FLEXIBLE COORDINATION OF SPATIAL COGNITION AND LANGUAGE

By

AKIKO FUSE

A dissertation submitted to the Graduate Faculty in Psychology in partial
fulfillment of the requirements for the degree of Doctor of Philosophy,
The City University of New York

2006

UMI Number: 3231973

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

This manuscript has been read and accepted for the
Graduate Faculty in Psychology in satisfaction of the
dissertation requirement for the degree of Doctor of Philosophy.

August 26, 2006	Laraine McDonough, Ph. D
Date	Chair of Examining Committee
August 29, 2006	Joseph Glick, Ph. D
Date	Executive Officer
	Laraine McDonough, Ph. D.
Soonja Choi, Ph. D	Benzion Chanowitz, Ph. D
Gisela Jia, Ph. D	Patricia Brooks, Ph. D
Outside readers	Supervisory committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

FLEXIBLE COORDINATION OF SPATIAL COGNITION AND LANGUAGE

by

Akiko Fuse

Advisor: Professor Laraine McDonough

Different languages can make unique distinctions in the way space is lexicalized (e.g., Choi and Bowerman, 1996a). The main purpose of the present study is to investigate spatial language in native Japanese-speaking adults and children from 2- to 5-years of age using an elicited-production task. The first experiment investigated the use of two different modeling methods (incomplete vs. complete modeling) and found no differences in the results of elicited spatial language in English. The second experiment investigated Japanese spatial terms in native Japanese adult speakers and compared the relations to which their terms are categorically extended to the relations denoted by terms elicited by English-speaking adults. The results showed that Japanese has many more precise terms for categorizing spatial relations than does English. The data in Experiments 1 and 2 were compared using different coding methods (i.e., comparing English prepositions to Japanese verbs or English verb-plus-preposition combinations to Japanese verbs). The results showed that the use of verb-plus-preposition descriptions to categorize English spatial terms critically changes the interpretation of how these two language differ semantically. The third experiment used a DVD to show participants the modeled relations. The results

showed that this is a valid technique that can be used to investigate how spatial relations are lexicalized in other languages as well. Lastly, significant developmental changes in the acquisition of spatial terms as well as in the various types of child-unique responses provided by the Japanese children were explored. Although some similarities were found in the categorization of space among English, Japanese and Korean languages, the findings of the present study showed language-specific categorization of space, even among the two Asian languages. However, the results also suggest that the boundaries of spatial categories are not clear-cut due to our flexible ability to coordinate spatial information with language.

Acknowledgments

Completing my dissertation was like trying to piece together an endless number of jigsaw puzzles, with some pieces fitting nicely and other pieces needing some brute force to get them to join. I would like to thank everyone who helped me complete this jigsaw puzzle. First, I am indebted to my advisor, Laraine McDonough who always believes in me, and encourages me by using numerous metaphors like protecting me through my graduate studies from things that "go bump in the night." I am grateful to Laraine for guiding my training in thinking and writing. I also wish to thank Benzion (Buzzy) Chanowitz and Patricia (Patty) Brooks for being part of my examination committees and providing me with helpful feedback to improve my research. Buzzy opened the door for me to Brooklyn College in more ways than one. I thank him for his support and time. Thanks go to Patty for her thoughtful comments on my dissertation and for her advice on my career. Many thanks to Soonja Choi for her expertise, who provided me comments that led me to re-think many issues. Her research with Melissa Bowerman provided the foundation for my research questions and their ideas motivated me to conduct more experiments than I originally imagined. I am also grateful for Gisela Jia, for sharing with me her insightful advice and guidance that has truly been invaluable. Her research increased my curiosity about issues concerning the human mind and how language is acquired. I smile when I thank Arthur Reber. Like a father, he inspired me to look at things in the world a bit differently. Writing a history paper about Whorf in his class was the starting point of my dissertation project. I would also like to thank Aaron Kozbelt who worked with me to find different ways of solving problems using statistics. I enjoyed my conversations with Glen Hass, and thank him for his support and intuitive advice in the many facets of teaching and for helping guide me through graduate school. I am delighted that Elisabeth Brauner spent the time to help me deal with the mysterious bureaucracy and make my dissertation defense possible. Many thanks to Elisabeth for sharing cultural experiences and perspectives and giving me the extra support I needed to get through graduate school. I would also like to thank my friends and colleagues at Brooklyn College and Lehman College, especially Elaine Gazes, Christine Baker, and Teresa Tannazzo for stress relief and friendship and for just always being there for me. A special thank you goes to my office mate, Alex Kranjec, who encouraged and helped me when I needed it. I would also like to thank those who have supported and encouraged me while studying in the United States. The Gurzynski and Lotruglio family were big supporters and always encouraged me to continue my studies in this country. Without Kathleen Pennoyer, I probably would not be in this field today. I would like to thank the children and adults who participated in the studies as well as the teachers at the day care center in Tokyo. Special thanks go to my personal friends, family, and relatives who are my supporters in both Japan and the U. S.

Words alone seem hardly sufficient to thank my husband, Randy Lunenfeld, for always being very supportive, and for his encouragement, understanding, and patience. Dear Randy, your encouragement really made me move forward "step by step." Your drawing of the turtle with the saying "Go bulldog. Super turtle" is now in our treasure box. Thank you very much for everything that you have done for me.

I am grateful for my dear sister, Kazumi Fuse, and my parents, Tomoji Fuse and Etsu Fuse, for their support and encouragement, and most of all, for believing in me and letting me follow my dream. Lastly, I would like to acknowledge my grandmother, Kiku Fuse who passed away in my childhood, and my grandfather, Sadaichirou Kitada who passed away while I was studying in the U.S., and my grandmother, Shigeko Kitada who is living more than 6000 miles away. I am very fortunate to have such great grandparents whose value of learning and education brought me the courage to pursue my studies and dreams. Imagining your smiles always bring me energy and strength. To all of you, I express my sincere thanks from deep in my heart.

Dedication

To my parents, Tomoji Fuse and Etsu Fuse

お父さん、お母さん、どうもありがとう。

Table of Contents

List of Tables

List of Figures

Chapter 1

Overview/introduction

Imagine going to a restaurant for lunch with your friends. You first open the door and enter the restaurant. When you get a table, you sit on the chair in front of the table and you and your friends may face each other. There may be other friends sitting next to your right and left sides. The waiter comes down to get your order, and serves the water, and puts it down in front of you on your right side. At the table, one may ask, “Could you pass me the salt right in front of you?” and you will pass the salt to the friend who requested the salt. The location of the salt was moved from point A (original location of the salt) to B (your hand) to C (your friend’s hand). Your friend puts the salt down after he/she finishes using it. Now the location of the salt was moved from point C to D (new location of the salt).

Every object and substance in the above scene has a location. Some objects may remain static and others may move from one location to the other. In our everyday lives, there are several objects that create various spatial relations from one object to the other. There locations involve both a static location (e.g., salt) and motion events (e.g., picking up the salt, and passing it onto your friend). Objects in motion will indicate a path with a starting and end point in any given location. At the same time, there are always starting points and end points (e.g., A → B, B→ C, C→ D) in motion events.

As you look up from reading and view the objects on your desk, it seems immediately clear not only where each is located but also the spatial relation of each object relative to the others. The pencils are in the pencil cup that is sitting on top of the desk. Alongside the pencils are a couple of stacks of books. The drawers in the desk may have handles attached to them. A glance under the desk reveals some paper clips on the floor below. This description seems adequate but you then realize that you could elaborate more extensively on the perceptual details of the object relations. For example, the top book in one of the stacks is oriented towards you making it easy to read the title and the books to the north of you. In English, absolute descriptions such as north or south seem odd when used in close spaces. Yet, as will be seen, other languages commonly use absolute descriptions across a wide range of contexts.

The goal of the present research is to investigate the relation between concepts of space and language. To approach this, the issue of the relation between thought and language that has been long debated by researchers across the disciplines will be addressed first. The discussions of these issues also cover color perception and language which seem to have similar characteristics. Both of the domains, space and color largely rely on the input through the visual system. A review of another domain, which is that of time, is included because it is often talked about in terms of space. This dissertation discusses the cross-linguistic and cultural influence on the concepts of space and language.

Next, the interacting roles of nature and nurture are discussed as they pertain to development and acquisition of language. This discussion leads to the importance of viewing our abilities as flexible in the way we learn spatial concepts and language. The embodied view of space is how spatial relations can be perceived through our sensory systems, and how the human body is structured which in turn influences how we experience the environment. It will be argued that this view supports our traditional belief in cognitive universals, allows for symbol grounding (a basis on which language can be learned in a meaningful way), and is developmentally plausible in terms of a learning-based approach for the acquisition of spatial concepts.

An examination of both the traditional cognitive universal view and the renewed interest in embodiment will be discussed next as these views pertain to how we perceive spatial relations and encode and represent spatial information linguistically. As will be seen, languages contrast in the various ways they lexicalize spatial relations depending on the details of the relation (e.g., degree of fit, the shape or orientation of the objects, the frame(s) of reference commonly used in the language; i.e., absolute, deictic, intrinsic), and the grammatical forms of the spatial terms themselves (e.g., prepositions, verbs). How these differences influence performance on what have been called ‘problem-solving’ tasks, both linguistic and non-linguistic, are also discussed as it pertains to the relation between spatial thinking and language. Cross-linguistic differences pose a problem in figuring out how various languages are initially learned given that the differences seem to undermine a universalist position.

The first of a series of experiments replicates and extends previous research using an English-speaking population. The extension addresses the impact of using different models in an elicited-production technique developed by Choi and Bowerman. In their research, partial models of dynamic spatial relations were demonstrated requiring participants to make inferences based on the path and manner of the varied spatial relations. When completed modeling of spatial relations are demonstrated, not only is the need for making inferences is eliminated, but it also provides more precise information about the manner and path of the activity used to demonstrate spatial relations.

In the next experiment, the differences found in the spatial categories lexicalized in English and Korean are also apparent in the comparison of English and another Asian language, Japanese. However, English is a manner language in that the verb typically conflates the manner of motion as in the statement "He swam across the river." The spatial relation is not in the verb; rather it is in the preposition 'across.' In another language such as Korean or Japanese one might say something more like "He went across the river swimming." In this case, two verbs, 'went [across]' and 'swimming' describe path of motion and manner of motion, separately. In English, the former represents the common expression whereas in Japanese and Korean the latter expression would be more common. Thus English (a 'manner language') and Japanese and Korean (both 'path languages') differ in where path information is commonly conveyed, i.e., prepositions in English and verbs in Japanese and Korean. Previous research compared spatial prepositions/adverbs in English to spatial verbs in Korean (Choi & Bowerman, 1991, Bowerman, 1996a). In the present research, not only prepositions (e.g., in, on)/adverbs (e.g., together) but also verbs (e.g., put) in English are compared to verbs in Japanese in order to examine the types of spatial categories. Coding both verbs and prepositions/adverbs in English may be more comparable to verbs in path languages in terms of comparing what types of semantic information is encoded in a sentence. The replication of the study in English raised the issue of variable responses. In a search of possible reasons for the variable responses, an examination of data using an English-speaking population by showing them systematic modeling presented on a DVD was conducted. The use of the DVD stimuli to test other languages in various geographical locations would be desirable for future research.

