrids so critical to the investigation of categorization.

In spite of the importance to the theory of categorization of the linguistic and conceptual processes involved in the perception of visual hybrids, few empirical studies in the domain of cognitive science have actually addressed these issues. One of the first studies was that of Nash (1974), who examined subjects' responses to mythological hybrids formed from combinations of humans and animals, pointing to factors such as, e.g., the kinds of body parts drawn from each parent and the emotional reactions triggered by the image, which affect the degree of "humanness" or "animality" attributed to the hybrid. However, the significance of Nash's results is limited for the following reasons. First, the hybrids examined were of one particular type, that combining human and animal parents. Secondly, since the stimuli used in the study were conventionalized images from ancient civilizations such as Egypt and Greece, it was not possible to control for variables affecting the degree of humanness that subjects attributed to the hybrids, as would have been the case for stimuli specially constructed for the purpose of the experiment. In another study, conducted within the framework of psychological essentialism theory, Wagner et al. (2010) examined some of the cognitive and affective processes involved in the conceptualization of hybrids whose parents were of two different animal species or two different human ethnic groups. They found that subjects were more likely to attribute an



FIGURE 47.1 A visual hybrid.

independent “essence” to each of a hybrid’s parents (e.g., a “sheepness” essence associated with all sheep) than to the hybrid in its entirety; in contrast, subjects experienced more negative affective reactions when faced with a whole hybrid than when faced with each of its individual parents.

In this chapter, we address an issue that has not received sufficient attention even in the few previous studies that have been concerned with hybrids. The question we pose is: is one of the hybrid’s parents more central to its conceptualization, and if so, which one? For example, is the



hybrid in Fig. 47.1 more man or more bird? This chapter surveys a series of studies that we have conducted over the past several years, investigating the processes involved in the conceptualization of visual hybrids.

Our studies focus on the ways in which the conceptualization of hybrids is governed by the *Ontological Hierarchy* (Connor & Kogan, 1980; Keil, 1979; Deane, 1992, and others), a basic knowledge structure that imposes a hierarchical order on different kinds of entities:

(1) The Ontological Hierarchy

*humans > animals > plants > inanimates.*

The central question examined in our studies was: what is the effect of the Ontological Hierarchy on the conceptualization of hybrids? Specifically, to what extent is there a tendency for hybrids to be categorized in accordance with the parent that is higher on the Ontological Hierarchy (e.g., a man–bird as a kind of man, not a kind of bird)?

Our main finding is that the Ontological Hierarchy is indeed relevant to the conceptualization of hybrids. However, this Ontological-Hierarchy effect is crucially dependent on the medium in which the categorization takes place. Specifically, *the verbal medium enhances the Ontological-Hierarchy effect.* The effect of the verbal medium on the categorization of hybrids is found to be manifest in the following three ways:

- (2) a. The Ontological-Hierarchy effect is greater for tasks that involve grammatical structure than for nonverbal tasks or tasks that involve just the lexicon.
- b. The Ontological-Hierarchy effect is greater for verbal tasks when there is “more grammar”; specifically, asymmetric versus symmetric grammatical structures.
- c. The Ontological-Hierarchy effect is greater for nonverbal tasks when they are primed by verbal ones.

The remainder of this chapter is organized as follows. Section 47.2 surveys previous studies in support of the Ontological Hierarchy. Section 47.3 presents the main results of our own empirical investigations into the categorization of visual hybrids, showing how the Ontological-Hierarchy effect is licensed by the verbal medium, in accordance with (2) above. Section 47.4 concludes with some general discussion.

## 47.2 THE ONTOLOGICAL HIERARCHY

Numerous previous studies have shown that the Ontological Hierarchy plays a central role in a variety of conceptual and linguistic phenomena. In the domain of conceptual development, Keil (1979) has demonstrated the sensitivity of conceptual development to the Ontological Hierarchy. In linguistics, versions of the Ontological



Hierarchy underlie the well-known *Animacy Hierarchy*, governing a wide range of grammatical phenomena such as gender systems (Corbett, 2001), agreement patterns (Corbett, 2006), morphosyntactic alignment (Becker, 2014), and many others. Other studies have pointed to the importance of the Animacy Hierarchy in domains such as diachronic word meaning extension (Heine, Claudi, & Hinnemeyer, 1991) and language production (Bock & Warren, 1985). The effect of the Animacy Hierarchy is particularly significant in the domain of word order (Deane, 1992, Larsen & Johansson, 2008, and many others). In general, items higher on the Animacy Hierarchy tend to occur before items that are lower down (Cooper & Ross, 1975; McDonald, Bock, & Kelly, 1993, and others). Cooper and Ross refer to this as the “me first” principle, whereby speakers prefer to assign earlier position to items that are deemed closer to their own “self-image” (e.g., students from Illinois might say that they are watching the *Illinois–Michigan* match, while students from Michigan might refer to the same event as the *Michigan–Illinois* match): preferences such as these are said to reflect a “World Order” of relative prominence.

The Ontological Hierarchy has also been shown to be of relevance in contexts of a creative nature. Lakoff and Turner (1989: 166–169) account for the way in which we interpret proverbs in terms of a similar hierarchy, which they refer to as the “Great Chain of Being.” Kelly and Keil (1985) examine fictitious changes of form in Ovid’s *Metamorphoses* and Grimm’s *Fairy Tales* and account for the attested types of changes in terms of a hierarchy similar to that of the Ontological Hierarchy. Connor and Kogan (1980) investigate the role of the Ontological Hierarchy in metaphor asymmetry; see also Deane (1992). Using a Metaphorical Triad Task involving pairs of pictures connected metaphorically (e.g., an old hunched-over man and an ancient gnarled tree), Connor and Kogan find that subjects tend to select the object higher on the Ontological Hierarchy as the target of the metaphor and the object lower on the hierarchy as its source (e.g., the man looks like the tree, rather than the tree looking like the man); a similar pattern is evident when, instead of pictures, subjects are presented with sentences describing the pictures.

