

## 19 Influences of Object Knowledge on the Acquisition of Verbs in English and Japanese

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This chapter reviews the evidence for an influence of object knowledge on verb learning. A number of lines of research provide evidence that the meanings of verbs are more general and flexible than are the meanings of nouns. In particular, the same verb can have markedly different meanings in the context of different objects and the different nouns that label them, whereas the meanings of nouns are relatively stable across different contexts. This flexibility in the meanings of verbs may have implications for verb learning. In particular, a child may need to learn about an object and the types of motions it is capable of before being able to understand what a verb may mean in the context of that object. This leads to the prediction that children should learn verbs more readily in the context of familiar objects than in the context of unfamiliar objects. Moreover, children who are presented with a verb in the context of an unfamiliar object may pay as much attention to that object as to its motion, in order to learn about the object and the types of motion it is capable of. Support for both of these predictions comes from recent research by Kersten and Smith (2002), who presented children with novel verbs, each of which was accompanied by both a particular object and a particular motion. Children were found to attend just as strongly to unfamiliar objects as to motions. In contrast, when verbs were presented in the context of familiar objects, children attended more strongly to motions than to those objects, learning more about those motions than they did when those motions were performed by unfamiliar objects. The remainder of the chapter discusses whether object knowledge influences the learning of all verbs, or only certain types of verbs. In particular, attention to object structure during verb learning is compared in children learning English, a language that most frequently employs intrinsic

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manner of motion verbs, and in children learning Japanese, a language that most frequently employs extrinsic path of motion verbs.

### Introduction

Imagine that you are exploring previously uninhabited terrain and you come across a creature unlike any you have ever seen before. It has five legs, two on each side and one attached to the rear, is covered with scales like a fish, and is as large as a cow. Now imagine that as you approach this creature, it detects your presence, jumps into the river next to which it was standing, and propels itself away, using the legs at its sides like oars and its rear leg like a rudder. When later describing this event to your friends, a likely account would be, "I discovered a new creature, which I am calling a pentapod, but when I tried to get a closer look it jumped into the river and swam away."

This scenario demonstrates an important difference between nouns and verbs in the types of meanings that they convey. This creature is unlike any you have seen before, and thus it requires a new noun label, namely *pentapod*. Its mode of locomotion in the water is also unlike any you have seen before, using its legs unlike any other creature you have encountered, and yet it is quite natural to make use of an existing verb, *swim*, to describe this motion.

This scenario is of course quite far-fetched, but this same basic phenomenon has occurred repeatedly throughout the history of language. For example, with the advent of electronic communications in the late twentieth century, a new noun, *e-mail*, was coined. The existing stock of nouns in the English language was apparently insufficient to describe this new form of communication, and thus a new noun was added to the language. No doubt quite shortly thereafter, this new noun was used in a sentence, perhaps "I just sent you an e-mail." Although in the past, the verb *send* had been used to describe the physical transmission of an object from one location to another, it was apparently quite natural to extend its use to the transmission of bits through cyberspace. Thus, when presented with a new (virtual) object to be described and a new way of acting upon that object, a new noun was required but an existing verb was sufficient.

### Experimental Evidence for Greater Flexibility in Verb Meanings Than in Noun Meanings

The preceding examples suggest that the meanings of basic-level nouns are relatively specific and unchanging, and thus when a new object has to be labeled, a new noun is required. In contrast, the meanings of verbs are more general and flexible, and thus when a new action needs to be labeled, the meaning of an old verb can be extended to include this new action. A number of lines of research

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provide support for this view. First, Gentner (1981) has noted that the average verb has more dictionary senses than does the average noun when the two classes of words are matched in frequency. This finding suggests that when a new action needs to be described, instead of adding a new verb to the language, an existing verb may acquire a new sense to accommodate this new action.

Second, Gentner and France (1988) have demonstrated that adult speakers of a language are much more willing to extend the meaning of a verb than to extend the meaning of a noun in order to allow comprehension of a seemingly anomalous sentence. In particular, they presented participants with sentences in which the noun and the verb were semantically mismatched, such as "The butterfly pondered," and asked them what these sentences meant. Participants were much more likely to alter the verb to be consistent with the noun (e.g., interpreting *pondered* to mean "hovered in one spot for a long time") than they were to alter the noun to be consistent with the verb (e.g., interpreting *butterfly* to mean "a person wearing bright clothes"). This finding suggests that a verb may acquire a new sense simply by being used in combination with a new noun.

Third, Kersten and Earles (2004) used a memory paradigm to demonstrate that the meaning of a verb changes more in the context of different nouns than does the meaning of a noun in the context of different verbs. They presented participants with simple intransitive sentences such as "The ball bounced" and instructed participants to remember either the noun or the verb from each sentence. Participants who were instructed to remember nouns were later tested for recognition memory of each of those nouns (e.g., *ball*), either in the context of the same verb it had accompanied earlier (e.g., *bounced*), or in the context of a different verb (e.g., *rolled*). Similarly, participants who were instructed to remember verbs were later tested for recognition memory of each of those verbs (e.g., *bounced*), either in the context of the same noun that it had accompanied earlier (e.g., *ball*), or in the context of a new noun (e.g., *quarter*). Recognition memory for verbs was found to be strongly dependent upon reinstatement of the same noun that had accompanied a verb earlier. In contrast, reinstatement of a verb had little effect on memory for a noun. This combination of findings suggests that the meanings of nouns are relatively stable across different semantic contexts. The meanings of verbs, on the other hand, are much more variable across semantic contexts. This makes it difficult to recognize that a verb presented in one semantic context had previously been encountered in a different semantic context, because the meanings encoded by the verbs may be quite different on the two occasions.

### Implications for Verb Learning

If the meanings of verbs are indeed more general and flexible than are the meanings of nouns, this may have implications for verb learning in children. Research

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dating back to Posner and Keele (1968; 1970) has revealed that categories involving a great deal of variability take longer to learn than do categories whose exemplars cluster tightly around the prototype. Thus, if verbs indeed involve greater generality (and thus variability) in their meanings than do nouns, one may make the prediction that it should take children longer to learn the meanings of verbs than to learn the meanings of nouns.