A review of the current research indicates that there are a few studies which compare manner and path languages, but a comparison between two path languages had not yet been done. The question addressed was whether or not speakers of all 'path' languages will describe spatial relations in the same or similar manner. To examine this issue, spatial verbs used in Japanese and Korean were also compared. Developmental comparisons were also made. The acquisition of Japanese spatial terms among young children and adults was examined and compared. For the developmental as well as cross-linguistic comparisons, spatial language was examined within and between the three languages: English, Korean, and Japanese. The boundaries of lexical spatial categories as well as the similarities/differences in the ways speakers of different languages lexicalize space are presented and discussed.

The above issues are discussed and data are presented on each. The results of the experiments are compared to the findings in previous research. The goal of this dissertation research is to allow us to understand further the complexities of different languages and to speculate on whether these differences can potentially influence our concepts about space.

Chapter 2

Thought and language

Interestingly, speakers of more than one language may often feel that they think differently depending on which of the languages they speak. For example, people who speak both Japanese and English may claim that they feel that they become a stronger and more direct person when speaking in English than when speaking in Japanese. Is this because there are differences in the characteristics of language (e.g., structures, grammar, pragmatics)? It is possible that one language might have a larger degree of freedom and looser use of words and grammatical structures than the others. One language may require a more direct structure and a clearer meaning of sentences than the other languages which prefer to express more ambiguous and indirect meanings in sentences. In other words, depending on the language, there are different kinds of limitations and availabilities in the use/selection of words, grammars, pragmatics, etc. to express our thoughts (Hunt & Agnoli, 1991).

Another possibility is that the influence of language is not simply on a linguistic level but it rather influences or shapes the way we think about the world (Whorf, 1956). This may also explain the feeling of personality changes that take place depending on the person's language is due to a semantic influence (Hunt & Agnoli, 1991; Wierzbicka, 1985). The implication is that when speakers of different languages experience the same event, they may think about the event in different ways because of the influence of the language they speak. Whorf (1956) claimed that language shapes or influences our thought.

This chapter first discusses the relation between thought and language from multidisciplinary perspectives. Next, previous studies on concepts of color and time and language will be discussed to lay the framework for the relations between the domain of space and language. The domain of color was chosen since it shares similar characteristics with the domain of space (e.g., the various ways in which a presumably shared perception can be described), and the previous studies reveal some similar issues when studying the influence of language on space. Another domain, which is that of time, will also be discussed because this domain has been understood in terms of space, and some researchers on time also propose a strong influence of language on how we think about time.

Historical views

The relation between language and thought has been long debated in terms of whether or not language is dependent on thought, or thought is dependent on language, or whether the two are dependent on each other. The controversial issue of the relation between language and thought has been discussed and studied by psychologists (e.g., E. V. Clark, 1973a, 1973b; Piaget, 1962; Slobin, 1971; Vygotsky, 1962), philosophers (e.g., Humboldt, 1836/1988), linguists (e.g., Choi, 1997; Sapir, 1921; Whorf, 1956), and anthropologists (e.g., Boas, 1938a, 1938b).

We share the same biology and live in the same world. Our reality is reflected by universal principles governing our thought and language. For example, time, space, and causation are some of the larger cognitive categories that are considered universal in all humans. German philosophers such as Gottfried Herder, Wilhelm von Humboldt, and Wilhelm Wundt have embraced views resembling Whorf's hypothesis (Fishman, 1960; Greenberg, 1954; Hill & Mannheim, 1992; Lucy, 1992). For example, according to Humboldt, language is metaphorically 'an organ' of thought, and both language and thought are interconnected with each other (Humboldt, 1836/1988).

The most controversial argument stems from the Sapir-Whorf hypothesis stating that language plays a major role in how people think about the world. The nature of the hypothesis as originally proposed by Whorf is that the language people use has an impact on the way they perceive the reality. Their proposal claims that because different cultures have different languages, people in different language groups must think about the world differently (Brown & Lennenberg, 1954; Lakoff, 1987; Whorf, 1956). There are two aspects of Whorf's proposal. One aspect of linguistic determinism states that language determines thought or strongly influences the way a person thinks about or perceives the world. According to this view, the thought of all humans is shaped by the language they use. Whorf claimed that language determines cognitive processes and is the source of (or evidence for) cognitive differences. Another version of the hypothesis is weaker in its claims (i.e., linguistic relativity) but still maintains that languages influence thought, albeit subtly. This is still a controversial hypothesis, which has been argued, reexamined, criticized, or largely ignored by many who simply dismissed it (Brown & Lennenberg, 1954; Hunt & Agnoli, 1991; Hill & Mannheim, 1992)

In a famous example of the observation of Eskimos by Boas, it was noted that Eskimos have a variety of words to describe snow compared to English, which only has one word, ‘snow’ (although this is controversial today given that English speakers also refer to snow as, for examples, slush or powder). One explanation of the differences between Eskimo (as the language was originally called by Boas, however it is now known that ‘Eskimo’ does not constitute a language, so one presumes that ‘Inuit’ is the language under discussion) and English is that an English speaker does not notice the differences of snow like an Eskimo does. Eskimo people have more life experiences with snow and therefore they have many differentiated categories of snow, each of which are considered relevant to their everyday life (Brown & Lenneberg, 1954; Lakoff, 1987). Whorf interpreted this example provided by Boas as evidence that people who experience different cultures and environments would also perceive things in the world in different ways. Therefore, the particular language one uses and the manner in which concepts are packaged in that language provides insight as to how thought is determined by the particular language itself. Later, linguistic determinism was considered a controversial theory and was disconfirmed in that evidence showing a causal relation between language and thought was not clearly found (Brown & Lenneberg, 1954; Lakoff, 1987; Lucy, 1992; Whorf, 1956, but see Levinson, 1996a, 1996b).

Whorf also studied lexical differences in the Aztec language spoken in Mexico. He discovered that Aztec only has a single term for ‘cold’, ‘ice’, and ‘snow’ whereas English has these three terms. He reasoned that the one term was sufficient in the Aztec community because of their warm weather in Mexico, and it is not necessary for people who speak Aztec to make the same distinctions

English does (Henle, 1958; Whorf, 1956). From these two examples (i.e., Eskimo and Aztec), it seems clear why Whorf came to the conclusion that language influences perception.

Whorf stated that speaking is as habitual as thought which explains the linguistic phenomena (what Whorf meant by 'habitual' is an automatic reaction) (Hill & Mannheim, 1992; Lucy, 1992; Slobin, 1996a, 1996b; Whorf, 1956). Whorf also proposed that the relation between language and thought is that "in main they have grown up together, constantly influencing each other" (Whorf, 1956, p.156). This weaker form of the hypothesis, linguistic relativity, has had some mixed support by researchers (e.g., Hunt & Agnoli, 1991; Hardin & Banaji, 1993; McDonough, Choi, & Mandler, 2003).

The cognitive revolution also started around the same time Whorf's view was being debated, and it focused on the universality of all humans, rather than cultural or individual differences. That is, all humans were thought to have the same biological/neurological structures and therefore their functioning must be the same. The study of individual differences was cast aside. Piagetian theory gained international attention and psychologists began to be actively engaged in developmental research. The value of developmental research was the promise it had for uncovering universal cognitive principles. For example, many of the experiences we share as children such as eating, playing, and sleeping are fundamental everyday events across many cultures, although the experiences and events may differ in detail from one culture to another.

Cognitive psychology was initially influenced by principles long held by Western philosophers, one being a belief in an objective and knowable reality (e.g., Nisbett, 2003). Through the endowment of common sensory experiences and logical reasoning, we can determine the nature of the world shared by all humans. So, if we come to understand our world by experiencing events through common sensory systems and using a scientific method to test our understanding of the world, then cultural or linguistic differences are viewed as merely flexible ways of conveying the same kind of understanding. Regardless of which language we speak, the meanings underlying languages should be the same. According to Chomsky (1965,1968), language is the outcome of an innate organ for conveying thought, not to be confused with thought itself. Thus began the controversies surrounding our theories about the nature of language.

The gist of the controversy stemmed from the relation between thought and language across the lifespan. Vygotsky (1962) proposed that language allows thought to be individual and social at the same time (Cole & Cole, 2001). He suggested that thought and language co-develop during the first two years of life after which they begin to influence each other. Slobin also suggested that the child must have an independent semantic intention to express something and must then discover the linguistic meaning of doing so. In his view, the child acquires language as a concept in and of itself (i.e., the concept of 'language'); after which language becomes a tool for thinking. When new concepts are learned (such as location or past action), children search for the means to encode them linguistically (Slobin, 1971, 1997). In sum, it seems that young children experience events through the bodily sensory experiences, and once they acquire language, they come to match the concepts that are acquired through their past experiences to express the events with the assistance of language.

Debates on thought and language: Domains of color and time

To investigate further the relation between thought and language, the domains of color and time will be discussed in the present section. First, the studies on the domain of color will be discussed. Concepts of time are often studied in terms of space, which begs further consideration of the Whorfian claim (Boroditsky, 2001). Examining these two domains will lead us to address the crucial issues in the relation of spatial thought to language in the following chapters.

In addition to his review of Boas's claims about Eskimo (Inuit) and his own investigation of Aztec, Whorf also studied color memory and suggested that people will "dissect nature along the lines laid down by (their) native languages" (Whorf, 1956, p. 213). Because color labels seemed to differ across cultures, these differences were considered evidence that supported either linguistic determinism or linguistic relativity.

A classic study by Berlin and Kay (1969) introduced the cross-linguistic differences in color terms as well as brightness, hues, and saturations. They reported variations in the number of 'basic' color terms in different languages. The wide range of the 'basic' color terms was from 2 to 12 depending on the languages. For example, English has 11 'basic' color terms compared to the Dani of Irian Jaya which has two 'basic' color terms. Based on the Sapir-Whorf hypotheses, differences in the numbers of color terms in one language may be a factor leading to the differences in the nonlinguistic processes of color perception. Because color labels seemed to differ across cultures, these differences were considered as evidence that supported either linguistic determinism or linguistic relativity.