Our investigations of visual hybrids provide a new window into the workings of the Ontological Hierarchy, one that derives from the hybrids’ lack of ready-made labels in our mental lexicon, and the resulting conceptual and linguistic strain. Whereas most previous studies of the Ontological Hierarchy are concerned primarily or exclusively with its manifestations in a linguistic medium, we examine the differential roles of the Ontological Hierarchy in linguistic and non-linguistic mediums. Our focus is on the version of the Ontological Hierarchy represented in (1) above, distinguishing between humans, animals, plants, and



inanimates. Our assumption is that the position of a particular item on the above hierarchy reflects its degree of *conceptual prominence*, whereby items higher on the hierarchy are of a more basic nature in conceptual structure, and acquired earlier in human conceptual development.

### 47.3 EMPIRICAL STUDIES OF THE CATEGORIZATION OF HYBRIDS

In this section, we survey a series of experiments showing how the linguistic medium enhances the effect of the Ontological Hierarchy on the categorization of visual hybrids, in accordance with (2) above.

Our experimental studies make use of a set of 24 custom-designed visual stimuli representing hybrids, such as that shown in Fig. 47.1. The 24 hybrids instantiate all six possible binary combinations of the four categories of the Ontological Hierarchy: human–animal, human–plant, human–inanimate, animal–plant, animal–inanimate, and plant–inanimate. Each of these six combinations is represented by four stimuli, two in which the parent higher on the Ontological Hierarchy is positioned above the parent lower on the hierarchy, and two in which the parent higher on the Ontological Hierarchy is located beneath the other parent—as happens to be the case in Fig. 47.1. This was in order to neutralize any potential effects of spatial orientation on the categorization of the hybrids.

In Sections 47.3.1, 47.3.2, and 47.3.3 below, we demonstrate, in turn, the effects of the verbal medium on the categorization of hybrids as represented in (2a), (2b), and (2c), respectively.

#### 47.3.1 The Effect of Grammar

In this subsection, we demonstrate that, in accordance with (2a) above, the effect of the Ontological Hierarchy on the categorization of visual hybrids is greater for tasks that involve grammatical structure than for nonverbal tasks or tasks that do not involve grammatical structure.

##### 47.3.1.1 *The Verbal Description Task*

Our first experiment was a description task in which speakers of Hebrew were asked to provide a short verbal description of each of the 24 hybrids (Shen & Gil, 2010; Shen, Gil, & Roman, 2006b). Their responses were then coded with regard to whether the description reflected a conceptualization of the hybrid as (1) belonging to the category of the parent higher on the Ontological Hierarchy, (2) belonging to the category of the parent lower on the Ontological Hierarchy, or (3) neutral, not belonging to either category to the exclusion of the other.



Some examples of subjects' responses to the stimulus in Fig. 47.1 illustrating each of these three possibilities are provided in (3)–(5) below:

(3) *Consistent with Hierarchy Hebrew*

(a) iš      šetafas                      nec  
man REL:catch.PST.3SGM hawk  
"man that caught a hawk"

(b) rakdan      kapuera      cipori  
dance:AG capoeira bird:ADJ.SGM  
"birdy capoeira dancer"

(4) *Inconsistent with Hierarchy Hebrew*

(a) cipor      řim      ragley                      adam  
bird with leg.CONSTR.PLM person  
"bird with person"s legs"

(b) cipor      mehuberet              leguf      tahton      enoři  
bird join.PASS.PRS.SGF to:body lower human:ADJ.SGM  
"bird joined to human lower body"

(5) *Neutral Hebrew*

(a) išneřer  
man:vulture  
"manvulture"

(b) řaci                      neřer/řayit—      řaci                      adam  
half.CONSTR.SGM vulture/hawk half.CONSTR.SGM person  
"half vulture/hawk—half person"

The experimental results point to a significant hierarchy effect. Excluding the neutral cases, which were relatively infrequent, subjects described the hybrids as belonging to the category of the parent higher on the Ontological Hierarchy, as in the examples in (3), in roughly two-thirds of the cases.

How might we interpret these results? At least two potential accounts present themselves. One might be to suggest that the greater conceptual prominence of items higher on the Ontological Hierarchy (e.g., Keil, 1979) is what leads subjects to categorize and then describe the hybrid in terms of the parent higher on the Ontological Hierarchy.

However, an alternative account would be of a more linguistic nature, involving the Animacy Hierarchy, which provides for a set of conventionalized grammatical principles governing the mapping of



semantic concepts onto linguistic forms. For example, languages have grammatical rules whose effect is to map semantically more salient concepts, such as those higher on the Ontological Hierarchy, onto grammatically more salient positions, such as, e.g., the head noun in a noun-attributive construction (see, e.g., Branigan, Martin, & Tanaka, 2008; Feleki, 1996). The Animacy Hierarchy thus relies heavily on the asymmetry characteristic of most if not all grammatical constructions, which provides for a natural way of expressing the asymmetry inherent in the Ontological Hierarchy. (More detailed discussion of this asymmetry is provided in Section 47.3.2 below.) In accordance with the Animacy-Hierarchy account, subjects asked to describe a hybrid in words switch over to a “linguistic mode,” and end up describing the hybrids in accordance with grammatical principles that make reference to the Animacy Hierarchy. Such an account is consistent with Slobin’s (1996) notion of “speaking for thinking,” in which the task of representing the conceptualization of nonverbal stimuli in language leads to the conversion of such conceptualizations into the linguistic structures made available by the language, and the subsequent adaption and modification of such conceptualizations in accordance with the available linguistic forms. Thus, in accordance with the Animacy-Hierarchy account, the hierarchy effect observed in the description task is due not directly to the conceptual prominence of items higher on the Ontological Hierarchy, but rather to the act of representing the conceptualization of hybrids in a verbal medium.

#### **47.3.1.2 The Nonverbal Categorization Task**

These two potential accounts may be teased apart by examining whether a hierarchy effect occurs in tasks of a nonverbal nature. In the nonverbal categorization task (Shen & Gil, 2010, 2013), subjects were presented with the same set of 24 visual hybrids; under each hybrid were two sets of visual images representing members of the two categories associated with each of the hybrid’s two parents. For example, for the “man–bird” hybrid in Fig. 47.1, subjects were presented with a set of visual images of humans and a set of visual images of birds. Subjects were asked to decide which of the two sets the hybrid belonged to.