This prediction appears to be largely supported, as documented by Gentner (1981, 1982; Gentner & Boroditsky, 2001). There remains a great deal of debate, however, about whether the earlier acquisition of nouns than of verbs is a universal phenomenon, or whether it is dependent upon how nouns and verbs appear in a particular language. For example, some have argued that verbs may be acquired earlier than nouns in languages such as Korean and Mandarin, in which verbs appear more frequently than nouns in parental speech to children, and appear more often in salient sentence positions (Choi & Gopnik, 1995; Gopnik & Choi, 1995; Tardif, 1996). Even in these languages, however, whether there is a verb advantage or a noun advantage in children's early speech depends on the way nouns and verbs are counted. In particular, whereas there is an apparent verb advantage when direct observation is used to assess a child's vocabulary, there is evidence of a noun advantage when a parental checklist method is used (Au, Dapretto, & Song, 1994; Tardif, Gelman, & Xu, 1999). Moreover, in most other languages that have been studied, a clear noun advantage is evident regardless of how nouns and verbs are counted. Thus, the consensus view that emerges from this research is that nouns enjoy an overall advantage over verbs in acquisition but that the size of this advantage is influenced by the way nouns and verbs appear in a particular language.

Evidence from child language acquisition is thus consistent with the view that the greater variability of verb meanings makes them more difficult to acquire than nouns. More specific predictions are possible, however, if one analyzes the sources of variability in verb meanings. In all of the examples presented so far, the extension of an existing verb's meaning to include some new scenario has resulted from the use of that verb in combination with a new object, or else in combination with a new noun used to label an object. The clearest example of this phenomenon comes from the research of Gentner and France (1988) involving semantically mismatched nouns and verbs. In this research, when a verb (e.g., *pondered*) was used in combination with a noun that it had not previously accompanied (e.g., *butterfly*), the verb took on a new meaning (e.g., *hovered in place*). This finding suggests a mechanism by which verbs may take on new meanings. In particular, when a verb is used in combination with a noun that it had not previously accompanied, the characteristics of the object labeled by the noun may be combined with the general meaning of the verb to produce a new interpretation of that verb. If this process were repeated over and over again in many different speakers, either through independent discovery or social transmission, the result

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would be the standardization of a new sense of the verb to accommodate that new object.

The results of Gentner (1981) and Kersten and Earles (2004) may represent the end product of this mechanism for extending the meanings of verbs to cover new objects. In particular, when a verb starts to be consistently used in combination with a new object, a new sense for that verb may emerge. In contrast, when a new object needs to be labeled, a new noun may be created rather than adding a new sense to an existing noun. Thus, over time, verbs may accrue new senses at a greater rate than nouns, accounting for Gentner's (1981) finding that the average verb has more senses than the average noun. Furthermore, if the different senses of a verb represent the use of that verb in combination with different objects, then these different senses should be elicited by the use of that verb together with different nouns. Thus, in Kersten and Earles's (2004) study of recognition memory for nouns and verbs, when a verb was presented at encoding in the context of a noun, this may have brought to mind a particular sense of the verb associated with the object labeled by that noun. When that same verb was presented along with a different noun at retrieval, this may have brought to mind a different sense of the verb, making it difficult to remember having seen that verb before.

If the variability in the meanings of verbs stems from the use of verbs in combination with different objects, then further predictions are possible regarding the acquisition of verbs. In particular, in order to understand what a verb means in a given instance, it may be necessary to know something about the object whose actions are being predicated. For example, in order to understand the meaning of the verb *run* in a sentence, it is important to know whether the object doing the running has two legs (as in the case of a human), four legs (as in the case of a horse), or no legs (as in the case of an engine). Thus, one may make the prediction that children should show faster learning of a novel verb when that verb is used to describe the actions of a familiar object than when the verb is used to describe the actions of an unfamiliar object. Second, one may make the prediction that when children are presented with a novel verb in the context of an unfamiliar object, they will attempt to learn about the nature of an object in order to try to understand what a verb may mean in the context of that object.

Naturalistic studies of verb use in children are difficult to evaluate with regard to these predictions, because it is hard to determine whether a verb used by a child was learned in the context of familiar or unfamiliar objects. Two different findings provide suggestive evidence, however, in favor of the prediction that children should show faster learning of verbs in the context of familiar objects. One is the previously described finding that in most languages that have been studied, nouns are learned earlier than verbs (Gentner & Boroditsky, 2001). One possible interpretation of this finding is that children need to learn about nouns and the objects they label before they can learn the meanings of verbs. A second

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finding comes from Bloom (1981), who observed that verb use is rare in the one-word period, whereas it is much more common when children start putting two words together, with these two-word combinations often comprising a noun and a verb. On the basis of this result, Bloom proposed that children learn verbs in combination with nouns rather than in isolation, suggesting that knowledge of objects is necessary before one can learn how to use verbs in the context of those objects.

Most experimental studies of verb learning also fail to provide evidence regarding these predictions because they exclusively employ the motions of familiar objects as stimuli. There have been several studies that have portrayed the motions of unfamiliar objects, however, and these studies provide support for the prediction that children focus on unfamiliar objects when learning a verb, perhaps in order to learn about the nature of those objects and the types of motions they can take part in. First, in the classic study of Brown (1957), children were presented with cards depicting novel actions involving novel objects and substances. Each card was accompanied by a novel count noun, mass noun, or verb. Children were later presented with three cards, one that matched the original on the action, one that matched the original on the object, and one that matched the original on the substance, and were asked to choose which of these three cards was the best example of the word heard earlier. When children were presented with a novel verb, they were most likely to select the card involving the same action, but 33% of their choices still involved novel objects and substances. This finding could be interpreted to suggest that children who were presented with a novel verb focused not only on the actions being performed, but also on the objects and substances involved in those actions.

The results of Brown (1957) are suggestive at best with regard to the present predictions, however, because no actual motions were presented, thus deviating from the typical verb learning scenario. More recent evidence involving actual motions comes from the research of Behrend (1990) and Forbes and Farrar (1995). Both of these studies involved presenting children with novel verbs accompanied by video clips involving people performing novel actions with novel instruments. Children were later presented with video clips involving changes to one or more attributes of these events and were asked whether each of these video clips still depicted an example of a verb heard earlier. Both studies revealed a tendency for young children to reject an event as being an example of a previously presented verb if the instrument depicted in the event had changed. This again could be taken to suggest that children focused to some extent on the object involved in an action when attempting to learn a verb for that action, perhaps in order to learn about the nature of that object and what could be done with it.