However, a study by Brown and Lenneberg (1954) examined the effect of language on memory by asking participants to label their perception of particular colors. The result showed that the color terms they gave influenced their color choices after a delay. Participants labeled secondary colors with descriptions such as sea green or sky blue. Studies of color memory with adults as well as with children indicate that labeling colors (e.g., 'blue', 'green') is correlated with memory for those particular colors. That is, after labeling a color 'blue', the participants will later choose that same color when asked which of several colors is 'blue' (Brown & Lenneberg, 1954; Davies, Sowden, Jerrett, Jarrett, & Corbett, 1998; Kimball & Dale, 1972).

Another test of Whorf's claim was conducted by Heider and Olivier (1972) who measured memory recall for chips used for color naming in two different languages, English and Dani. Studies of the Dani language found that color representations are quite similar to English speakers regardless of the number of color terms they have. Because the Dani has only two color terms, 'dark' and 'light', they seem to categorize colors based on the brightness rather than hues as the English speakers do (Heider, 1972; Heider & Olivier, 1972). The results of the study by Heider and Oliver (1972) indicated, regardless of the different numbers of the ‘basic’ color terms in each language, both groups of participants performed the same in color matching memory tasks. They concluded that “descriptively, we can say that ‘mental’ visual images, at least of colors, like ‘perception itself’ (Gibson, 1967), do not appear easily changed by language” (p. 352). Other researchers conducted a study of color naming and memory using the same materials used by Heider and Olivier with a different population, the Berinmo in Papua, New Guinea. The Berinmo have 5 ‘basic’ color terms compared to two ‘basic’ color terms of the Dani. Davidoff, Davies, and Roberson (1999) investigated whether the color terms in the Berinmo will influence memory, and if so, the categories of color naming should appear the same as encoded in memory, and the results were also compared to the results in English. The results showed that the recognitions were influenced by color terms when low-saturated colors were tested. The results also indicated that the influence of languages appeared on color categories for the speakers of Berinmo as well as English. (Davidoff et al., 1999; Roberson, Davies, & Davidoff, 2000).

Kay and Kempton (1984) confirmed that the implicit availability of lexical terms influences perception in their studies comparing Taraumara in Mexico and English in the United States. This finding was interpreted as supportive of Whorf’s stronger version of his hypothesis, that of linguistic determinism. However, their data is more closely aligned with a relativity interpretation. A study was also conducted involving a comparison between Setswana and English, showing that there are similarities and differences of color choices between languages (Davies et al., 1998).

Several studies tested the influence of language and thought by using language tasks such as color memory or color naming tasks and compared them to the results of nonlinguistic tasks. This is an important point because a few studies use nonlinguistic tasks. The challenge remains as to how participants construe such tasks. Even when nonlinguistic tasks are used, people will often engage in linguistic strategies. Reliance on language in nonlinguistic contexts adds substance to Whorf's claim that language and thought are intertwined intrinsically. Most of the research has been conducted on color perception and color terms showing that labels are influencing thought in indirect but automatic and habitual ways even when nonlinguistic information is processed. However, testing color naming and color memory involves three different aspects in the sensory system: hue, saturation, and brightness, but previous studies found that hue terms refer to the same denotations in color across languages (Abramov, 1997; Berlin & Kay, 1969; Kay & McDaniel, 1978). After all, if the components of color stimuli are constant and structures for perceiving color are universal, then cross-linguistic differences in terms of the boundaries for extending color terms should not be found.

If a language has only two color terms, the speakers of the language may attend less or be less sensitive to the variety of hues than speakers who have many color terms, even though they should have the same mechanism of color perception. This attentional difference may also apply to remembering colors. Speakers of a language who have a few color terms may have difficulties in remembering colors shown, and having numerous color terms may assist remembering and discriminating colors. Under this assumption that when language is used for encoding, then memory should show improvement. However, some studies suggested that the demands of task processing such as that implicated in linguistic encoding may be leading the influence of color perception (Berlin & Kay, 1969; Kay & McDaniel, 1978; Roberson et al., 2000).

As Whorf claimed, would there be cognitive differences that correlated with lexical differences of languages? Recognition and codability are important points in this topic (Brown & Lenneberg, 1954). As data of the Zuni showed, difficulties in recognizing the colors orange and yellow in a recognition task were found. No lexical items for these colors are found in Zuni. The study concluded that these colors are highly codable in English but not in Zuni. Even the bilingual speakers of Zuni and English made the same errors as monolingual Zuni speakers did (Lenneberg, 1953). Color terms are quite sensitive but do not have one clear definition. It should be noted that there were some methodological issues raised in the studies which tried to replicate previous findings. Reliable methodology to test sensations of color is important because the method used influences the results of studies in terms of color naming and perception (Gordon, Abramov, & Chan, 1994). Throughout the examinations of the influence of language in the domains of color naming and memory, when there were influences of language indicated in previous studies, they most likely appeared as small effects of language but not as strong influences of language on memory.

Interestingly, the issue raised in the studies of color perception and color terms also seem to appear in the domain of space. For the issue of nonlinguistic vs. linguistic tasks, color terms do not have clear definitions and the boundaries of categories are also not clear. Do we process the information in automatic/habitual ways or are there differences in our attention when we perceive the information through our sensory system attributable to linguistic influences. How would this relate to the recognition, remembering and codability of color information? These issues may be shared in both domains because the information of both color and space are first processed by our visual system.

Next, the domain of time will be examined. Concepts of time are often discussed in terms of space, and the influence of language when we think about time has also been examined. Compared to the studies in the domains of color examining the effect of language on thought, the nature of concepts of time is more abstract. Whorf studied the Hopi language, especially the grammatical system, in terms of the manner in which time and space are lexicalized. For example, English but not Hopi marks time by verb tense. Generally speaking, English has three tenses (present, past, future) and these are indicated by verb inflections. However, according to Whorf, the Hopi language refers to time by its duration without reference to any clear-cut beginning or end point of an event. Hopi speakers can refer to time, but it is not referred to by their verbs. Whorf compared the patterns of Hopi to various European languages (e.g. English, French, German), and claimed that English speakers conceptualize time differently than Hopi speakers. These particular findings became the basis of the Sapir-Whorf hypothesis (H. H. Clark, 1996; Hill & Mannheim, 1992; Kay & Kempton, 1984; Lee, 1997; Lucy, 1992; Whorf, 1956).

More recent studies have investigated the relation of thought and language on the domain of time. Boroditsky (2000, 2001) claimed that language may set up a ‘mental model’ for thinking. Time concepts can be discussed in the forms of spatial metaphors across languages. She suggested that Mandarin Chinese speakers use ‘vertical’ metaphors to talk about time whereas English speakers think about time in ‘horizontal’ metaphors, therefore concepts of time in the speakers of these two languages differ. Horizontal metaphors in English, for example, can be described with words such as ahead, forward, behind, or back. English speakers may talk about time as ‘New Year is ahead of us’, or ‘looking back at history’. In vertical metaphors in Mandarin, the term ‘shang’ in Mandarin means ‘up’ which refers to the events in the past or behind and the term ‘xia’ in Mandarin means ‘down’ which refers to the events in the future or ahead. For example, 2004 is down from 2003, World War I is ‘up’ from World War II for Mandarin speakers. If language is influencing the way speakers think, then it can be reasoned that language is a potential tool for problem-solving (Boroditsky, 2000, 2001; Levinson, 1996a, 1996b). Boroditsky used a priming task by showing scenes of horizontal- or vertical-spaced objects, and asked participants to choose a correct ‘temporal’ statement from the choices, such as ‘X is behind Y', ‘X is above Y’. The results showed that Mandarin speakers responded more quickly after seeing the vertical priming scenes, whereas English speakers responded faster when they were shown the horizontal priming scenes. However, her research also showed that English speakers could use vertical primes to think about time, thus this indicates that the English speakers’ conceptions of time were flexible (Boroditsky, 2001). It remains an open question whether the influence is specific to language or an inherent aspect of culture.

Research by Zheng and Goldin-Meadow (2002) on deaf children who developed their own home sign language suggests that language can be more influential than culture. Their participants were from China (raised in a Mandarin-speaking environment) and the United States (raised in an English-speaking environment). Regardless of the culture in which they were raised, their home signs were remarkably similar. This finding suggests that differences among languages are likely to evolve and the reason for linguistic change is not well understood. Culture may still influence language but not in its initial creation.

Boroditsky (2001) stated, "metaphorical language plays an important role in shaping abstract thought" (p.24). She also stated, "abstract knowledge can be built analogically from more experience-based knowledge" (Boroditsky & Ramscar, 2002, p.185), and stated that "some abstract knowledge might be construed and shaped by language" (Boroditsky & Ramscar, 2002, p.188; see also H. H. Clark, 1973; Lakoff & Johnson, 1980). According to these claims, the abstract domain of time concepts appears to be influenced, perhaps even shaped, by language (Boroditsky, 2001; Boroditsky & Ramscar, 2002; Gentner, Imai, & Boroditsky, 2002). A problem might exist in Boroditsky's task, in that the task is a language task which does not necessarily indicate the status of what the non-linguistic mental representation is. One might argue that a priming task could be used to test whether language can be used for problem solving so that the result can be concluded that language influences thought. This argument appears to be circular but has been used in interpretations of this line of research. Using language to evaluate the influence of language circumvents its influence on thought. Comparisons of cross-linguistic differences for testing an effect of language on thought are crucial, and cross-linguistic studies should be conducted by using non-linguistic tasks.

In the following chapters, research in the domain of space will be discussed. As has been seen in debates, it is not still clear to what degree language may be involved in the structure of spatial concepts. A focus on discussing concepts of space and spatial language from the developmental as well as cross-linguistic perspectives will be made. A series of experiments will then be proposed. The focus of the experiments is to examine the acquisition of Japanese spatial language and to make cross-linguistic comparisons of spatial language between English, Korean and Japanese. The results will be discussed with the issue raised in the studies of color perception and color naming as well as the relation of spatial concepts and language.

Chapter 3

Spatial thought and spatial language

Fundamental issues about space

The domain of space has been long discussed by the researchers across disciplines including philosophy, anthropology, cognitive science, cognitive linguistics, linguistics, and psychology. By investigating the relation between spatial thought and language, we will come across the issue of nature versus nurture of whether the concept of space and acquisition of language are within humans' innate abilities with no learning involved (Chomsky, 1965, 1968; Spelke, 1990, 2000). The universalists claimed that we all have the same brain mechanisms to perceive space through our universal innate abilities. They claimed that not only are we endowed with the same sensory system but the world is also filled with regularities regarding the material that is available for concepts about space, time, numbers and others.