The nonverbal categorization task makes it possible to differentiate between the two accounts. If the hierarchy effect in the description task were due to the conceptual prominence of items higher on the Ontological Hierarchy, then we would expect the effect to be replicated in the nonverbal categorization task. On the other hand, if the hierarchy effect in the description task were due to the verbal medium and the Animacy Hierarchy, then we would expect the hierarchy effect to be significantly lower for the nonverbal categorization task.



To our initial surprise, the results of the nonverbal categorization task showed a dramatic decrease in the hierarchy effect. Whereas for the verbal categorization task some two-thirds of the responses were in accordance with the hierarchy, for the nonverbal categorization task the responses in accordance with the hierarchy were around 50%, or in other words, at chance level. A more fine-grained analysis of the results distinguishing between the six different combinations of the four ontological types revealed that for each of the six different combinations, the hierarchy effect was significantly greater in the verbal description task than in the nonverbal categorization task.

In conjunction, then, the results of the verbal description and nonverbal categorization tasks show clearly that the conceptualization of visual hybrids is dependent on the medium in which it is conducted, with the verbal medium having a significant effect on the categorization of hybrids, through the mediation of the Animacy Hierarchy.

#### **47.3.1.3 Further Tasks**

The role of the Animacy Hierarchy and the linguistic medium in the categorization of hybrids is further substantiated by results from four additional tasks. Of these, two were of a verbal nature making use of grammar, involving choice of descriptions and choice of metaphors; one was of a verbal but non-grammatical nature, involving choice of lexical labels; and one was entirely nonverbal, involving color inferences (Mansour, 2008; Shen & Gil, 2010).

While the verbal description task in Section 47.3.1.1 was a production task, the nonverbal categorization task in Section 47.3.1.2 was a comprehension task. In order to neutralize the distinction between these two different kinds of tasks, the tasks presented in this section are all comprehension tasks, involving a forced choice between alternative options.

In the first verbal task, Hebrew-speaking subjects were presented with hybrids from the basic set of 24 stimuli, where alongside each hybrid two descriptions were offered, one consistent with the Animacy Hierarchy, e.g., "man with bird's wings," the other inconsistent with the hierarchy, e.g., "bird with man's legs." In the second verbal task, Arabic-speaking subjects were presented with the same hybrids, but this time, each hybrid was accompanied by two metaphors relating the parents of the hybrid, one in accordance with the hierarchy, e.g., "the man is like a bird," the other going against the hierarchy, e.g., "the bird is like a man." The prediction was that, as verbal tasks, the Animacy Hierarchy would play a role in the subjects' choices, and this was borne out overwhelmingly by the results. When choosing descriptions, subjects preferred those in which the hybrid was described in terms of the entity higher on the Animacy Hierarchy, and when choosing metaphors, subjects showed a significant preference for those in which the target of the



metaphor, expressed by the subject of the sentence, was higher on the Animacy Hierarchy than the source, to which it was likened.

In the verbal but non-grammatical task, Hebrew-speaking subjects were presented with each hybrid, under which were two labels representing its two parents. For example, for the hybrid in Fig. 47.1, subjects were presented with the word meaning "man" and the word meaning "bird." Subjects were asked to decide which of the two labels constituted a more appropriate name for the hybrid. This task thus corresponds closely to the nonverbal categorization task in Section 47.3.1.2, except that instead of containing visual images of items constituting a category, the category name is provided. In that sense, the task is verbal; however, unlike the two verbal tasks just described, it does not involve any of the asymmetries that are typically associated with grammatical structure. Accordingly, it provides no room for the Animacy Hierarchy to kick in, and therefore the prediction was that the results would be at chance. As indeed it was: just as in the nonverbal categorization task in Section 47.3.1.2, roughly half of the subjects' choices were in accordance with the hierarchy, while the other half were not.

Finally, in the nonverbal task, Arabic-speaking subjects were presented with visual images of the hybrid's parents, each in a different color. Under the two parent images was a colorless silhouette of the appropriate hybrid. Subjects were then asked to infer the color of the hybrid based on the colors of its two parents. For example, for the hybrid in Fig. 47.1, they might have been presented with a red man and a green bird: would the hybrid silhouette then be red or green? If, as suggested up to now, the Animacy Hierarchy only plays a role in linguistic tasks involving grammar, then it is predicted that there should be no hierarchy effect in what was essentially a nonverbal task. And indeed there was no such effect; subjects' choices were at chance, just like they were with the preceding choice of lexical label task and earlier nonverbal categorization task.

In conjunction, then, these four additional tasks provide strong additional support for the claim that Ontological-Hierarchy effect for hybrid categorization is greater for tasks that involve grammatical structure, where it is mediated by the Animacy Hierarchy, than it is than for nonverbal tasks or for tasks that involve just the lexicon.

#### **47.3.1.4 Across Languages**

To this point, all of the experiments discussed were conducted on speakers of Hebrew or related Arabic. However, although numerous grammatical studies have shown that the Animacy Hierarchy is of universal cross-linguistic validity, its manifestations may differ from language to language. For example, while in some languages gender systems involve animacy distinctions in other languages they may instead be limited to



other features such as sex, size, shape, and so forth (see, e.g., Corbett, 2001). Similarly, whereas in some languages patterns of syntactic alignment are based on animacy, in others they may make reference to various other features (see, e.g., Siewierska, 2005). This raises the question whether the effect of the Animacy Hierarchy on the categorization of hybrids may have been due to some peculiar aspects of Hebrew (or Arabic) grammar.

In order to explore the cross-linguistic validity of the animacy effect on the categorization of hybrids, we repeated two of the preceding tasks, the verbal description task (Section 47.3.1.1) and the nonverbal categorization task (Section 47.3.1.2) on three additional languages: Bulgarian (Admon, 2008), Indonesian and Minangkabau (an Austronesian language of western Sumatra)—see Shen, Gil, and Roman (2006a). In all three languages, the original results from Hebrew were replicated: whereas in the verbal description task, a significant hierarchy effect was in evidence, in the nonverbal categorization task, there was no such effect—categorization was roughly 50/50.