The results of Behrend (1990) and Forbes and Farrar (1995) thus provide evidence that children learning a verb attend to a novel object playing the role of

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instrument in an event. More recent research by Kersten and Smith (2002) provides evidence that children learning a verb also attend to a novel object playing the role of agent in an event. In this research, 3.5- to 4-year-old children were presented with novel, buglike creatures moving around on a television screen. Each such event was accompanied by a novel verb. Two different verbs were presented, corresponding to two different motions and two different creatures carrying out those motions. In particular, the verb *morping* always accompanied an event involving a creature with a rounded, orange body with red spots on it, moving toward a second creature such that the two ended up in contact with one another (see figure 19.1). In contrast, the verb *spogging* always accompanied an event

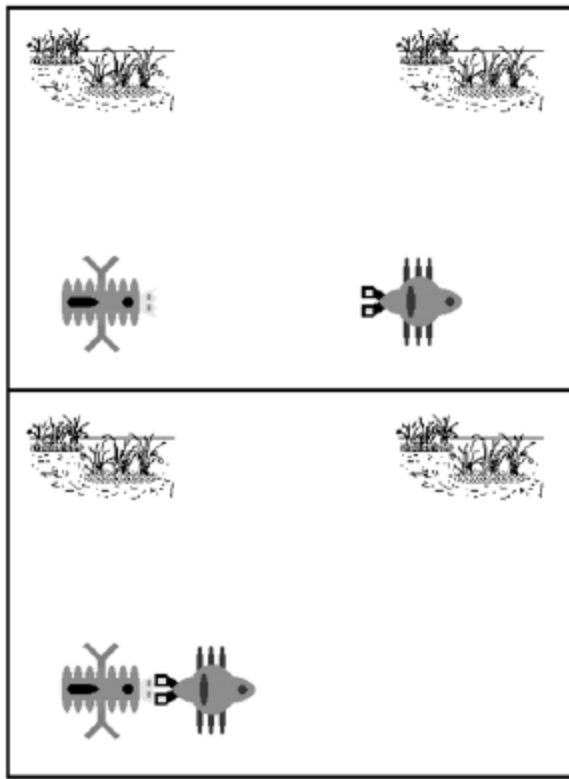


Figure 19.1. Two frames of an example event from Kersten and Smith (2002) Experiment 1. The upper frame depicts the starting positions of the two characters, whereas the lower frame depicts their positions at the end of the event. (From "Attention to Novel Objects During Verb Learning," by A. W. Kersten and L. B. Smith, 2002, *Child Development*, 73, p. 97. Copyright 2002. Adapted with permission.)

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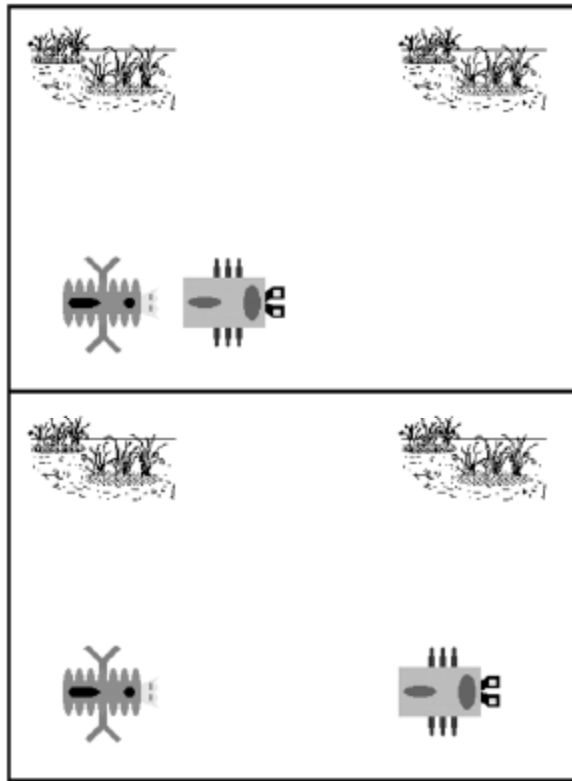


Figure 19.2. Two frames of a second example event from Kersten and Smith (2002) Experiment 1. The upper frame depicts the starting positions of the two characters, whereas the lower frame depicts their positions at the end of the event. (From "Attention to Novel Objects During Verb Learning," by A. W. Kersten and L. B. Smith, 2002, *Child Development*, 73, p. 99. Copyright 2002. Adapted with permission.)

involving a creature with a rectangular, purple body with gray spots on it, moving away from a second creature (see figure 19.2). Thus, children could potentially have mapped a verb onto the motion depicted in an event, the creature carrying out that motion, or both.

The extent to which children attended to these two different types of information was measured by subsequently presenting children with a number of test events and asking children if each of these events was still an example of the verb *morping*. Some events were identical to previous examples of *morping*, some involved the correct motion but the wrong creature (i.e., the creature previously associated with the verb *spogging*), some involved the correct creature but the wrong

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motion (i.e., the motion previously associated with the verb *spogging*), and some involved both the wrong creature and the wrong motion.

The results of this experiment are depicted in the left column of figure 19.3. Children accepted events involving the correct motion and the correct creature as examples of *morping* a high percentage of the time, indicating that they had learned something about the meaning of this new verb. Children were less likely to accept an event as an example of *morping* if either the motion or the creature was incorrect. In fact, children were just as likely to reject an event involving the correct motion and the wrong creature as they were to reject an event involving the correct creature and the wrong motion. This suggests that children were attending just as strongly to the object in motion as they were to the motion itself. This result provides evidence in favor of the prediction that children will attend to

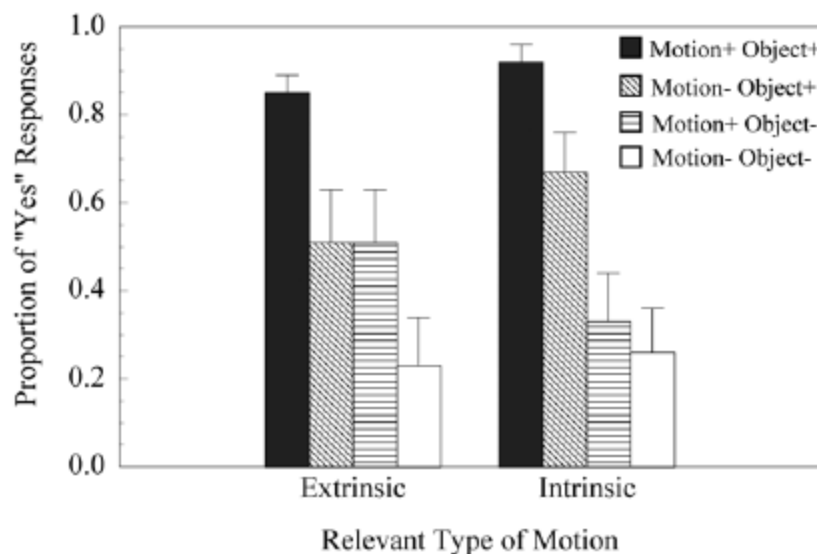


Figure 19.3. Combined results of Kersten and Smith (2002) Experiments 1 and 2. The results of Experiment 1, in which extrinsic motion was relevant, are depicted on the left. The results of Experiment 2, in which intrinsic motion was relevant, are depicted on the right. The y axis depicts the proportion of "yes" responses to the question, "Is this one *morping*?" Motion+ object+ events involved both the correct motion and the correct object. Motion- object+ events involved the correct object performing the wrong motion. Motion+ object- events involved the correct motion performed by the wrong object. Motion- Object- events involved the wrong object performing the wrong motion. (From "Attention to Novel Objects During Verb Learning," by A. W. Kersten and L. B. Smith, 2002, *Child Development*, 73, p. 103. Copyright 2002. Adapted with permission.)