Based on more recent research findings, others may argue that concepts of space are structured through our bodily structures (H. H. Clark, 1973), outcomes of interactions between the external world (environments) and internal (private) experiences. Therefore, our understanding of space should indicate similarities among people but the differences would also appear based on the individuals' unique environment and experiences. In addition, experiences of each individual are not separated from the language spoken, or the culture, society, and environmental in which each individual lives. The issue relates to more recent claims by Levinson and his colleagues (Levinson, 1996a, 1996b, Levinson, 2003, Pederson et al., 1998) that a strong influence of language shapes the way we perceive the world (the influence appeared in the nonlinguistic problem-solving task). However, recent developmental/cross-linguistic research shows little support for Levinson's strong claim about the relation between thought and language.

As mentioned earlier, Dan Slobin proposed that language plays a role in thinking for speaking. According to Slobin, who has conducted many cross-linguistic studies, language is a tool for thinking that is used to communicate with others. Slobin argued that the child must have an independent semantic intention to express something and must then discover the linguistic means of doing so. In his view, the child acquires language as a concept in and of itself (i.e., the concept of 'language'). When new concepts are learned (such as location or past action), they encourage the child to seek the means to encode them linguistically (Johnston & Slobin, 1979; Slobin, 1971, 1997).

Other cross-linguistic studies have also investigated how language influences thought in terms of spatial categorization. For example, research on English and Korean spatial terms suggested that languages differ more dramatically than can be easily accounted for by our traditional theories (Bowerman, 1996a, 1996b; Bowerman & Choi, 1994, 2001; Choi, McDonough, Bowerman, & Mandler, 1999). Cross-linguistic data have recently revealed that language can influence thought at least in terms of a person's initial construal of a scene (McDonough et al., 2003), but it is still not clear as to the degree to which language influences thought in general (Choi et al., 1999; Talmy, 1985, 1988).

Developmental researchers are also interested in the relation between language and thought, because it is still not clearly known how infants initially construe the world and how they extend words they learn as they develop. Infants and children face many situations in which they do not know what a word means or do not know a word to express the meaning they intend (Baillargeon, 1987; Quinn, 1994a, 1994b; Spelke, Breinlinger, Macomber, & Jacobson, 1992). Choi and Bowerman's study (Bowerman, 1996a) showed that different languages make different distinctions in spatial categorization in their comparisons of English, Korean, and Dutch speakers. They concluded that categorization of space is influenced by language. This conclusion is based on their results showing that children as young as two years of age made categorizations that are similar to adults who speak the same language. This makes sense after all, children learn language from adults so their use of it should mirror what they are exposed to. But the crucial issue was how they extended the words they learned to different context. These data show that languages differ more dramatically than traditional theories in development would assert (Bowerman, 1996a, 1996b; Bowerman & Choi, 2001; Bowerman, de Leon, & Choi, 1995; Choi & Bowerman, 1991).

In contrast to the interpretation by Choi and Bowerman (1991), our traditional views (particularly those outlined by Piaget) claimed that concepts are acquired before language. According to the view that conceptual development comes first, learning language was not thought to influence thought initially (Gardner, 1985; Piaget, 1962, 1967). Yet Piaget was surprisingly silent at what point in development language becomes meaningful or symbolic. He did not consider a child's first words as evidence for representational thought, but as egocentric speech. In contrast to Piaget's view that early language was egocentric without cognitive or communicative bases, Vygotsky (1934/1987) proposed that what Piaget called 'egocentric speech' is speech that assists cognitive functioning. For example, when a child is solving a difficult problem, the child will tend to talk about the problem (e.g., Kohlberg, Yaeger, & Hjertholm, 1968; Nelson, 1985) which serves communicative functions as well. Vygotsky believed that thought and language co-develop during the first two years of life after which they begin to influence each other. According to Vygotsky, language allows thought to be individual and social at the same time (Cole & Cole, 2001). Both views (Piaget and Vygotsky) have influenced the studies on first language acquisition yet neither claimed that language determines or strongly constrains cognition. However, unlike Piaget, Vygotsky acknowledged the role of social and cultural contexts on cognition.

To explore further the relation of thought and language specifically with respect to the domain of space, the following sections first review the previous research on spatial concepts and language while focusing on developmental as well as cross-linguistic findings.

Flexible space and language

Previous studies reported that spatial terms can be difficult to acquire because space is a flexible notion and language is also flexible. Space can be described in absolute terms (i.e., North, South, East, or West), deictic terms (i.e., left or right), or intrinsic terms (i.e., in front of, behind of) (Bowerman, 1996a, 1996b; E. V. Clark, 1973a, 1973b). Language is also a flexible notion. Depending on which particular language is learned, speakers of different languages often categorize spatial relations differently. The results of cross-linguistic studies showed that each language is different and the spatial categories of one language cross-cut those of other languages (Levinson, 1994; McDonough et al., 2003). For example, recent studies investigated whether language influences thought in terms of spatial categorization. English speakers, for example, categorize the relations, 'put ring on pole' and 'put pegs in holes' into two different lexical categories with the use of the prepositions of 'on' or 'in'. For Korean speakers, those two separate categories made by English speakers would be categorized into one category with the verb, 'kkita' in Korean, with the meaning of interlock or fit tightly. The data showed that 'loose in' and "tight in" relations are obligatorily contrasted in Korean but are optional in English; 'loose on' and 'tight on' relations are also contrasted in Korean; and 'tight in' and 'tight on' relations are contrasted in English but not Korean. English contrasts containment and support (in vs. on) regardless of fit. By examination of these languages (and others as well) one can clearly see that these differences contrast sharply (Bowerman, 1996a, 1996b; Bowerman & Choi, 1994, 2001; Choi et al., 1999). Recent cross-cultural research on language production and comprehension have found that children learn spatial relational terms and extend them in language-specific ways (Choi et al., 1999; McDonough et al., 2003).

In summary, regardless of the various ways languages may carve up the world, we still do not know how to tell clearly when and to what extent language influences our earliest thoughts (but see Choi, 2006). How can we approach this issue? Recent studies suggested that language-specific input might influence early semantic development. Current cross-linguistic research has suggested that linguistic input begins to influence children at a remarkably young age, and by eighteen months of age, children comprehend such spatial terms in highly language specific ways. Children categorize space in terms of the language that they are learning as shown by the extensions of their first-learned spatial terms, and as such they could have an understanding of space that is dependent on the language that they are learning. In developmental perspectives, this is quite remarkable but nevertheless a controversial topic, because we still do not fully understand how infants construe the world before they acquire language (Baillargeon, 1987; Quinn, 1994a, 1994b; Spelke et al., 1992) and then how they acquire language that coordinates with this understanding. The views of cognitive universals are supposed to account for the seemingly easy acquisition of words in all languages. However, as cross-cultural data on acquisition has become more available, it has become apparent that languages are acquired in widely different forms. Perhaps it is the case that preverbal infants have more resources at hand to assist in learning language than previously thought (McDonough et al., 2003).

The next section discusses an embodiment view. When you look at space, images come in through the retina and the images are perceived and experienced. The experiences through the sensory systems such as perception and motor systems are imbedded in cognition of humans living within the culture. This issue is closely related to how infants and children comprehend spatial concepts and how they begin to express them using language during the period of early development.

Embodiment view

Ever since Kant (1781/1965), spatial relations were thought to be perceived in much the same way by all people regardless of language and culture. After all, humans share the same neurobiological subsystems (visual, auricular, kinesthetic) and several theorists have assumed that humans naturally categorize their spatial environments using the planes of the human body (e.g., front v. back, left v. right, up v. down). This argument was furthered by H. H. Clark (1973) in his thought provoking chapter on the embodiment of spatial relations which, combined with particular affordances of the world (e.g., gravity), we potentially use as a metaphor for how we come to understand and talk about time.

Embodied cognition is discussed by the interaction of bodily experiences and the external world. According to this view, our cognition is “meshed” (Glenberg, 1997) with our bodily experiences through our sensory systems. Embodiment has therefore attracted many researchers across the disciplines, such as philosophy, cognitive science, psychology, linguists, and neuroscience (Gibson, 1967, Glenberg, 1997, Johnson, 1987, Lakoff 1987, Lakoff & Johnson, 1980, Talmy, 1985, 1988).

Along with the proposal by E. V. Clark (to be discussed later), H. H. Clark (1973) laid a theoretical foundation for how we acquire concepts about space. In the sense that our concepts about space are constrained or guided by the bilateral symmetry of the human body, Clark’s position has been called a nativist one.

However, he was not a nativist in terms of spatial concepts themselves. Rather, he claimed that spatial knowledge is constructed from the perspectives of the human body. For example, a vertical plane dividing the left and right sides of the body allows us to configure one reference plane using a Cartesian coordinate system. From this plane we can construct concepts about verticality (up v. down), which are consistent with principles of gravity. A distinction between front and back is given from directly experiencing the world in front of us because it is perceptually salient given the location of our eyes. In contrast, back is less perceptually salient because what is behind us is not easily perceived by our sensory systems. Even though the location of our ears are to the sides of our head, ears are cupped forward for better capturing sound coming from the front of our bodies. Once a reference plane or planes are drawn in relation to our body, one then can draw perpendicular lines or planes from them giving another direction and location. Objects can be thought of in terms of their locations on these planes. The reference points along the planes can always be reconfigured relative to other planes or objects. Thus, the location of our perceptual systems on our bodies can potentially guide how we construe location in space.

Embodiment has been discussed in terms of our cognition. This notion is supported by the findings in cognitive neuroscience (Damasio, 2000). Glenberg (1997) also investigated the relation between our body and space. Information of objects, actions, and motions in three dimensional space is encoded and conceptualized through the structures of environment, our body, and our experiences that are embedded in memory. Therefore, our perception of space is highly dependent upon one's own body, which also guides the patterns of actions and the actions will become automatic. Varela, Thompson, and Rosch (1991) discussed embodied actions relative to cognition. They stated that our cognition is dependent on what we experience through our sensory systems. Furthermore, the capacities in sensory systems are embedded among the psychological, cultural and other biological factors. They suggested that our perception is guided by actions that were repeatedly experienced through our sensory systems.

Piaget (1953) studied how the development of sensory-motor functions and new experiences of infants contribute to form concepts in mind (e.g., concepts of permanent objects in space). He claimed that infants have sensorimotor systems which are part of the notion of embodiment. A strong theory of embodiment is opposed to the idea of Cartesian mind/body dualism. Piaget stated not only the importance of cognitive development, but also the social interaction. However, in his point of view, the infants' ability to perform cognitive tasks was not clearly separated from what infants know about the world (Spelke, 1990).

We can experience any kinds of movement using our bodily functions and motor or sensory system (touching, seeing) in space. At the same time, we also perceive actions and events in space happening around our body. Previous studies found that when objects are perceived in space, more salient or significant parts of objects are verified faster than the others (Biederman, 1987; Hoffman & Richards, 1984; Tversky & Hemenway, 1984). This is because there is an interaction between the body and in the way we perceive space (Tversky, 2003).