Some examples of subjects' responses to the stimulus in Fig. 47.1 in Minangkabau are provided in (6)–(8) below:

(6) *Consistent with Animacy Hierarchy* Minangkabau

(a) urang bakapalo alang  
 person MED:head eagle  
 "person with head of an eagle"

(b) manusia basifat bak buruang  
 human MED:character like bird  
 "human with characteristics like a bird"

(7) *Inconsistent with Animacy Hierarchy* Minangkabau

(a) buruang babadan urang  
 bird MED:body person  
 "bird with body of a person"

(b) saikua buruang tabang yang baikua kaki urang  
 one:CLF bird fly REL MED:tail leg person  
 "a bird flying with tail of a person's legs"

(8) *Neutral* Minangkabau

(a) saparo buruang, saparo urang yang sedang  
 one:half bird one:half person REL PROG  
 mangapakan sayap  
 ACT:wing:APPL wing  
 "half bird, half man flapping wings"



(b) ado kaki urang, diatehnyo      ado buruang elang  
 exist leg person LOC:top:ASSOC exist bird eagle  
 jo sayoknyo yang gadang  
 with wing:ASSOC REL big

"There are legs of a person, above that there's an eagle with its big wings"

Although Minangkabau grammar differs greatly from that of Hebrew, the experimental results were strikingly similar. As was the case for the corresponding Hebrew examples in (3)–(5), the neutral descriptions, as in (8), constituted a small minority. Of the other two types, descriptions consistent with the animacy hierarchy, such as those in (6), were roughly twice as frequent as those inconsistent with the hierarchy, such as those in (7). However, for the nonverbal categorization tasks, no hierarchy effect was evident. Thus, the results from the Minangkabau experiment, together with those from Bulgarian and Indonesian, lead to the conclusion that the effect of grammatical structure on the categorization of hybrids is not specific to Hebrew but rather a plausible candidate for a cross-linguistic universal. (Some additional studies of hybrid conceptualization from a cross-linguistic perspective are provided in Kotzer, 2011.)

#### 47.3.1.5 Across Ages

A further important issue concerns the ways in which the principles governing the categorization of hybrids are acquired by infants. To the best of our knowledge there are no previous studies examining the developmental course of hybrid conceptualization (but see Nash & Maki, 1978); certainly none which examine the role of the Ontological Hierarchy in categorization of hybrids across different verbal and nonverbal tasks.

First, we repeated the verbal description task (Section 47.3.1.1) and the nonverbal categorization task (Section 47.3.1.2) on two younger age groups, 6-year-old and 10-year-old speakers of Hebrew (Aleluf, 2005). For both age groups, the results were the same as for the adults: whereas for the verbal description task there was a significant hierarchy effect with about twice as many descriptions consistent with the Animacy Hierarchy as there were inconsistent with it, for the nonverbal categorization task there was no hierarchy effect, with the results at around 50/50.

We next repeated the same two tasks on a group of Hebrew 3-year-olds (Sanhedrai, in preparation). According to some studies (Childers & Echols, 2004), this is the age at which children acquire knowledge of the Ontological Hierarchy and competence in grammatical constructions of an asymmetrical nature—the two basic prerequisites for the Animacy Hierarchy. This, then, is the age at which a hierarchy effect on the



categorization of hybrids might be seen to develop. The 3-year-olds' results were similar but not identical to those of the older children and the adults. As with the older groups, the hierarchy effect was significantly higher for the verbal description task than for the nonverbal categorization task. However, for both tasks, the hierarchy effect was weaker overall than it was for the older groups. Thus, whereas for the older groups the hierarchy effect was at roughly two-thirds versus one-half for the verbal description and nonverbal categorization tasks, respectively, for the 3-year-olds, it was at around 55% versus 40% for the two tasks. A more detailed analysis of the results suggests that the decreased hierarchy effect amongst the 3-year-olds was due to those hybrids in which one of the two parents was human (i.e., human–animal, human–plant, or human–inanimate), which the 3-year-olds tended to conceptualize in accordance with the lower of the two parents, that is to say, in accordance with an “anti-Animacy Hierarchy”. Various speculations can be offered for this curious result; e.g., it could be the case that young children exhibit a negative affective reaction to hybrids involving humans. Be that as it may, the main result to emerge is that even for 3-year-olds, the role of the Ontological Hierarchy is stronger for the verbal description task than it is for the nonverbal categorization task. This then suggests that the effect of grammatical structure on the categorization of hybrids kicks in pretty much as soon as the Animacy Hierarchy is acquired by young infants.

#### **47.3.1.6 On-Line Tasks**

Up to now all the tasks discussed were off-line, focusing on the products of hybrid conceptualization. The question arises whether a greater Ontological Hierarchy effect for verbal tasks is present also in the on-line processing of hybrid comprehension. In order to examine this question we constructed two tasks involving the measurement of reaction times (Mashal, Shen, Jospe, & Gil, 2014).

In the first, verbal task, Hebrew-speaking subjects were asked to decide whether particular phrases constituted appropriate descriptions for certain visual hybrids; while some of the descriptions were consistent with the hierarchy, others were inconsistent. For example, for the hybrid in Fig. 47.1, some subjects received a description resembling those in (3) while others received a description similar to those in (4). If an on-line hierarchy effect were present, we would expect descriptions consistent with the hierarchy to be judged faster than descriptions inconsistent with the hierarchy. And indeed, this prediction was borne out by the experimental results: phrases consistent with the hierarchy were judged significantly faster.

In the second, nonverbal task, subjects were shown a visual image of two items belonging to the category associated with one of the two



hybrid's parents, e.g., two men or two birds; they were then presented with an image of the hybrid itself. Subjects were asked to decide whether the hybrid belongs to the category just presented. Once again, if an on-line hierarchy effect were present, we would expect categorization of hybrids to proceed faster in the case of categories higher on the Ontological Hierarchy than in the case of categories lower on the hierarchy. This time, however, there was no such effect: reaction times were similar in both cases.

In conjunction, then, the above two tasks show that for the categorization of hybrids, the greater Ontological Hierarchy effect associated with verbal tasks that is evident in the off-line products of conceptualization is mirrored by a similar linguistic effect also in the on-line processing of hybrid comprehension.