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a novel object when learning a verb, perhaps in order to learn about the nature of the object and the types of motion it is capable of.

The study of Kersten and Smith (2002) also provides evidence for the first prediction that children will learn a verb more readily in the context of a familiar object than in the context of a novel object. In particular, Kersten and Smith compared verb learning in the context of unfamiliar objects, namely the buglike creatures described previously, and in the context of familiar objects, namely cars and trucks. In both conditions, a given verb was always accompanied by a particular motion as well as a particular object carrying out that motion. For example, in the familiar objects condition, the verb *morping* always accompanied an event in which a car moved toward a van, such that the two ended up in contact at the end of the event. In contrast, the verb *spogging* always accompanied an event in which a truck moved away from the van. Thus, children could potentially have associated the verb *morping* with a motion, an object (i.e., a car), or both, just as in the unfamiliar objects condition.

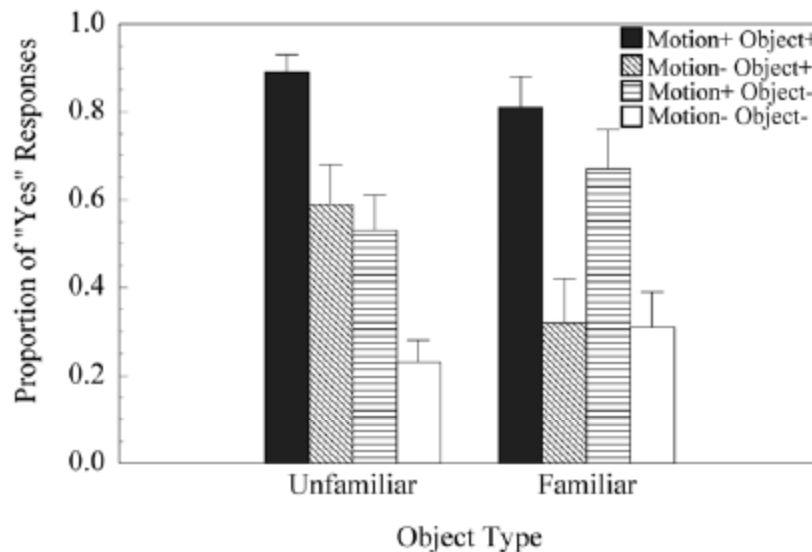


Figure 19.4. Results of Kersten and Smith (2002) Experiment 3. The y axis depicts the proportion of "yes" responses to the question "Is this one morping?" Motion+ object+ events involved both the correct motion and the correct object. Motion- object+ events involved the correct object performing the wrong motion. Motion+ object- events involved the correct motion performed by the wrong object. Motion- object- events involved the wrong object performing the wrong motion. (From "Attention to Novel Objects During Verb Learning," by A. W. Kersten and L. B. Smith, 2002, *Child Development*, 73, p. 105. Copyright 2002. Adapted with permission.)

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The results of this experiment are depicted in figure 19.4. As can be seen, children in the familiar objects condition focused much more strongly on motions than on objects. In particular, children in the familiar objects condition were more likely to reject an event involving the correct object (i.e., a car) performing the wrong motion (i.e., moving away), than they were to reject an event involving the correct motion (i.e., moving into contact) performed by the wrong object (i.e., a truck). In contrast, children in the unfamiliar objects condition attended equally to objects and motions, in replication of the experiment described above. Comparing across the two conditions, children in the familiar objects condition were significantly more likely than children in the unfamiliar objects condition to reject an event involving the correct object but the wrong motion as an example of *morping*. If one takes the ability to associate a verb with a motion as one's measure of verb learning, then this result provides evidence in favor of the prediction that children should learn verbs more readily in the context of familiar objects than in the context of unfamiliar objects.

There is thus support for both of the above predictions regarding influences of object knowledge on verb learning. In particular, there is evidence that children learn verbs more readily in the context of familiar objects, perhaps because knowledge of an object and what it is capable of constrains the possible meanings of a verb in the context of that object. Furthermore, there is evidence that children learning verbs in the context of unfamiliar objects attend to those objects as well as the motions they are performing, perhaps because they are attempting to learn about those objects and the types of motions they are capable of.

#### The Generality of Influences of Object Knowledge on Verb Learning

The research described in the previous section provides evidence for an influence of object knowledge on verb learning. The question remains as to how general such influences are. In particular, does object knowledge influence the learning of all verbs, or is this influence limited to certain classes of verbs, with other classes of verbs being learned relatively independently of object knowledge?

A prediction that different classes of verbs will be differentially influenced by object knowledge comes from the research of Kersten (1998a, 1998b, 2003). Kersten proposed a distinction between two different classes of motion verbs. Extrinsic motion verbs involve the motion of an object with respect to a frame of reference external to that object, such as a second object. For example, the verb *collide* describes the motion of one object into contact with a second object. In contrast, intrinsic motion verbs involve the motions of the parts of an object with respect to the object itself. For example, the verb *run* in the context of a human being describes the ways the arms and legs move with respect to the body of the

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human during locomotion. The terms extrinsic and intrinsic motion are closely related to the linguistic terms path and manner of motion (see e.g., Talmy, 1985), although extrinsic and intrinsic motion are more explicit about the nature of the perceptual information underlying those terms (see Jackendoff, 1987, for a related distinction). Thus, any differences in the processing of extrinsic motion and intrinsic motion verbs are likely to generalize to differences in the processing of path and manner of motion verbs.

Kersten (1998a) proposed that the meanings of intrinsic motion verbs are strongly dependent upon the nature of the object whose motion is being described. For example, the meaning of the verb *run* is very different in the context of the nouns *person*, *horse*, and *engine*. The reason for this close relationship between objects and intrinsic motions is that intrinsic motions are defined in terms of the relative motions of the parts of an object, and thus intrinsic motions are strongly dependent upon the way the parts of an object are configured. For example, the verb *run* describes pendular motions of the arms and legs with respect to the body when used in conjunction with a human being, but in the context of an object that does not have arms or legs (e.g., an engine), a very different meaning is brought to mind.