Tversky proposed a spatial framework theory based on some of the ideas by H. H. Clark (1973) by claiming that space is organized based on three dimensional axes of the upright body (head/feet, front/back, and left/right). Tversky and her colleagues examined whether the mental representation of space is constructed by the language we speak or the way we experience space through our body. The participants were asked to retrieve the objects they have seen from the different directions (3 axes through the upright body). They found that reaction time was fastest for the head/feet body axis, the front/back and left/right axes followed respectively. The head/feet axis is the most salient because both body and space are asymmetric and gravitationally salient. On the other hand, the space perceived by the front/back axis is also salient because it is asymmetric. The back of the body looks very different than the front. The left /right axis is symmetric and as such it is less salient (Bryant, Tversky, & Franklin, 1992; Franklin & Tversky, 1990, Tversky, 1996, 2003). They concluded that the differences in accessibilities between our body and space and gravity in the physical world influence how we perceive space.

By living in space, we not only just perceive objects and motion in space, but we also search the location of objects in different scales of space. For example, the scale of space is different when you are looking for a pair of scissors in a room and when you are visiting NYC and looking for the Empire State building in Manhattan. The latter involves navigation either using a map or asking someone for directions to get to the building. In the example of finding the Empire State building in Manhattan, knowing that north is uptown, south is downtown in the case of Manhattan, would make the navigation easier. Searching location in a large scale often requires consideration such as distance, and/or geographical characteristics so that we can gather all the information to reach the goal.

However, an opposing view was proposed by Sinha and de López (2000) based on the evidence in cross-linguistic/cultural studies on semantic development of spatial concepts. They argued that even though our body may play a role as spatial schema for conceptualizing and expressing spatial information, there are still differences in the patterns of spatial descriptions depending on the languages. The differences can rise in our perception of the world. Any assumptions we make about our environment are based on what is available to our sensory systems as well as our memory of prior experiences. Our prior experiences can be influenced by our culture and our language, particularly given that much of our world knowledge is constructed within the culture in which we are raised. What is being pointed out here is that culture can potentially influence our world view.

As previously discussed, our experiences are through our sensory systems synchronized in our body, therefore, our experiences of the world in everyday life must be the same or quite similar. According to H. H. Clark (1973), we receive different kinds of information: acoustic information through listening, articulatory information for comprehension for speaking, visual information for recognizing words for reading, motor information for writing words. The encoding process of the representation of the events may engage different information processing pathways. Our experiences are also constrained or guided by attentional factors.

What we attend to in perceptual events is based on the knowledge we have. According to previous research, forms of perception and memory of events can be influenced by the experiences in the past (Carmichael, Hogan, & Walter, 1932; Gibson, 1929; as cited in Carmichael et al., 1932; Johansson, 1973). For example, seeing a picture labeled with different object naming (e.g., table, hour-glass) influenced the re-drawing of that picture by the observer. The original straight-line was drawn as a curved-line in the reproduced 'hour glass' picture (Carmichael et al., 1932). As is seen in this evidence, figure assimilation (Gibson, 1929; as cited in Carmichael et al., 1932) occurs due to the way information was coded. The changes that occurred in the reproduced picture are not solely based on the picture seen earlier during the experiment. Rather, the picture is drawn using the memory of images of the labeled object in the past. Thus, the representation of objects is fragile and flexible and can be affected by our knowledge and previous experiences. One of Johansson's findings in human perception indicated that humans have abilities to make adjustments in the continuous changes in the representation of visual stimuli (Johansson, Hofsten, & Jansson, 1980). These results indicated that our cognition and sensory systems are sensitive to the stimuli given and are flexibly adjusted by its changes. The changes are made not only based on the stimuli changes but also the influences from the knowledge and experiences formed in the mind. That is, our pre-existing knowledge may also vary within and between culture and languages.

These findings will now be examined to see whether there are consistencies in the findings of developmental studies.

Early spatial concepts and spatial terms

To summarize, we still do not fully understand how infants construe the world before acquiring language. Supposing that infants do have concepts before they acquire language (a supposition we must make if symbols are to become imbued with meaning), then it is possible that they also have concepts of space before learning language (Chomsky, 1965, 1968; H. H. Clark, 1973).

The results of previous research that support a cognitive universalist view were conducted on European languages, with an emphasis on English along with a few studies in French and German (Ammon & Slobin, 1979; Bloom, 1981; E. V. Clark, 1973a, 1973b). For example, E. V. Clark (1973a, 1973b) examined the order in which children acquire spatial terms in English. She found that words for containment and support (e.g., in, on) are acquired before proximity relations (e.g., next to, beside, between). Later in development, words for projective relations (e.g., in front of , behind) are acquired. E. V. Clark proposed that this order of acquisition reflected the difficulties children have comprehending or conceptualizing spatial relation. That is, some relations are easier to conceptualize (e.g., a word 'in' for containment relations) than others (e.g., next to, behind). The earliest learned words supposedly reflect the easiest concepts, a point that will be returned to later. Along with this proposal was the (implicit) assumption that spatial relations are universal (see H. H. Clark, 1973 for arguments supporting this position).

Previous studies examined the understanding of spatial relations such as above and below with 3-month-old infants. The infants were first familiarized to scenes showing either a dot above or below a horizontal bar. After the familiarization trials, a dot was presented in the new place either above or below the bar. The results indicated that infants prefer to look at the unfamiliar relation suggesting that young preverbal infants can categorize spatial relations based on their analysis of the perceptual characteristics of 'above' and 'below' (Quinn, 1994a, b). However, Quinn (personal communication, April, 2003) also tested other relations such as 'next to' and 'between', and young infants were not successful in the task. Baillargeon and her colleagues (Baillargeon, Needham, & DeVos, 1992) have tested containment as well as support relations. For example, support relations were tested using a box placed on a long platform with 6.5 month-old infants. The box was placed on the left side of the edge of the platform and then was pushed to the other side of the edge. The results suggest that infants sense the box needs to have a certain contact area with the platform to be supported, otherwise the box will fall (Baillargeon et al., 1992). Yet, preferential looking to impossible events are difficult to interpret in terms of the extent to which an infant understands the relation tested.

The results with preverbal infants appear to support the previously discussed findings by E. V. Clark (1973a, 1973b), and suggest that young infants understand the spatial relations such as 'above' or 'below', but not the relations, 'next to' or 'between'. As E. V. Clark proposed, the spatial relation such as 'next to' or 'between' were difficult to understand for young children. This evidence supports the hypothesis that children can acquire concepts before they acquire language. However, whether or not children understand relations that are not lexicalized in the language they will be learning (or alternatively are lexicalized in other languages they could potentially learn) has not been extensively tested (but see McDonough et al., 2003).

McDonough et al. (2003) studied the comprehension of spatial relations in 9-, 11-, 14-month olds as well as adults using a nonlinguistic task, called a preferential looking task. The infants who participated in the study were living in either monolingual English- or Korean-speaking environments, and the adults were also monolingual speakers of English or Korean. Preverbal infants and adults were shown three spatial relations, tight- and loose-containment and loose-support. Contrasts between tight-containment and loose-support as well as between tight-and loose-containment were tested. English contrasts space based on containment versus support whereas Korean contrasts space based on loose ('nohta') versus tight-fit ('kkita') relations. The results indicated that preverbal infants living in both language environments distinguished all the spatial relations tested, whereas adults failed to recognize the spatial relations not lexicalized within their language. For example, English-speaking infants can distinguish the contrast relation such as tight-and loose-containment; however, English-speaking adults failed to distinguish the relations and Korean adults easily distinguished these relations. The results suggest that infants are flexible in the ways they can categorize spatial relations whereas language may have an impact on the ways we think about space.

Phonemes (i.e., the sounds that make up words) do not have meaning, and without having meanings, they are less useful for communication. For example, an initial part of language acquisition is acquiring the sounds of language. Infants will listen to the sounds they hear from everyday life, and they acquire patterns of the sounds in the language spoken in their environment (Werker, Gilbert, Humphrey, & Tees, 1981), but the speech sounds by themselves do not teach infants the meaning of symbols. Young infants are capable of acquiring any language because their brains are sensitive to wide ranges of sounds produced in languages (Werker & Lalonde, 1988; Werker & Tees, 1984). Werker and Tees (1984) found that 6- to 8-month-old infants living in English-speaking environment can distinguish phonemic contrasts produced in other languages. However, at about 10- to 12-months of age, infants only discriminate the phonemic contrasts produced in the language they are being raised with, and they no longer distinguish the contrasts uniquely made in other languages. Other studies suggest that the ability to distinguish phonemic contrasts in other languages declines by the end of the first year of life, and the ability will be very difficult to discern again. Phonemes experienced in the native language environment remain as discrimination patterns, but the meaning is not derived from phonemes alone. On the one hand, Levinson, Kita, Haun, and Rasch (2002) claimed that learning symbols such as words do not give the meaning of the words themselves nor provide the basis from whence the meaning comes. Then where does the meaning come from?

As previously discussed, the cognitive universal view and the embodied view posit that our sensory experiences must be the same (or similar) regardless of the language we speak or culture where we live in. However, it would appear that the origin of our concepts, meanings, and perceptions of the world are inseparable from language and culture factors. To approach this issue, the findings from cross-linguistic research will be discussed in the following chapter.

Chapter 4

Cross-linguistic investigation on the domain of space

Initially, most of the research on spatial language was conducted on European languages (Ammon & Slobin, 1979; Bloom, 1981; E. V. Clark, 1973a, 1973b), and more recently cross-linguistic studies on non-European languages became available. Many more studies on South American (e.g., Tzeltal spoken by Mayan Indians; P. Brown, 1998) and Asian languages such as Chinese, Korean, or Japanese (Au, 1983, 1984; Bowerman, 1996a, 1996b, Bowerman & Choi; 1994, 2001; Choi, 1997; Sinha, Thorseng, Hayashi, & Plunkett, 1994) have been conducted. Yet studies on non-European languages are still relatively uncommon compared to the number of studies on English and other European languages. We still do not know the full extent of how differently other languages perceive and talk about space. To examine the cross-linguistic/cultural differences in how we express space, the issue of how we perceive, encode, and represent objects and motion events in space will be discussed first.

Encoding and representing spatial information

How do we perceive space? When we see the objects or motion events in space, how do we talk about space using language? According to Marr (1982), central representation is interfaced with other levels of systems (e.g., visual, linguistic). Visual information through the retina and through images are eventually translated into spatial representation which interface with conceptual structure. One may explain the connection between conceptual structure and spatial representation by a dual coding system, which is conceptual structure that encodes propositional representation (Johnson-Laird, 1996; Mandler, 1996; Paivio, 1971; Tversky, 1996).