### 47.3.2 The Effect of More Grammar

In the course of Section 47.3.1 above, we presented an array of experimental studies showing that, in accordance with (2a), the Ontological-Hierarchy effect is greater for tasks that involve grammatical structure than for nonverbal tasks or tasks that involve just the lexicon. The question arises whether it is the mere presence of grammar that is responsible for the observed hierarchy effects, or whether perhaps some specific property or properties of grammatical structure might be responsible for the role of the Animacy Hierarchy in the categorization of hybrids. In this section, we survey two studies that point towards the latter possibility. Specifically, we show that the crucial property of grammar that is responsible for the hierarchy effects is the pervasive *asymmetry* that is characteristic of most grammatical constructions; as spelled out in (2b), more grammatical asymmetry leads to more of an Ontological Hierarchy effect.

Consider, for example, a typical linguistic description of the hybrid in Fig. 47.1: *man with bird's head*. Rather than being of equal status, the two nouns denoting the hybrid's two parents, *man* and *bird*, exhibit an array of grammatical asymmetries. Most obviously, *man* precedes *bird* in linear order. More significantly, *man* asymmetrically c-commands *bird* in constituent structure; that is to say, *bird* is part of the phrase *bird's head*, *bird's head* is in turn part of the phrase *with bird's head*, while only the latter phrase is a sister constituent to *bird*. Most importantly, perhaps, *man* is the head of the entire phrase, a fact that bears formal and semantic consequences. Formally, it is *man* rather than *bird* which triggers agreement; e.g., if the entire phrase binds a pronoun later in the sentence or discourse, that pronoun will be *he* or *him* rather than *it*. And semantically, the entire phrase refers to a man rather than a bird;



it is of course precisely this fact that makes it possible for linguistic descriptions such as those in (3)–(8) to provide a window into our conceptualization of visual hybrids. Now for other descriptions of the same hybrid, or for descriptions of other hybrids, or for descriptions of the same hybrids in other languages, different arrays of grammatical asymmetries may be present. However, the presence of such asymmetries is a ubiquitous feature of grammar. Accordingly, such grammatical asymmetries provide a natural target for the Ontological Hierarchy to map on to, in the myriad ways that linguists typically subsume under the workings of the Animacy Hierarchy.

Now let us consider an alternative description of the hybrid in Fig. 47.1, involving a coordination: *man and bird*. Unlike the preceding example, *man and bird* exhibits but a single asymmetry, that of linear order: *man* comes before *bird*. However, both *man* and *bird* occur in the same syntactic configuration, each c-commanding the other. And neither *man* nor *bird* enjoy privileged status as the head of the entire phrase. Thus, apart from linear order, coordinative constructions such as *man and bird* are symmetric. Since speech is embedded in time, linear order is an intrinsic and well-nigh inescapable property of the verbal medium; however, of the asymmetries mentioned above, it is the most superficial, with the least ramifications vis à vis grammatical organization. Accordingly, in what follows, we shall refer, a little loosely, to coordinative constructions as symmetric, in contrast to other constructions which exhibit a richer array of grammatical asymmetries. An alternative way of putting this is that asymmetric constructions exhibit “more” grammar than their (nearly) symmetric coordinating counterparts.

We shall now examine the empirical evidence that, as spelled out in (2b), the Ontological-Hierarchy effect on the conceptualization of hybrids is greater for verbal tasks when there is “more grammar,” involving asymmetric structures, than it is when there is “less grammar,” in the case of symmetric structures.

#### **47.3.2.1 The Online Judgement Task**

The first task addressing this issue involved the measurement of reaction times, as in the tasks discussed in Section 47.3.1.6 (Mashal et al., 2014). Hebrew-speaking subjects were presented with visual hybrids and potential verbal descriptions, and asked to judge whether each description was an appropriate one for the corresponding hybrid. The verbal descriptions were of the following two kinds: (a) asymmetric descriptions, either consistent with the Animacy Hierarchy (as in (3)) or inconsistent with it (as in (4)), or (b) symmetric descriptions, in which the order of the two items was in accordance with the hierarchy (as in (5a)) or in opposition to it (as in (5b)).



If the hierarchy effect demonstrated in Section 47.3.1 were due merely to the verbal medium and the presence of grammatical structure, then one would expect to find reaction-time differences in two cases: (a) for asymmetric descriptions, shorter reaction times for descriptions consistent with the Animacy Hierarchy than for descriptions inconsistent with it, and (b) for symmetric descriptions, shorter reaction times for descriptions in which the order of the two items was in accordance with the hierarchy than for descriptions in which the order of the two items was in opposition to it. On the other hand, if the hierarchy effect is dependent specifically on the presence of grammatical asymmetries, then one would expect to find reaction-time differences only in the former (a) case, involving asymmetric descriptions, but not in the latter (b) case, involving symmetric descriptions. And indeed, the results of the experiment showed just this: reaction-time differences were in evidence for the asymmetric descriptions but not for the symmetric ones.

Thus, the online judgement task shows that it is not the verbal medium per se but rather the presence of asymmetric grammatical structures that introduces the Animacy-Hierarchy effect. Thus, more grammar means more of an Animacy-Hierarchy effect in the categorization of hybrids.

#### **47.3.2.2 *The Verbal Description Task (Revisited)***

Further support for this conclusion is derived from a closer examination of the results of the verbal description task. In discussing the verbal description task, in Section 47.3.1.1 for Hebrew-speaking adults, Section 47.3.1.4 for adult speakers of other languages, and Section 47.3.1.5 for Hebrew-speaking children, attention was focused on the asymmetric descriptions, showing that, for all the populations examined, a significant majority of the asymmetric descriptions were consistent with the Animacy Hierarchy. But what of the symmetric descriptions that were also offered? As pointed out above, the so-called symmetric descriptions, involving coordination or other similar constructions, also exhibit a weak asymmetry, due to linear order. In accordance with the preceding discussion, one would predict that the hierarchy effect should be weaker for symmetric descriptions than for their asymmetric counterparts.