Kersten proposed a mechanism to account for this dependence of intrinsic motion verbs on object structure. In particular, he proposed that object categories (as well as the nouns that refer to these categories) include information not only about the static configuration of the parts of an object, but also about the typical ways those parts move in relation to one another. Stated differently, object categories are defined not only in terms of the static shape of an object, but also how the shape of an object changes over time. The role of an intrinsic motion verb, then, may be to select which of the various intrinsic motions associated with an object is relevant in a given instance. In particular, an intrinsic motion verb may carry only a generic meaning when used in isolation, but this generic meaning may be compared to each of the more specific intrinsic motions associated with an object in order to select one of these motions as being relevant. For example, the meaning of the verb *run* may mean little more than "to move rapidly" when used in isolation. When used in combination with the noun *person*, however, a more specific interpretation is selected involving the motions of arms and legs. If this same verb is used in conjunction with the noun *engine*, a very different interpretation is selected, involving the motions of valves and pistons. This mechanism thus accounts for the apparent dependence of intrinsic motion verbs on object structure, because the same verb will select different intrinsic motions when used in conjunction with different nouns.

In contrast to intrinsic motion verbs, Kersten (1998a) proposed that the meanings of extrinsic motion verbs are relatively independent of the nature of the objects carrying out those motions. Because the motion of an object is defined in terms of a frame of reference external to the object, the detailed structure of an

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object is irrelevant to the meanings of these verbs. For example, when describing the meaning of the verb *collide*, the two objects involved can be conceptualized as points or undifferentiated blobs, with those two points or blobs moving into contact with one another.

Kersten (1998a, 1998b) used a miniature artificial language learning task to provide evidence that intrinsic motion verbs are more dependent than extrinsic motion verbs on the meanings of the nouns that accompany them. Adult participants were presented with a series of animated events, similar to the ones employed by Kersten and Smith (2002). Each such event was accompanied by a sentence involving a novel noun and verb, such as "The zeebee is morping," presented orally through headphones. Each noun was related not only to the static characteristics of one of the bug-like creatures appearing in an event, but also a particular intrinsic motion, namely the way the legs of a bug moved in relation to its body (see figure 19.5), and a particular extrinsic motion, namely the direction the creature moved in relation to a second bug appearing on the screen. Thus, a participant could potentially have associated a noun with an intrinsic motion, an extrinsic motion, or both. Each verb was also related to a particular intrinsic motion and a particular extrinsic motion. Thus, a participant could similarly have associated a verb with an intrinsic motion, an extrinsic motion, or both.

After viewing a number of learning events, participants were tested on their knowledge of relations between nouns and verbs and the two different kinds of motion. Two different kinds of test trials were presented. In one type of trial, participants were tested on their knowledge of motions associated with individual nouns and verbs. In each such trial, participants were presented with two events, one after the other, and were asked to choose which of the two events was the better example of a particular noun or verb. The two events in a trial differed either on intrinsic motion or extrinsic motion. Each trial thus tested for knowledge of the relation between a particular noun or verb and a particular type of motion. For example, if the verb *morp* had always accompanied events in which one creature moved into contact with a second creature, a test of this relation would have involved presenting one event involving a creature moving into contact with a second creature, and a second event involving a creature moving away from a second creature, and asking participants which of these two events was the better example of the verb *morp*.

A second type of test trial involved presenting participants with combinations of nouns and verbs that had never gone together before. The nouns and verbs appearing in these combinations in fact made opposing predictions with regard to intrinsic motion and extrinsic motion. This second task was thus similar to the task of Gentner and France (1988) in which participants were asked to interpret combinations of nouns and verbs that were semantically mismatched. For example, if the noun *zeebee* had always accompanied events in which one creature moved into contact with a second creature, and the verb *spogging* had always accompanied

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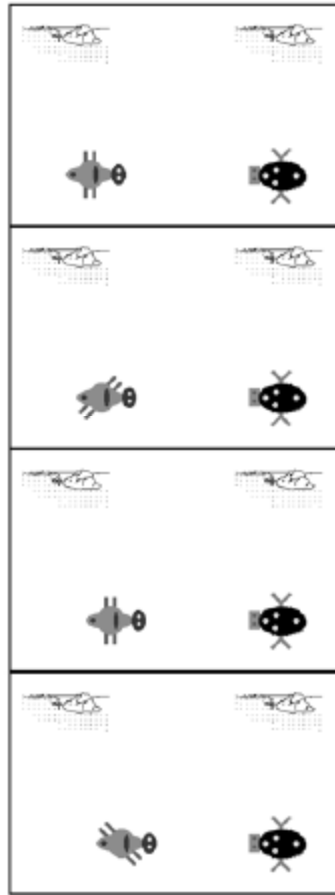


Figure 19.5. Four frames of an example event from Kersten (1998a), providing an example of an intrinsic motion of one of the buglike creatures. In the first frame, the creature starts the event with its legs at its sides. In the second frame, the creature angles its left legs forward and its right legs back as the creature as a whole moves forward. In the third frame, the legs of the creature return to its sides as the creature advances once more. In the fourth frame, the creature angles its right legs forward and its left legs back as the creature advances further. The legs of the creature would then return to its sides, starting the process over again. This sequence would continue until the end of the event, which in this event would occur when the two creatures came into contact with one another. (From "A Division of Labor Between Nouns and Verbs in the Representation of Motion," by A. W. Kersten, 1988, *Journal of Experimental Psychology: General*, 127, 34–54. Published by the American Psychological Association. Adapted with permission.)

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events in which one creature moved away from a second creature, participants would now have been presented with the sentence "The zeebee is spogging." Participants were asked to choose which of two events was better described by each such sentence. In half of these trials, the two events in a test trial differed only on extrinsic motion. For example, one event may have involved a creature moving toward a second creature and one event may have involved a creature moving away from a second creature. In other trials, the two events differed only on intrinsic motion. In particular, one event involved a creature that moved its legs in the same way that previous zeebees had done, whereas the other event involved a creature that moved its legs in a manner consistent with previous examples of the verb *spogging*.

A measure of the influence of object knowledge on the interpretation of a motion verb can be derived by comparing participants' performance in these two types of test trials. For example, as a measure of the influence of object knowledge on the interpretation of an extrinsic motion verb, one can compare the likelihood of choosing the extrinsic motion associated with a verb when that verb appears alone, to the likelihood of choosing that same extrinsic motion when the verb appears with a semantically mismatched noun. The prediction from Kersten (1998a) is that nouns should have relatively little influence on the interpretation of extrinsic motion verbs, and thus participants should perform similarly on tests of extrinsic motion, regardless of whether or not a verb appears with a semantically mismatched noun.

One can also derive a measure of the influence of object knowledge on the interpretation of an intrinsic motion verb by comparing performance across these two types of test trials. The prediction from Kersten (1998a) is that nouns should have a much greater influence on tests of intrinsic motion than on tests of extrinsic motion. Thus, participants should be much less likely to choose the intrinsic motion associated with a verb when that verb appears with a semantically mismatched noun, compared to when that verb appears alone.