A well supported theory of spatial representation is Marr's 3-D model. When the object information through our eyes is encoded into a particular image of object shape, there already is an observer's point of view to the image. The difference between image and representation is that an image is limited to a certain view, and only provides the information that is viewed through our eyes. Marr's 2 ½ - D model indicates that the visual images that come in through our eyes is the information that we consciously attend and present in our vision (Marr, 1982).

How are the visual and linguistic systems connected? Marr-Biederman's theory for object shape claimed that an object shape is encoded as decomposed geometric parts in the spatial representation format. Based on those parts, the conceptual structure system can then generalize the shape as a whole. This indicates that perceptual details of the objects influence our perception. As seen in Carmichael and his colleagues' study (Carmichael et al., 1932), if an object's name was given first, a figure assimilation process (Gibson, 1929 cited by Carmichael et al., 1932) would occur when reproducing the object by drawing (a bean shape is drawn like the label attached to it, i.e., a canoe). In the process of figure assimilation, the parts of the object would be reconstructed differently in the representational format.

Regarding the relation of conceptual structure and language for objects and events in space, location and path of objects plays an important role. For example, the statement, “The New York Times is on the table” indicates the location of the object. In another statement, “The express train just passed the other train which was stopped at the local train stop”, you can also infer the other train must be a local train that was stopping at the local stop and that the express train passed the local train and moved ahead. The meaning of a word always includes conceptual structure and also may include a spatial representation. When you think about the concept of a dog, without describing a dog using language, you can simply think of features and categories of a dog (Jackendoff, 1994, 1996). Jackendoff also stated that the semantic level of representation is universal and language is independent from conceptual structure. Based on this view, spatial concepts and non-spatial concepts show parallel functions in semantics.

Objects and motion events in space: cross-linguistic evidence

Representations of object or motion events in the world seem to just be derived from perceptually obvious and direct information. However, since each individual lives in a particular culture and speaks a particular language in everyday life, our knowledge is constructed not only by our individual experiences but also through interactions with others. Users of different languages have grammatical structures formed in the language, so that they may encode and describe perceptual information differently.

Malt, Sloman, Gennari, Shi, and Wang (1999) examined the differences in object naming by native speakers of English, Spanish, and Chinese. They tested 60 contained objects to look at how different languages may distribute naming in similar ways (a comparison between the scope of lexical categories was compared). Their results indicated that there are no strong correlations between these three languages (see also Malt, Sloman, & Gennari, 2001, 2003).

The result from Malt and her colleagues contrasts with the traditional cognitive universal point of view. Does this mean that humans perceive things differently? Obviously, this study involves linguistic representations so the influence of language on thought is not straightforward. Malt et al. (1999, 2001) also conducted an object-sorting task to avoid the linguistic representations in the native English, Spanish, and Chinese speakers. The participants sorted the objects based on physical qualities, function or use, and the overall qualities of the containers. In this nonlinguistic sorting task, the results showed considerably higher correlations among the three linguistic groups than the naming task had shown. As the results indicated, the relation between English, Spanish, and Chinese on the nonlinguistic object-sorting task as well as the object-naming task are relatively low. Although the speakers of different languages may have shown some similarities in sorting objects, there are still differences among the languages on the nonlinguistic tasks. As the results indicated, there must be a linguistic influence in processing information of the representation of objects. Our view of the world is not only experienced through our sensory systems, but it also seems to be influenced by linguistic (perhaps also cultural/social) factors.

Other researchers have investigated the representation of motion in language and cognition. Papafragou and her colleagues investigated how English- and Greek-speaking children and adults represent motion events using nonlinguistic tasks, and how they express the motion events using linguistic tasks.

The two languages differ in that English is a manner language and Greek is a path language. For manner languages, manner of motion is carried by the verbs (e.g., jumping, skipping). For the path languages, the direction of motion is included in the verbs (e.g., a word 'ireru' meaning 'putting in' in English). They found that the representation of motion events was the same regardless of the languages. However, interestingly, they also found that there were no consistent responses between the nonlinguistic tasks, which measured memory and categorization of events, and the linguistic task which asked to describe the events within the language group. They concluded that concepts are separate from language-specific inputs (Papafragou, Massey, & Gleitman, 2002, 2006). The implication of this research finding is not consistent with the Whorfian view.

Other researchers have also compared manner and path languages, English versus Spanish, to examine the linguistic influences on describing motion events (Naigles, Eisenberg, Kako, Highter, & McGraw, 1998; Naigles & Terazas, 1998). Naigles and her colleagues studied whether adult speakers of English and Spanish interpret novel verbs in sentences differently. Each of the sentences depicted the manner and path of the motion. For each frame, a sentence which includes a novel verb was presented. The results indicated that there are significant differences in the way speakers of different languages interpret the novel motion verbs presented. The English speakers interpreted the novel verbs to encode the manner of motion whereas the Spanish speakers interpreted the novel verbs to encode the path of motion. They concluded that differences in the characteristics of languages (manner vs. path) influenced how we encode events and generalize novel verbs appearing in motion events.

In sum, there are no agreements in the findings in the previous studies. Some studies indicated no language influences in the way we perceive the objects and motion in space (e.g., Papafragou et al., 2002), but some other research showed that linguistic characteristics create the discrepancies between how we perceive space and talk about space (e.g., Carmichael et al., 1932; Malt et al., 1999, 2001). To fill the gap, the following sections will discuss the possible cross-linguistic differences in the accessibilities and preferences to take one perspective over the others when we talk about space. It first examines the objects features and dimensions, and axis of objects. Afterwards, it discusses how we use axes and frames of references to describe not only an object in space but relations of objects relative to the viewer of the objects.

The absolute frame of reference can be described in terms such as North, South, East, or West, and is often used by English speakers when talking about a large scale of space. The deictic frame of reference can be described as right or left which is a changeable perspective, depending on the viewer's point of view. Intrinsic frame is an object-centered view and used to describe the spatial relation of an object relative to another such as in front of or in back of (Jackendoff, 1994, 1996; Johnson-Laird, 1976; Levelt, 1996, 1999; Levinson, 1994, 1996a, 1996b; Pederson, et al, 1998).

Cross-linguistic studies show that some languages tend to use one frame of reference whereas others will use a different one. In English, we use all three but which one we choose at a given time largely depends on the contexts (e.g., indoor vs. outdoor, Li & Gleitman, 2002). For example, the intrinsic frame is used among Mopan (Mayan) and Kilvila (Austronesian), a relative frame is used in Japanese and Dutch languages, and an absolute frame is taken in Tzeltal (Mayan) and Longgu (Austronesian) languages. Mixed spatial perspectives, such as a combination of relative and absolute frames, are seen in Yucatec (Mayan) and Tamil (Dravidian) languages (Pederson et al., 1998).

Another frame of reference is found in Tzeltal, which uses the terms of body parts of humans and animals such as face, back, nose, or stomach depending on an analysis of the shapes of objects. This is used in similar ways in English. For example, English speakers describe the parts of objects as 'the legs on a table'. In the Tzeltal language, they use the term 'nose' to describe the sharp protrusion of the part of object, and the term, 'mouth' is used to describe the edge/ orifice of part of the object. Tzeltal seems to be completely object centered and disregards a viewer's point or the orientation of objects (P. Brown, 1998; Levinson, 1996a, 1996b; Pederson et al.,1998).

Do these cross-linguistic results provide for the evidence that the way in which we talk about space influences how we think about space? Some evidence for the influence of language on thought in the domain of space has recently surfaced. Pederson et al. (1998) examined the spatial cognition in different speakers of languages who use either intrinsic or absolute frames of reference. To test spatial cognition, linguistic and nonlinguistic tasks were administrated. For example, in the man-and–tree task, the location of a tree is shown either on the right or left side of the picture with the man shown standing next to the tree. In subsequent pictures, the man's position relative to the position of the tree is changed. For example, in one picture, the man standing next to the tree was rotated 180 degrees. So, if the man was previously facing towards the participants, after the rotation he would be facing away from the participants.

Participants were tested in pairs so that one took the role of a director who described each scene in the 12 pictures (combinations of the tree and man in different position/relations) and the other (who could not see which particular picture was being described) took the role of a matcher who searched and selected the picture that was verbally described by the director. Note that an absolute frame of reference (e.g., South, West) is independent from an observer's point of view and the rotation of the man. An intrinsic frame of reference (e.g., the front of an object, the back of an object) is also independent from the viewer's point of view; however, the rotation of the man will influence the man's spatial perspective relative to the tree. The tree is in front of the man (when he is facing it), but after the man rotates 180 degrees, the tree will be to the back of the man. However, for speakers who use the relative frame of reference (e.g., right, left), their viewpoint is dependent on the changes of their own position. As observers' angles change, encoding the spatial location of the objects in the pictures will be changed relative to their own viewpoint.

The results from the Pederson et al. study indicated that the description of the pictures was consistent with the linguistic frame used in the language for organizing space. Using evidence similar to the study with adults above, researchers such as Levinson (1996a, 1996b) as well as Pederson and his colleagues (1998) claimed that these kinds of examples constitute strong evidence for the influence of language in the organization of space.

In other studies, Levinson and his colleagues (Levinson, 1996a, 1996b; Pederson et al., 1998) examined the hypothesis that language is a tool for problem-solving by comparing the results of participants' recall of the arrays of objects after the participants rotated their bodies 180 degrees. As discussed before, if the speakers of one language describe relations using a relative frame, the re-arranged objects should be placed in the order memorized relative to the viewer, such as right or left. Levinson and his colleagues interpreted the results of this problem-solving task by concluding that the languages used by the participants predicted the same type of frame of reference in their responses. Based on these findings, Levinson (1996a, 1996b) concluded that spatial cognition differs depending on the types of frame of reference used in languages. Furthermore, they argued that a particular frame of reference used in language is deeply rooted in our thought, so that a nonlinguistic task can show the same results as a linguistic task. The study also suggested that frames of reference preferred by languages would apply to other processes such as inference, recognition, or gesture.

McDonough et al. (2003) studied the infants and adults to test the comprehension of spatial relations in English and Korean (for the details see Chapter 3). They suggested that it is not clear that the nonverbal task (preferential looking task) used in their study was purely nonlinguistic for adults. Even though the experiment was conducted without using language, it is still not clear how the differences in the results are reflected in differences between the languages. One way to explain this is that the way the adults construe spatial relations in the world is different. After adults participated in the preferential looking task (see the details of the task in Chapter 3), McDonough et al. gave them an oddity task in which four relations previously presented in the looking task were demonstrated again by an experimenter. One of the four demonstrations was a different relation than the other three. The participants were to select the odd demonstration and then explain why it was different from the others. The overall results (but not an examination of individual participants' performance) were consistent with the looking task. English speakers could make correct selections when the contrast was between tight-containment and loose-support (a distinction between "in" and "on") but not as easily when the contrast was between tight-containment and loose-containment (only 22% correctly described the relational differences). For this task, the Korean adults were successful (all but one participant showed categorization in the looking task and 80 % of the participants correctly described the distinction). Yet, when the data were examined within individual participants, there was no clear predictive indication that success on the looking task led to success on the oddity task or vice versa. That is, it was not clear whether participants were conscious of engaging in linguistic strategies or engaging in categorizing during the looking task. They were instructed to look at the scenes, nothing more. A task interfering with linguistic coding strategies, as was the procedure in other studies (Hermer-Vazquez, Spelke, & Katsnelson, 1999; Hermer-Vazquez, Moffet, & Munkholm, 2001), was not used.