However, for most of the populations examined, the number of asymmetric descriptions that were offered vastly outnumbered that of the symmetric descriptions, to the extent that there were not enough of the latter, symmetric descriptions for the prediction to be testable. Still, an interesting developmental pattern revealed itself whereby as children matured into adults, the proportion of asymmetric descriptions that they offered increased in a consistent and significant fashion. Thus, for the



youngest age group examined, the 3-year-olds (Sanhedrai, in preparation), there were sufficient numbers of symmetric descriptions for the prediction to be tested. In fact, the 3-year-olds, alone of the age groups examined, also offered a significant number of one-word descriptions, which of course could only denote one of the two parents of the hybrid stimulus – but with respect to which we could also test for a hierarchy effect: does the single-word description denote the parent higher on the Animacy Hierarchy? Thus, for the 3-year-old subjects, a more articulated prediction suggests itself, whereby the hierarchy effect should be stronger for asymmetric descriptions than for symmetric ones, but stronger for symmetric descriptions than for one-word descriptions. And indeed, this prediction was borne out in its entirety. Thus, the verbal descriptions of the 3-year-old children show that even at that very early age, more grammar means more of a hierarchy effect, that is to say, greater grammatical asymmetry entails a greater role for the Ontological Hierarchy in the categorization of visual hybrids.

### 47.3.3 The Effect of Verbal Priming

In Section 47.3.1, we presented a series of studies showing that, in accordance with (2a), the Ontological-Hierarchy effect is greater for tasks that involve grammatical structure than for nonverbal tasks. We shall now provide evidence for a somewhat more dramatic version of the same effect, namely that, as suggested in (2c), the Ontological-Hierarchy effect is greater for nonverbal tasks when they are primed by verbal ones.

The verbal priming task sequence was performed in two stages one week apart (Shen & Gil, 2013). In the first stage, Hebrew-speaking subjects performed the nonverbal categorization task (Section 47.3.1.2). In the second stage, the subjects were asked to perform the nonverbal categorization task again, except that this time, before categorizing each hybrid, they were asked to describe it in words, as per the verbal description task (Section 47.3.1.1). The prediction was that hybrids would be more likely to be nonverbally categorized in accordance with the Ontological Hierarchy if such categorization took place immediately following a verbal description task. For example, the hybrid in Fig. 47.1 would be more likely to be categorized as human if the subject had just finished describing the hybrid in words. The results showed that this was indeed the case. Note that the priming effect was of a “local,” stimulus-specific nature; that is to say, when the description was consistent with the hierarchy, the following nonverbal categorization tended to be consistent, but when the description was inconsistent with the hierarchy, the following nonverbal categorization also tended to be inconsistent. Thus, the



tendency for the second nonverbal categorization to conform to the Ontological Hierarchy emerges as a result of the same tendency being present in the verbal description task. What the verbal priming task sequence shows, then, is that, when occurring in a priming context, the grammatical patterns associated with the Animacy Hierarchy have the power to induce a verbal mode of reasoning and thereby affect the way in which we categorize hybrids, even in an otherwise nonverbal task.

It might be suggested that the results of the verbal priming task sequence represent the outcome of a general tendency for a given task to influence another immediately following task, whatever the nature of the two tasks in question. In order to explore this possibility, a mirror-image task sequence to the one described above was constructed (Finkel, 2010). In the mirror image task sequence, Hebrew-speaking subjects performed the verbal description task, then, one week later, the same subjects performed the verbal description task immediately preceded by the nonverbal categorization task. If the results of the original verbal priming task sequence were indeed the product of a general tendency for earlier tasks to affect subsequent ones, then in the mirror-image task sequence, we would expect the hierarchy effect characteristic of the verbal description task to be reduced the second time around, under the influence of the immediately preceding nonverbal categorization task, given the absence of hierarchy effects associated with the nonverbal categorization task. But this was not the case: the hierarchy effect was equally in evidence in the verbal description task even when it was performed right after the nonverbal categorization task.

Thus, when viewed together, the two task sequences suggest that the verbal priming effect is not due merely to some general tendency for earlier tasks to affect later ones. While the verbal priming seems to flip a switch in our minds, causing us to shift from nonverbal to verbal modes of reasoning, the nonverbal priming does not simply flip the switch back, causing us to revert to a nonverbal mode of reasoning. This asymmetry points towards a Whorfian perspective according to which language has an effect on the way we think. Note, however, that unlike some versions of Whorf's hypothesis, which speaks of different languages affecting our thought in different ways, here the causal factor is not this language in contrast with that one but rather language in general as opposed to the absence of language.

Why there should be such a contrast between verbal and nonverbal priming is not obvious; nevertheless, we offer the following conjecture. In general, the relationship between the two modes of reasoning is not equipollent but rather privative, with the verbal mode built up on top of a more fundamental nonverbal mode. One specific instantiation of this privative nature is of course provided by the verbal Animacy Hierarchy which is based on the nonverbal Ontological Hierarchy. The privative



relationship between verbal and nonverbal reasoning is a clear mirror of phylogeny, as is evident from the fact that animals, at least higher ones, are clearly capable of nonverbal categorization (see, e.g., Zentall, Wasserman, Lazareva, Thompson, & Ratterman, 2008), while lacking the linguistic competence characteristic of humans. Accordingly, whereas nonverbal reasoning exploits only a subset of our full cognitive abilities, verbal reasoning makes use of all of our capacities: those present in nonverbal reasoning plus in addition those specific to the linguistic medium. It would seem plausible, therefore, that our default mode of reasoning should be the one that makes use of our entire range of cognitive abilities, namely the verbal mode, whereas the more restrictive nonverbal mode of reasoning would be more fragile and prone to interference from the verbal mode—as indeed is suggested by the differential results of the verbal and nonverbal priming task sequences.

## 47.4 DISCUSSION

---

The empirical investigations into hybrid conceptualization presented in this chapter offer a distinctive contribution to the theory of categorization in (at least) the following two domains: first, the distinctiveness of hybrids and its implications vis à vis cognitive processes, and secondly, the constraints that apply to the Ontological Hierarchy in processes of categorization.