This analysis was applied to the results of the three experiments conducted by Kersten (1998a, 1998b) in which a direct comparison of intrinsic motion and extrinsic motion was possible. The results of this analysis are depicted in figure 19.6. The y axis in figure 19.6 represents the percentage decrease in verb-consistent responding resulting from the addition of a semantically mismatched noun. As can be seen, the addition of a semantically mismatched noun had relatively little influence on the interpretation of an extrinsic motion verb. In particular, participants chose the extrinsic motion associated with the verb almost as often in the presence of a semantically mismatched noun as they did when the verb appeared alone. In contrast, the addition of a semantically mismatched noun had a much greater influence on the interpretation of an intrinsic motion verb. In particular, participants were much less likely to select the intrinsic motion associated with a verb when that verb was accompanied by a noun associated with a different intrinsic motion.

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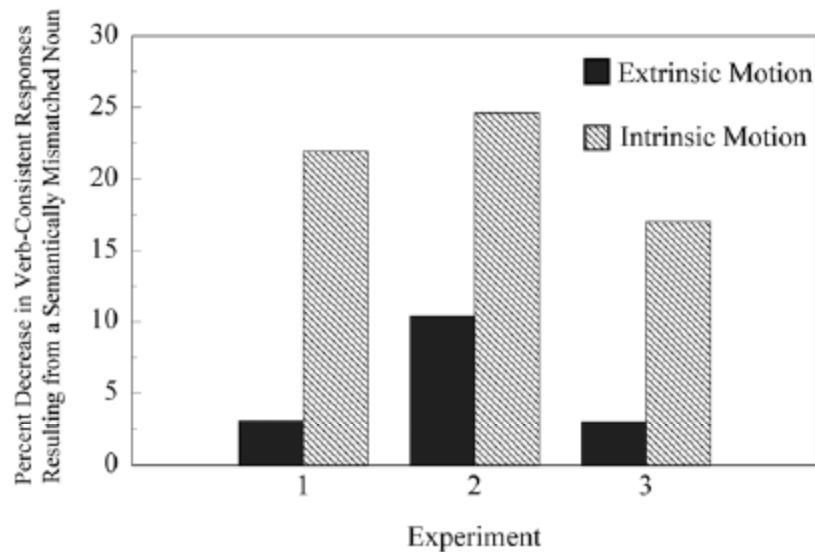


Figure 19.6. Effects of a semantically mismatched noun on the interpretation of extrinsic motion verbs and intrinsic motion verbs in three different experiments: (1) Kersten (1998a) Experiment 2, (2) Kersten (1998a) Experiment 5, and (3) Kersten (1998b) Experiment 1. The y axis represents the decrease in the percentage of choices consistent with the verb resulting from the addition of a semantically mismatched noun. For example, the leftmost bar for each experiment represents the percentage of trials in which participants chose the correct extrinsic motion associated with a verb when that verb was presented in isolation, minus the percentage of trials in which participants chose the extrinsic motion associated with a verb when that verb was presented along with a noun that was associated with a different extrinsic motion. The rightmost bar similarly represents performance on trials testing knowledge of intrinsic motion.

These results are consistent with the idea that the meanings of extrinsic motion verbs are less dependent upon object structure than are the meanings of intrinsic motion verbs. In particular, the meaning of an extrinsic motion verb may remain largely the same regardless of the nature of the objects carrying out that motion. These results may have implications for verb learning. In particular, a child may not need to learn about the nature of an object before learning the meaning of an extrinsic motion verb in the context of that object. Instead, that object may need only to be conceptualized as a point or a blob, allowing children to represent the motions of this point or blob with respect to its surroundings. Thus, one may make the prediction that children will exhibit less attention to object

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structure when learning an extrinsic motion verb than when learning an intrinsic motion verb.

Some support for this prediction comes from the research of Kersten and Smith (2002), who examined attention to novel objects during both the learning of extrinsic motion verbs and the learning of intrinsic motion verbs. In particular, in Experiment 1 of Kersten and Smith (2002), a particular verb (e.g., *morp*) was always accompanied by a particular object, which always moved on a particular path with respect to a second creature on the television screen (i.e., an extrinsic motion). In contrast, in Experiment 2, a particular verb was always accompanied by a particular object with a particular way of moving its legs (i.e., an intrinsic motion). Comparing across these two experiments, children were more likely to attend to novel objects when learning intrinsic motion verbs than when learning extrinsic motion verbs (see figure 19.3). In particular, children were more likely to reject an event on the basis of a change in object when the relevant type of motion was intrinsic than when the relevant type of motion was extrinsic.

The fact remains, however, that children exhibited significant attention to objects even in the context of an extrinsic motion verb. This finding would appear to be inconsistent with the theory that attention to object structure is not necessary to learn the meaning of an extrinsic motion verb. A possible reconciliation of these results with this theory, however, comes from the fact that all of the children in the research of Kersten and Smith (2002) were native English speakers. As pointed out by a number of researchers (e.g., Gennari, Sloman, Malt, & Fitch, 2001; Naigles & Terrazas, 1998; Slobin, 1996; Talmy, 1975), the most commonly used class of motion verbs in the English language describes the manner of motion of an object (e.g., *run*, *walk*, *skip*, *saunter*). Although the correspondence between manner of motion and intrinsic motion is not perfect, many of these verbs also fall into the category of intrinsic motion verbs. Because the interpretation of an intrinsic motion verb is strongly dependent upon the nature of the object carrying out that motion, children learning English may develop a general tendency to focus on objects in a verb learning context. Children may thus exhibit this tendency not only when they are learning an intrinsic motion verb, but also when they are learning an extrinsic motion verb, as in Experiment 1 of Kersten and Smith (2002).

Some evidence for this conjecture comes from a comparison of the results of Kersten and Smith (2002) on verb learning to the results of a study by Landau and Stecker (1990) examining the learning of novel prepositions. Landau and Stecker presented 3- and 5-year-old children with novel objects in different locations on a box. For some children, this arrangement was accompanied by a novel noun. In particular, children were told "This is a corp." For other children, this arrangement was accompanied by a novel preposition. In particular, children were told "This is a corp my box." Children were then tested on whether they thought these novel terms referred to objects, locations, or both. Children in the noun condition were found to attend exclusively to the object, ignoring the location of that objects. In

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contrast, children in the preposition condition attended exclusively to location, ignoring the identity of an object. Thus, whereas children in Kersten and Smith's (2002) study of verb learning attended just as strongly to objects as to motions, children in Landau and Stecker's (1990) study of preposition learning ignored objects and attended only to a static relation involving that object.