It should be noted that the results of the problem-solving task by Levinson and his colleagues are controversial due to the methodology and the interpretations of research. One controversy is that the series of spatial cognitive tasks conducted by Pederson et al. (1998) and Levinson (1996a, 1996b) may not be purely nonlinguistic tasks. The methodological issue of nonlinguistic vs. linguistic task was also raised when the influence of language (e.g., number of color terms) was examined on color perception. Just because a task is 'nonlinguistic' in terms of the dependent measure, it does not necessarily mean that participants do not engage in linguistic strategies for solving the task. Participants in the Levinson et al. task could have encoded the array using language by mentally talking to themselves during encoding and then used their linguistic encoding to guide their reconstruction of the array during the test. One way to disengage or prevent linguistic strategies is to have participants engage in a task that would interfere with linguistic coding. For example, in research on space and number by Spelke and Tsivkin (2001), participants were required either to count backwards by 3's or to "shadow" another speaker by repeating verbatim everything the speaker said. Thus, language was employed to mask linguistic coding of the task at hand.

A masking technique was not used in the problem-solving tasks by Levinson and his colleagues, therefore a softer conclusion about the relation between language and thought is warranted. It should not be surprising that participants may "talk to themselves" during nonlinguistic tasks thus it should also not be too surprising that their performance will reflect the language they use. In sum, the spatial tasks used cannot be considered purely nonlinguistic. Levinson et al. (2002) claimed that the frames of reference used in the recalled objects' array were the same as the viewer's language would be if used to describe spatial orientation, and the results are consistent with their linguistic task. Therefore, language *can* be an aid for the problem-solving (if one agrees that their task requires problem-solving), but it remains difficult for the results to be interpreted in terms of nonlinguistic frames of reference.

Levinson and his colleagues believed that mental representation driven by language should also be found in other domains. However, if we carefully look at their data analysis for estimating the uses of absolute frames of references in Dutch and Tenejapan languages, only 60% of the Tenejapan participants consistently used absolute frames of reference in their languages. They also conducted other problem-solving tasks; however, the Tenejapan participants consistently used the absolute frame of reference less than 50 % of the time in both tasks. Obviously, there is high variability in the data, and this variability is not considered in their interpretations of the results.

Li and Gleitman (2002) pointed out that there are also some confounds in the research by Levinson and his colleagues. Li and Gleitman used the same tasks with native English speakers. The experimental settings used in the Levinson et al. studies were in an environment that was natural and practical for the participants living in their respective cultures (the Dutch speakers were tested in a lab setting whereas speakers of Mayan languages were tested outside). Speakers of English, which is considered primarily a relative frame language, participated in Li and Gleitman's study. Their results indicated that 18% of the responses used an intrinsic frame, and the rest of the responses (82 %) used a relative frame, consistent with predictions. The study was then conducted in various conditions. In two conditions, participants were tested inside a laboratory that had a large window. Some were tested with the window covered (i.e., blinds-down condition), whereas others were tested with a clear view from the window to the outside (i.e., blinds-up condition). The remaining participants were tested outside (i.e., outside condition). Li and Gleitman (2002) proposed that rich environmental cues may affect the performance in the task.

The results of English speakers inside the lab in the blinds-down condition replicated Levinson's finding with Dutch speakers who were also tested in the inside lab setting; however, English speakers tested in the other two conditions performed differently. It is possible that participants in the lab setting were more focused on the frame of reference most commonly used in their language, whereas participants tested in the other two conditions were more sensitive to the available environmental cues. We process the information internally, at the same time, there are continuous interactions with our external information source, environments. The outside views surrounding them may have led the participants to rearrange the objects outside of the frame typically used in their language. In sum, the methodology used in the Levinson et al. research should be reconsidered, and the problem-solving task should be reconducted after resolving the problems of varying environmental factors. Since their studies tested a wide range of languages and cultures, experimental designs should be valid across different environments. As seen in this finding as well as the studies on color perception (see Chapter 2), it is crucial to use reliable methods to conduct nonlinguistic tasks (Brown & Lenneberg, 1954; Gordon et al., 1994; Li & Gleitman, 2002).

From a developmental perspective, a relative frame of reference is perhaps 'easier' for children to learn without linguistic input, because the relative frame is the viewer's perspective, and as such is egocentric. On the other hand, absolute or intrinsic frames require one to look at the spatial relation of an object relative to another, while considering a perspective independent of one's own view. As such, these frames may require a more developed cognitive system and perhaps require language as well. This proposal is based on Piagetian theory that young children are egocentric and are unable to take the perspective of others. Although some research (e.g., Tomasello, 2003) suggests that children's abilities to engage in perspective taking is more advanced than proposed by Piaget, we still do not know for certain if one frame of reference is really more difficult than another. To the extent that language acquisition reflects cognition, it is possible that the different frames of reference are equally easily learned (Levinson et al., 2002). However, the requisite research examining how children extend spatial terms in production as well as comprehension has not been conducted.

In sum, this chapter reviewed the research on how we encode, perceive and represent spatial information. The systems involved in processing and translating spatial information into linguistic format were discussed. The differences between nonlinguistic and linguistic formats of space when perceiving space using axes or frames of reference were also presented. Based on the cross-linguistic evidence, although there is some controversial methodology and interpretations of the findings, there are clear differences as to how spatial relations are described between languages. The results indicated that not only the language, but also culture and environmental factors seem to influence lexical decisions in terms of choosing a particular perspective (i.e., frame of reference).

Chapter 5

An introduction to Japanese language

In order to provide the reader with an understanding of Japanese, this section will begin with a discussion of other languages and then will later show the similarities and differences between them and Japanese. The importance of cross-linguistic research that extends beyond European languages is that it clearly shows that there are several ways languages can parse what was presumed to be universal ways of viewing the world. One of the best examples comes from the lexicalization of spatial relations, data which have since challenged Clark's earlier proposal. The results of other research suggested that conceptual structure (features and functions of objects/substances) in our cognitive system is universal; however, semantic patterns will differ depending upon languages (Jackendoff, 1994, 1996). Recent cross-linguistic studies revealed that depending on which language we use to describe object relations in space, there are tendencies to use particular frame(s) of reference over the others. Another cross-linguistic difference was found in the way we encode motion events between manner (e.g., English, Chinese) and path languages (e.g., Greek, Japanese, Korean). In the next section, I begin to discuss the cross-linguistic differences in categorizing dynamic spatial relations between manner and path languages.

Spatial categories of manner and path languages

In the previous chapters, various views were presented on the relation of spatial concepts and language. However, recent cross-linguistic research suggests that views such as the embodiment view or the cognitive universal view do not adequately explain the differences that appear in describing space using frames of reference among the languages. In addition, not many developmental investigations have been made across languages. In this section, reviews of the findings of specific languages such as English, Dutch, Korean, and Tzeltal (e.g., P. Brown, 1998; Bowerman, 1996a; Bowerman & Choi, 1994; Bowerman et al., 1995) will be presented. Then developmental cross-linguistic comparisons of spatial categories in English and Korean will be addressed.

Choi and Bowerman (Bowerman, 1996a; Choi & Bowerman, 1991) showed that different languages make different distinctions in spatial categorization. They compared English, Dutch, and Korean by asking native speakers to describe the spatial relation between two or more objects. They found that depending on the language, space is described in different ways. For example, for Korean speakers, spatial relations are marked by degree of fit, a quality that is usually irrelevant in talking about spatial relations in English. English contrasts containment and support, a relation that is ignored in Korean when one is talking about objects that fit together tightly. In Tzeltal, one must consider the axial structure of an object such as the ratio of height to width in discussing the spatial relation and orientation of a container (Brown & Levinson, 1993). Note how dramatically this latter linguistic pattern contrasts from the ones mentioned earlier where the shape of the objects guide but are not closely coupled to the relation in question.

Researchers have also investigated how children and adults categorize spatial relations within and across different languages, and how children understand spatial relations such as support (on) v. tight support relationships, or loose containment (in) v. tight containment relationships (Bowerman 1996a, 1996b; Bowerman & Choi, 2001; Choi & Bowerman, 1991; McDonough et al., 2003). Choi et al. (1999) investigated the comprehension of two spatial terms used in English and Korean languages in young children who are acquiring the language. They used one term in each language, 'in' (containment) for English leaning children and 'kkita' (tight fitting) in Korean learning children, to look at whether the children would show an understanding of the term in various events. Korean-speaking children used verbs to describe spatial relations. They found that by 2.5 years of age, children were extending the spatial terms they knew in language-specific ways (Choi & Bowerman, 1991) and by about 22 months of age, children showed comprehension for spatial terms in language-specific ways (Choi et al., 1999).

Other cross-linguistic research reported that the comprehension of spatial relations by infants is influenced by the linguistic input. For example, a child's utterance appears at barely more than one and a half years old and is reflected by a language-specific spatial organization (Bowerman, 1996a). There also exists cross-linguistic differences in the way space is classified into categories. The results suggest that children categorize space in terms of the language that they are learning (rather than using some universal construal of space), and may have a different understanding of spatial relations depending on the language that they are learning.

Developmental research with children who are just beginning to talk has shown that children extend spatial words they have learned according to the language they are learning. Bowerman (1996a, 1996b) made a strong argument favoring the language specificity of spatial learning. That is, she proposed that children learn about spatial relations directly through linguistic input. On hearing the same word used across several situations, children abstract the common relation depicted in each situation, and then learn how spatial relations are to be categorized. Because their earliest productions are closely linked to the language they are learning, their extensions of spatial terms look more like the extensions adult speakers of the language would make than those made by the same-aged children learning other languages.