### 47.4.1 The Distinctiveness of Hybrids

The question how we conceptualize a novel stimulus or a novel entity is a central concern in theories of categorization; see, e.g., Murphy (2004). For the most part, the stimuli that have been used in previous studies of categorization, such as Murphy's, have represented either familiar entities or else completely new ones. Visual hybrids differ from both of these types in that, on the one hand they represent novel entities not mapping onto familiar concepts, but on the other hand they consist of components representing familiar entities. Such novel-yet-familiar duality makes it possible to investigate conceptual and linguistic processes that do not ordinarily reveal themselves in the context of either completely familiar or completely novel entities. In particular, visual hybrids enable us to address questions such as which of the hybrid's parents is more central to its conceptualization, and what role the Ontological Hierarchy plays in this choice.

The distinctiveness of visual hybrids as a domain of investigation is highlighted by consideration of such hybrids in the context of another



important and established domain of inquiry, that of *conceptual combination*, when two nouns are put together to express a novel concept, such as e.g., *mourner musician*. Numerous scholars have studied the cognitive processes characteristic of such conceptual combinations; see Murphy (2004) for a review, and also Gil (this volume) for discussion of the Association Operator. In a sense, the process of conceptualization of visual hybrids may be viewed as a kind of conceptual combination, in which the entities being combined are the hybrid's parents. However, there are a number of properties associated with visual hybrids which distinguish them from noun–noun combinations and which may therefore potentially enrich the theory of conceptual combination.

Most obviously, visual hybrids differ from conceptual combinations in that they are visual rather than verbal. As such, visual hybrids lack the grammatical structures and in particular the grammatical asymmetries that are associated with conceptual combinations, such as, e.g., those that are involved in the encoding of head-modifier relations which determine the reference of the expression. On the other hand, visual hybrids are endowed with attributes such as size, orientation, and color which are absent from the verbal medium, but which may also play important roles in the conceptualization of the hybrid. Thus, a contrastive analysis of conceptual combinations and visual hybrids may shed light on the differential roles that are played by grammatical and visual features in processes of categorization.

Another important difference between the two is that while conceptual combinations typically refer to familiar objects, visual hybrids, as pointed out earlier, usually represent entities that are novel and unfamiliar. Thus, e.g., whereas *mourner musician*, under one possible interpretation, might refer to a musician who plays for mourners, the visual hybrid in Fig. 47.1 does not represent a familiar entity. As a result, exposure to hybrids such as these places the perceiver under conceptual strain, which may provide further insights into the cognitive processes involved in the categorization of hybrids.

#### 47.4.2 The Ontological Hierarchy and Processes of Categorization

As pointed out in Section 47.2, previous studies of the Ontological Hierarchy have demonstrated its importance to a wide range of conceptual and linguistic phenomena. In this chapter, we examined the role of the Ontological Hierarchy in the situation of conceptual strain that is generated by the exposure to visual hybrids. A series of empirical studies led to the surprising conclusion that, with respect to the categorization of visual hybrids, the role of the Ontological Hierarchy is medium



dependent. When a hybrid is represented verbally, with asymmetric grammatical structures, the Ontological Hierarchy comes into play; but when the verbal medium is absent, the Ontological Hierarchy has no role in the categorization of the hybrid. This conclusion constitutes an important constraint on the role of the Ontological Hierarchy in human cognition.

Moreover, the results of the investigations described herein point towards a reassessment of interpretations afforded to previous studies concerned with the role of the Ontological Hierarchy in cognitive processes. Consider, for example, the study by Connor and Kogan (1980) mentioned in Section 47.2 above. In one task, Connor and Kogan presented subjects with two pictures (such as an old man and an ancient tree) and asked them to construct a comparison of the form "X is like Y" based on the pictures. Then, in another task not involving visual stimuli, they asked subjects to judge verbal comparisons of the form "X is like Y." In both tasks they found hierarchy effects, from which they concluded that the role of the Ontological Hierarchy is medium-independent. However, the results of our experiments on hybrids suggest that their conclusion may be unwarranted: in both tasks, an asymmetric grammatical construction of the form "X is like Y" was present, and it was this grammatical asymmetry that licensed the application of the Ontological Hierarchy in their two tasks.

## 47.5 CONCLUSION

In this chapter we provided extensive empirical evidence to the effect that language exerts a significant influence over the way in which we conceptualize visual hybrids. When grammatical asymmetries are present, we categorize hybrids in accordance with the parent that is higher on the Ontological Hierarchy; but when they are absent, the effects of the hierarchy are no longer discernible. The results of our experiments thus provide support for a cognitive architecture consisting of two major levels, with a basic nonverbal level of conceptualization providing the foundations for a higher level of conceptualization associated with the linguistic medium. Thus, while the basic level was accessed by all of the nonverbal categorization tasks, the higher level was involved in all of the categorization tasks involving grammatical asymmetries, in which the role of the Ontological Hierarchy was in evidence. This two-level cognitive architecture provides a faithful reflection of phylogeny, with the more recently evolved human-specific verbal cognition sitting on top of an older nonverbal cognition which humans share with some of their non-human counterparts in the animal world.



## Acknowledgments

We would like to express our deepest gratitude to Bernard Comrie and the Max Planck Institute for Evolutionary Anthropology for making our long-distance collaboration possible with frequent reciprocal visits to Leipzig and Tel Aviv. We would also like to thank Hillel Roman for his initial study which introduced us to the investigation of hybrids, Ariella Tamir for assistance with the experiments in Israel as well as subsequent coding and analysis, and Hengky Firmansyah, Santi Kurniati, Silvie Antisari Anhar, Yessy Prima Putri, and Tessa Yuditha for assistance with the experiments in Indonesia. This research was supported by The Israel Science Foundation administered by The Israel Academy of Sciences and Humanities, no. 1196/12 for Yeshayahu Shen.