Although Landau and Stecker (1990) only presented children with static arrangements, their results may still have some bearing on the learning of motion words such as verbs. In particular, some of the first motion terms that English-speaking children learn are prepositions such as *in*, *out*, *up*, and *down* (Bowerman, 1978; Farwell, 1977; Gentner, 1982; Gopnik & Choi, 1995; Greenfield & Smith, 1976; McCune-Nicolich, 1981; Nelson, 1974; Smiley & Huttenlocher, 1995; Tomasello, 1987). As pointed out by Jackendoff (1987) and Talmy (1985), the motions described by such prepositions tend to be extrinsic in nature, describing the path of an object with respect to an external reference point. Thus, whereas verbs in English are learned in the context of intrinsic motion, prepositions may be learned primarily in the context of extrinsic motion. If the interpretation of extrinsic motion is indeed less dependent upon object structure than is the interpretation of intrinsic motion, this may explain the different results of Landau and Stecker (1990) and Kersten and Smith (2002). In particular, children in the study of Kersten and Smith (2002) may have attended to objects during verb learning because of their experience of learning a large number of intrinsic motion verbs, whose meanings are strongly dependent upon object structure. In contrast, children in the study of Landau and Stecker (1990) may not have attended to objects during preposition learning because of their experience of learning prepositions that convey extrinsic motion, whose meanings are less dependent upon object structure.

#### Attention to Novel Objects During Verb Learning in Japanese

The findings described in the previous section provide some evidence that extrinsic motion is less dependent upon object structure than is intrinsic motion. English-speaking children may thus attend strongly to object structure when learning verbs because of their prior learning of large numbers of intrinsic motion verbs. If this is the case, one may make the prediction that children who speak a language that makes less frequent use of intrinsic motion verbs and more frequent use of extrinsic motion verbs should show reduced attention to object structure during verb learning. One such language is Japanese. According to Slobin (2004), the most commonly used type of motion verb in Japanese describes the path of an object, a clear example of extrinsic motion. Thus, if extrinsic motion is indeed less dependent upon object structure than is intrinsic motion, one may make the prediction that Japanese children should attend less to object structure during verb learning than do English-speaking children.

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Kersten, Smith, and Yoshida (2005) tested this prediction by presenting 4- to 5.5-year-old Japanese- and English-speaking children with the stimuli employed by Kersten and Smith (2002). The method for the English-speaking children was identical to that used in Experiment 1 of Kersten and Smith (2002). The method for the Japanese children was the same, except that all of the instructions were presented in Japanese by a native speaker and Japanese-sounding novel words were employed. In particular, English-speaking children heard "This one is morping" when they saw an event in which a creature with a rounded, orange body with red spots on it moved into contact with a second creature, whereas Japanese children heard "Kore wa mobette-iru yo" ("This is mobetting") when they saw this event. In contrast, English-speaking children heard "This one is spogging" when they saw an event in which a creature with a rectangular, purple body with gray spots on it moved away from a second creature, whereas Japanese children heard "Kore wa sokutte-iru yo" ("This is sokutting") when they saw this event. Thus, children could have associated these novel words with a particular creature, a particular motion, or both.

As in the study of Kersten and Smith (2002), children were tested by presenting them with events that were either identical to or somewhat different from the previous examples of a particular verb, and asking them if these were still examples of that verb. Some of these events were identical to previous examples of the verb, some involved the correct motion performed by wrong creature, some involved the correct creature performing the wrong motion, and some involved both an incorrect creature and an incorrect motion. English-speaking children were asked the question "Is this one morping?" along with each such test event, whereas Japanese children were asked "Kore wa mobette-imasuka?" ("Is this mobetting?"). If a prior language learning history involving a preponderance of extrinsic motion verbs indeed causes Japanese children to attend less to object structure during verb learning, then Japanese children would be expected to be less likely than English-speaking children to reject an event as an example of a verb as a result of a change in the creature participating in that event.

The results of this study, however, revealed nearly identical patterns of performance in the two language groups. In particular, both groups were more likely to reject an event as an example of a verb as a result of a change in motion than as a result of a change in the creature carrying out that motion. A change in creature also produced a significant reduction in children's willingness to accept an event as an example of a verb, however. The magnitude of this effect was almost identical in Japanese- and English-speaking children, suggesting that the two groups of children attended similarly to object structure during verb learning.

This result runs counter to the prediction that speakers of a language that makes frequent use of extrinsic motion verbs should exhibit less attention to object structure during verb learning than do speakers of a language that makes more frequent use of intrinsic motion verbs. There are a number of possible explanations for this discrepancy. One explanation is that the proposed distinction

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between intrinsic and extrinsic motion verbs in their sensitivity to object structure is wrong. Stated in a more positive light, an influence of object knowledge on the interpretation of a verb may be an even more general phenomenon than originally proposed, applying to verbs in general rather than just to specific classes of verbs. Thus, the meanings of extrinsic motion verbs, as well as the meanings of intrinsic motion verbs, may be dependent upon the nature of the object whose motions are being predicated, encouraging children to attend to object structure in order to help them determine what a verb may mean in the context of a particular object.

A second possibility is that the similar pattern of performance in Japanese and English-speaking children derives from the fact that English and Japanese are not entirely different in their verb conflation patterns. In particular, English as well as Japanese employs extrinsic path of motion verbs (e.g., *come*, *arrive*, *enter*, *exit*), although they may not be used as frequently as intrinsic manner of motion verbs (Naigles, Eisenberg, Kako, Highter, & McGraw, 1998). Moreover, Japanese as well as English employs intrinsic manner of motion verbs (Koike, 2003), although they may not be used as frequently as are extrinsic path of motion verbs (Slobin, 2004). The fact that children learning Japanese are sometimes confronted with intrinsic motion verbs, whose meanings are strongly dependent upon object structure, may encourage them to attend to object structure to help them determine the meaning of these verbs. If this happened with sufficient frequency, it could potentially cause Japanese children to develop a general strategy of attending to object structure during verb learning, similar to that seen in English-speaking children.

This idea could explain the apparent discrepancy between the results of Landau and Stecker (1990) on preposition learning in English and the results of Kersten et al. (2005) on verb learning in Japanese. The most likely type of motion to be conveyed by each of these word types is extrinsic motion. Japanese verbs also sometimes convey intrinsic motion, however, and thus Japanese children may learn that attention to object structure is sometimes useful in order to learn the meaning of a verb. In contrast, the use of English prepositions to convey intrinsic motion may be much rarer (Jackendoff, 1987; Talmy, 1975).<sup>1</sup> Thus, English-speaking children may generally be able to learn the meanings of prepositions without reference to the nature of the object whose motion is being described, accounting for Landau and Stecker's finding that English-speaking children ignore object structure when learning prepositions.