## References

- Admon, L. (2008). *Visual hybrids and the conceptual hierarchy: Studying the perception of hybrids among Bulgarian speakers*. Unpublished paper, Tel Aviv University, Tel Aviv.
- Aleluf, O. (2005). *Verbal description and visual categorization of hybrids: A developmental study*. Unpublished paper, Tel Aviv University, Tel Aviv.
- Becker, M. (2014). *The acquisition of syntactic structure, animacy and thematic alignment*. Cambridge: Cambridge University Press.
- Bock, K., & Warren, R. (1985). Conceptual accessibility and syntactic structure in sentence formulation. *Cognition*, 21(1), 47–67.
- Branigan, H. P., Martin, J. P., & Tanaka, M. (2008). Contributions of animacy to grammatical function assignment and word order during production. *Lingua*, 118(2), 172–189.
- Childers, J. B., & Echols, C. H. (2004). 2½-Year-old children use animacy and syntax to learn a new noun. *Infancy*, 5(1), 109–125.
- Connor, K., & Kogan, N. (1980). Topic-vehicle relations in metaphor: The issue of asymmetry. In R. P. Honeck, & R. R. Hoffman (Eds.), *Cognition and figurative language* (pp. 283–310). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Cooper, W. E., & Ross, J. R. (1975). World order. In R. E. Grossman, L. J. San, & T. J. Vance (Eds.), *Papers from the parasession on functionalism* (pp. 63–111). Chicago, IL: Chicago Linguistic Society.
- Corbett, G. G. (2001). *Gender*. Cambridge: Cambridge University Press.
- Corbett, G. G. (2006). *Agreement*. Cambridge: Cambridge University Press.
- Deane, P. D. (1992). *Grammar in mind and brain: Explorations in cognitive syntax*. Berlin: Mouton de Gruyter.
- Feleki, E. (1996). *The effects of conceptual accessibility on language production: Experimental evidence from modern Greek*. Edinburgh: Centre for Cognitive Science.
- Finkel, J. (2010). *The role of the ontological hierarchy on the perceptions of hybrids: Does a visual task prime a verbal one?* Unpublished paper, Tel Aviv University, Tel Aviv.
- Gentner, D., & France, I. M. (1988). The verb mutability effect: Studies of the combinatorial semantics of nouns and verbs. In S. L. Small, G. W. Cottrell, & M. K. Tanenhaus (Eds.), *Lexical ambiguity resolution: Perspectives from psycholinguistics, neuropsychology, and artificial intelligence* (pp. 343–382). San Mateo CA: Morgan Kaufman.
- Gil, D. (this volume). *Isolating-monocategorical-associational language*.
- Heine, B., Claudi, U., & Hunnemeyer, F. (1991). *Grammaticalization: A conceptual framework*. Chicago, IL: University of Chicago Press.
- Keil, F. C. (1979). *Semantic and conceptual development: An ontological perspective*. Cambridge, MA: Harvard University Press.
- Kelly, M. H., & Keil, F. C. (1985). The more things change. . . : Metamorphoses and conceptual structure. *Cognitive Science*, 9(4), 403–416.



- Kotzer E. (2011). Conceptual organization: Visual hybrids and the conceptual hierarchy. Phd Dissertation, Tel Aviv University, Tel Aviv.
- Lakoff, G., & Turner, M. (1989). *More than cool reason: A field guide to poetic metaphor*. Chicago IL: University of Chicago Press.
- Larsen, E.A., & Johansson, C. (2008). Animacy and canonical word order – Evidence from human processing of anaphora. In C. Johansson (Ed.). *Proceedings of the Second Workshop on Anaphora Resolution (WAR II)*, Bergen (pp. 55–61).
- Mansour, A. (2008). *Studying hybrids in the context of the ontological hierarchy*. MA Thesis, Tel Aviv University, Tel Aviv.
- Mashal, N., Shen, Y., Jospe, K., & Gil, D. (2014). Language effects on the conceptualization of hybrids. *Language and Cognition*, 217–241.
- McDonald, J. L., Bock, K., & Kelly, M. H. (1993). Word and world order: Semantic, phonological, and metrical determinants of serial position. *Cognitive Psychology*, 25(2), 188–230.
- Murphy, G. (2004). *The big book of concepts*. Cambridge MA: MIT Press.
- Nash, H. (1974). Judgment of the humanness/animality of mythological hybrid (part-human, part-animal) figures. *Journal of Social Psychology*, 92(1), 91–102.
- Nash, H., & Maki, P. B. (1978). Hair as sex-discriminating cue for young children. *Perceptual and Motor Skills*, 47(1), 25–26.
- Sanhedrai, N. (in preparation). *The influence of the “ontological hierarchy” on hybrid perception by children with normative development and by children with language impairment*. Phd dissertation, Bar Ilan University, Ramat Gan.
- Shen, Y., & Gil, D. (2010). The role of language in the conceptualization of visual hybrids. Paper presented at the Department of Cognitive Science. Case Western Reserve University, Cleveland, OH.
- Shen, Y., & Gil, D. (2013) What can hybrids tell us about the relation between language and thought? In *Symposium on The creating mind: Interdisciplinary perspectives*. The Gonda Multidisciplinary Brain Research Center, Bar Ilan University, Ramat Gan, December 18, 2013.
- Shen, Y., Gil, D., & Roman, H. (2006a). Language, thought and the animacy hierarchy: Comparative experimental studies of hybrids. Paper presented at the Fourth Workshop on Indonesian Linguistics, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany, July 13, 2006.
- Shen, Y., Gil, D., & Roman, H. (2006b). *What can hybrids tell us about the relationship of language and thought?* Paper presented at the International Society for the Empirical Study of Literature and Media, Munich, Germany, August 5–8, 2006.
- Siewierska, A. (2005). Alignment of verbal person marking. In M. Haspelmath, M. Dryer, D. Gil, & B. Comrie (Eds.), *The world atlas of language structures* (pp. 406–409). Oxford: Oxford University Press.
- Slobin, D. (1996). From ‘thought and language’ to ‘thinking for speaking’. In J. Gumperz, & S. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 70–96). Cambridge MA: Cambridge University Press.
- Wagner, W., Kronberger, N., Nagata, M., Sen, R., Holtz, P., & Flores Palacios, F. (2010). Essentialist theory of ‘hybrids’: From animal kinds to ethnic categories and race. *Asian Journal of Social Psychology*, 13(4), 232–246.
- Wengrow, D. (2014). *The origins of monsters*. Princeton, NJ: Princeton University Press.
- Zentall, T. R., Wasserman, E. A., Lazareva, O. F., Thompson, R. K. R., & Ratterman, M. J. (2008). Concept learning in animals. *Comparative Cognition and Behavior Reviews*, 3, 13–45.