If Japanese children's attention to object structure during verb learning indeed results from the existence of intrinsic motion verbs in Japanese, then it remains possible that children who are exposed to a language that does not employ intrinsic motion verbs will not develop a tendency to focus on object structure during verb learning. It is not clear if any such languages exist, however. For example, Romance languages such as Spanish are frequently cited as examples of languages in which the use of extrinsic path of motion verbs is preferred (see e.g.,

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Gennari et al., 2001; Slobin, 1996; Talmy, 1985), but intrinsic manner of motion verbs are still preferred in certain contexts even in Spanish (Naigles et al., 1998; Naigles & Terrazas, 1998).

A third possible account of the similar patterns of performance in Japanese and English-speaking children is that attention to object structure during verb learning does not represent a verb learning strategy per se but rather represents a generalization of a tendency acquired in the context of learning nouns. In particular, there is now a substantial body of evidence suggesting that attention to object shape increases over early word learning, as children acquire a large vocabulary of shape-based nouns (e.g., Gershkoff-Stowe & Smith, 2004; Smith, 1999). One possible explanation for children's attention to objects during verb learning is that a tendency to focus on object shape, acquired in the context of noun learning, generalizes to the learning of other types of words such as verbs. If the meanings of intrinsic motion verbs are in fact strongly dependent upon the nature of the object in motion, then this attention to object shape may actually be beneficial to verb learning, especially for children learning languages such as English that frequently employ intrinsic motion verbs. This attention to objects may be less useful when learning verbs in a language such as Japanese that more frequently employs extrinsic motion verbs, but may occur nonetheless as a result of prior noun learning.

This account could explain the verb learning results of Kersten and Smith (2002) and Kersten et al. (2005) by proposing that there exist multiple, competing influences on children's attention in a verb-learning context. In particular, children may learn at a relatively early age to attend to object shape in word-learning context, as a result of learning a large number of nouns that can be readily discriminated on the basis of shape. This attention to shape may not be limited to a noun-learning context, but rather may generalize to the learning of other types of words such as verbs and adjectives (see Smith, Jones, & Landau, 1992, for evidence with regard to adjectives). As children later start to learn large numbers of verbs, they may learn that attention to motion is also useful in the context of verb learning. The performance of children in the studies of Kersten and Smith (2002) and Kersten et al. (2005) may reflect a combination of these two influences. In particular, cues to a word-learning context may elicit attention to object shape, whereas the syntactic and morphological markers of a verb may elicit attention to motion, resulting in attention being directed to both of these types of information.

This account could also explain why Japanese- and English-speaking children perform so similarly in a verb learning task despite the differences in the types of motion encoded by verbs in the two languages. In particular, attention to object structure may reflect one's prior noun learning history, and this noun learning history may be quite similar for speakers of the two languages. Although Japanese and English nouns differ with regard to the count/mass distinction (Imai & Gentner, 1997; Soja, Carey, & Spelke, 1991), animate objects such as the buglike

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creatures employed in the Kersten et al. (2005) study are treated as count nouns in both languages. Thus, the presence of an animate object may elicit attention to object shape in speakers of both languages, even in a verb learning context.

This account leaves open the possibility that differences in the verb learning performance of Japanese- and English-speaking children may emerge later in development. In particular, young children may exhibit a universal tendency to focus on objects in a word learning context, a tendency that was acquired in the context of learning nouns. As children get older, syntactic cues may become increasingly important in driving attention to different attributes of a stimulus, overwhelming this more general tendency to focus on objects. Thus, differences between Japanese- and English-speaking children may become evident only after this initial tendency to focus on objects is overcome. It would be interesting to test whether adult speakers of English and Japanese differ in any measurable degree in their verb learning performance given the different structure of their languages.

Further research is needed to determine which of these explanations best accounts for the similarity in the performance of Japanese and English-speaking children in a verb learning task. For example, an approach that could be used to test for influences of one's prior noun learning history on subsequent verb learning would involve testing speakers of different languages in a context in which their prior noun learning histories differed. For example, English and Japanese differ in their treatment of simple objects such as bricks, with English treating them as count nouns (i.e., a brick), and Japanese treating them as mass nouns (i.e., a piece of clay). Thus, Japanese-speaking children learn to attend to the substance of such an object in the context of a novel noun, whereas English-speaking children attend to its shape (Imai & Gentner, 1997). If Japanese- and English-speaking children were presented with the motions of such an object along with a novel verb, they could be tested to see to what extent they attended to the shape and substance of the object, as well as its motion. If attention to objects during verb learning reflects one's prior noun learning history, then Japanese- and English-speaking children would also be expected to attend differently to shapes and substances in a verb learning context.

## Conclusion

The research reviewed in this chapter provides evidence that children attend not only to motions but also to object structure when learning verbs. This strategy may reflect the nature of verb meanings, which vary considerably in the context of different objects. Thus, children may attempt to learn about an object and the types of motion it is capable of in order to help them figure out what a verb means in the context of that object. Different types of verbs may differ in the extent to which they are dependent upon object structure, however. In particular, intrinsic motion verbs, which describe the relative motions of the parts of an

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object, may be strongly dependent upon the static configuration of those parts. Extrinsic motion verbs, on the other hand, which describe the motion of an object as a whole with respect to an external reference frame, may not be as dependent on object structure. Instead, one may be able to conceptualize the objects taking part in these motions as points or blobs, without needing to flesh out the detailed structure of these objects.

Evidence for a distinction between intrinsic motion and extrinsic motion verbs in their dependence on object structure is still quite limited. Speakers of English and Japanese, two languages that differ in their use of intrinsic and extrinsic motion verbs, show similar patterns of attention to objects and motions in a verb learning task. This may suggest that attention to object structure is useful not only in the learning of intrinsic motion verbs but also in the learning of extrinsic motion verbs. Alternatively, attention to object structure during verb learning may reflect a generalization of tendencies acquired in a noun learning context. These tendencies may be useful when learning an intrinsic motion verb, encouraging attention to the structure of an object and thus allowing children to constrain the possible meanings of the verb. These tendencies may be less useful when learning extrinsic motion verbs. Further research involving the motions of novel objects is needed in order to better understand the role of object knowledge in the acquisition of verbs.

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#### Note

1. When used as verb particles in combination with particular verbs, prepositions do sometimes convey intrinsic motions. For example, the verb-particle combination *reach out* describes a way of moving the arms in relation to the body, making it an example of intrinsic motion. Such uses may represent metaphorical extensions of the more basic meanings of these prepositions, however, which appear to primarily convey locations and motions with respect to an external reference frame (Lindner, 1982).

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