As mentioned in the previous chapter, previous research found that some relations are understood by preverbal infants (i.e., tight-fitting containment, loose-fitting containment relation, and loose-fitting support) (McDonough, et al., 2003). Research with very young preverbal infants (younger than 9 months of age) has also shown that they are sensitive to spatial distinctions in very narrow contexts (Baillargeon, 1994, 1995; Spelke et al, 1992, Spelke, Katz, Purcell, Ehrlich, & Breinlinger, 1994; Quinn, 1994a, b), whereas slightly older, preverbal infants categorize these relations across widely varying objects (McDonough et al, 2003). Clearly only a few of the many possible relations lexicalized in different ways in different languages have been tested with preverbal infants. How many relations are conceptualized prior to language acquisition is still largely unknown. It remains possible that some relations may be learned via linguistic assistance, but we will not fully understand the contribution language makes until we make more progress unveiling the mind of the preverbal infants.

It should be noted that until we understand the extent of differences across languages in how spatial relations are lexicalized, it will be difficult to know of the range of possibilities under which young infants categorize such relations. Although it would be desirable to begin with tests of preverbal infants, it would be more informative initially to know what the range of possibilities are in considering the kinds of categories they may have prior to learning language. A careful examination of the paths of actions, the manners of actions, the shapes/forms of objects, their orientation and contextual influences of how spatial relations are lexicalized among highly contrasting languages should provide a clearer insight as to how one might test preverbal categories. One place to start this investigation would be comparing manner and path languages (English vs. Korean vs. Japanese) to examine whether there would be differences in the way speakers of different languages talk about motion events.

As discussed above, some evidence in the previous cross-linguistic studies show that depending on which language we speak there are different ways to categorize space. There are several varied ways in which languages describe and categorize spatial relations. However, as reviewed in the previous chapter, differences of manner and path languages are crucial when comparing the descriptions of motion events in cross-linguistic research. For example, English is a manner language (i.e., the verb conflates manner with motion and expresses path separately, a. k. a. satellite framed language) whereas Japanese is a path language (i.e., the verb conflates path with motion and expresses manner separately, a. k. a. verb-framed language). English describes the event as ‘the cat runs across the street’ while a path language such as Japanese says, ‘neko ha hashitte toori o watatta’ which means ‘the cat across the street by running (while running)’. This difference is crucial. Previous research by Choi and Bowerman compared the prepositions (e.g., in, on) in English to verbs in Korean (also a path language) in their description of spatial relations. A comparison of prepositions/adverbs that convey static information with verbs that convey both path and manner information is not a semantically equivalent comparison. Even though the spatial events are the same, descriptions of the events and the meaning carried in the descriptions are likely to differ depending on the language.

The cross-linguistic examinations also revealed that there is variability in describing space among the speakers within the same language. More than one spatial term used to describe a particular relation was evident in Choi and Bowerman’s study. This finding indicates the variability in agreement of spatial terms among the adult speakers of English and Korean. This has also been seen in previous studies on color perception and color terms. Previous research found that the boundaries of lexical color categories are not clear cut and flexible. Color is also perceived through our visual system as space is. For example, the light of a wavelength that appears yellow is the mixture of two other wavelengths, which appear red and green, and the color, yellow is specified by the relative intensities of the “red” and “green” in the mixture. However, as we know from the previous studies, once a particular color is expressed using one language (e.g., blue), there can be discrepancies in naming the same color in other languages (e.g., Russian does not have a word for ‘blue’). This is not because humans have different visual systems, but because of the influences of language differences. Although there is a difference in lexical color categories, the best exemplar of color for hue terms are equivalent and seem to be free from language (Berlin & Kay, 1969; Gordon et al., 1994; Heider, 1972; Kay & McDaniel, 1978).

As discussed earlier, one explanation could be due to the flexible characteristics of language and space. It seems that because of the flexibility, there are many factors involved in representation of space and lexicalization of spatial information. Such factors are shapes, dimensions, features, and orientation of objects, how we draw the axes for objects, orientation of a viewer, axes of body or frames of reference to perceive and lexicalize space. For the motion events, other factors such as directions, distance, or speed of motion are involved. In addition to this, environmental factors such as lighting, shade, and other factors such as our familiarities (prior knowledge and/or experiences) of objects or motion events are involved in representing spatial information. Our prior knowledge or experiences as well as our lexical decisions from the available words to describe object relations and motion events in space is unique in each individual. These factors can partially explain the variability and unclear boundaries between one spatial relation and another.

The next section will discuss the studies on another Asian language, Japanese. Japanese is also a path language and comparing the Japanese language with English and Korean as well as investigating the acquisition of the Japanese language is one of the main focuses of current experiments.

Exploration of the Japanese language

As seen in Korean (Bowerman, 1996a; Choi & Bowerman, 1991) as well as in the current study with Japanese adults, these languages use a number of verbs to describe motion events. Another question addressed by the current research, concerns how Japanese language is structured and at what age children learn these various terms. Before discussing the Japanese spatial language, the characteristics of the Japanese language are discussed to understand the possible factors which may influence its acquisition.

An examination of the Japanese writing systems show that there are three types rather than one type of Japanese writing systems. One is known as ‘Hiragana’ which is the Japanese cursive syllabary. Japanese also uses ‘Katakana’ which is a different writing form of ‘Hiragana’ for describing the words imported from Western languages. The last is called ‘Kanji’, which consists of Chinese characters; each character has a number of meanings and has two or more different pronunciations in Japanese.

Japanese uses all of these for writing and which one is used is highly dependent on the context. To complicate matters somewhat, in the Japanese language, there are many homonyms. All words can be written in Hiragana, however, when words are written in one form they may take on a different meaning when written in Kanji. For example, for one of the verbs produced in the present study, ‘haku’, which was produced in the items, ‘sock on’ and ‘shoe on', the reader or listener needs to make a judgment of what the word, 'haku' means depending on the context the word is used in. If the word, 'haku' appeared on a computer screen by itself in the 'hiragana' form, the meaning of the word, 'haku' could be the following verbs; put on, wear, sweep, spit, vomit, or as a noun, meaning of overnight stay in Japanese. Another example is the word, 'haru', which was produced in the item, 'bandaid on hand', has a meaning as a noun of Spring (the season), and in terms of verbs it means to stick, put, set up, stretch, freeze, or cover. Many verbs are described with the combined 'kanji' (Chinese characters) and 'hiragana' for a final (ending) (e.g., ha'ku', ha'ru') in Japanese. A reader will decide the meaning of the words depending on the meaning of Chinese characters and the context in the sentence. In the oral form, a listener will hear the prosodic differences (intonations) in the word pronounced. Then, the listener must infer from the context which meaning is currently being referred to (Sinha et al., 1994).

Another characteristic is the context sensitivity of language. Previous studies found context sensitivity in Chinese and Japanese (Aaronson & Ferres, 1986; Kameyama, 1987). An example would be to say something in English by omitting reference to the subject. This would be an ambiguous sentence in English, but not in Japanese (i.e., a subject is not required in a sentence for it to be grammatically correct in Japanese, although this is only true of conversation). There are no articles and plural forms in Chinese or Japanese languages (Jia, 2003). The Japanese listener is capable of inferring the topic or point of view in a sentence. Japanese uses classifiers (e.g., 'hon' for usually long thin objects such as pencils, ‘satsu’ is particularly for books, ‘ko’ for general objects such as cups, eggs) when indicating the number of different types of objects. Because some classifiers are more specifically used for particular objects, if one says, 3 satsu, a listener will immediately understand what objects the speakers meant (i.e., books because the quantifier ‘satsu’ is specific to books).

Studies on Japanese language

The Japanese language has been studied on the topics of early word learning and object naming (Imai & Gentner, 1997), noun learning (Yoshida & Smith, 2001) and the influence of language in the development of ontological knowledge (Imai & Mazuka, 2003). However, there are only a few studies which have systematically investigated how spatial terms are lexicalized.

Another study by Bowerman and Choi (2001) introduced some examples of how static spatial relations can be described in Japanese. When describing the state of the object, one may say, ‘oite (putting on) aru (being)’ or ‘haitte (putting in) iru (being)’. In addition, static spatial relations can be described using locative nouns (e.g., ue (on top of), shita (below), migi (right), hidari (left), mae (in front of), ushiro (behind of), yoko (next to), naka (inside), soto (outside)). However, unlike English prepositions, these locative nouns are only used when specific locations of objects need to be specified in static relations. In a sentence, these locative nouns are used with locative particles (e.g., wa, ga, mo, o, ni). For example, if someone is asked “Where is the mail?”, the answer might be, ‘tukue (desk) no (particle) ue (on top of)’. Munnich, Landau, and Dosher (2001) showed that Japanese encodes contact relations involving support regardless of the supported object's position to the reference object (e.g., top or sides). This differs from English which focuses on the support of a reference object (e.g., an apple on the table) which in turn differs from Korean in that support terms are used less often and are not obligatory. But if objects are in the process of actively being situated to other objects such as 'putting a cup on a table' or 'putting an apple in a bowl', one may describe these using the words 'oku' ('putting on') or 'ireru' ('putting in').

Some time ago, Clancy (1985) reported that there is some evidence that locatives are acquired in a stable sequence indicating initial acquisition of terms indicating containment/support, at, to/toward, the place at which action is performed, up to, and from. Slightly later, the terms for top, middle, inside, bottom, side and place are learned. Clancy reports that this sequence is similar to Turkish locatives but also reports that more systematic data are clearly needed before conclusions can be made.

Investigating the acquisition of spatial terms is theoretically crucial to understand the relation between thought and language. However, for the Japanese language, very little developmental research has been conducted. Only one empirical study has been found in the literature. Sinha et al. (1994) studied the acquisition of spatial terms in Danish (N = 2), English (N = 2), and Japanese (N = 1). Comparisons of the data of Danish- and English-speaking children showed the overlapping of acquisition of spatial meanings which Sinha and his colleagues called 'basic' locative terms. The results indicated that the Danish children showed earlier acquisition of locative particles than the English-speaking children. The numbers of locative verbs produced by the Japanese-speaking child is the same number as the Danish children's locative particle production. The results examined locative particles (6 in Japanese compared to around 66 in English), partonymic-locative nouns that denote parts and regions of landmarks that can co-occur with locative particles (Yamada, 1990), and verbs which are important in the expression of spatial relations in Japanese. Locative particles are often omitted in colloquial speech and especially in child-directed speech thus making particles a late acquisition in Japanese.

The spatial verbs are of particular interest because Japanese, like Korean, is a S-O-V (Subject-Object-Verb) ordered language, making verbs highly salient and learned early in development. The Japanese-speaking child produces fewer locative particles than verbs because locative particles need to be used with locative nouns to have meanings of spatial relations. It probably takes a long time for the Japanese-learning child to learn locative particles and locative nouns, and the meanings in the verb forms may be used for acquiring the combination of the locative particle and noun forms.

Differences in acquisition of the different parts of speech may be due to the frequency of input as well as linguistic characteristics for describing spatial relations. Sinha and colleagues reported that children learning either Danish, English or Japanese underextend or conservatively use spatial terms, a pattern quite different from that found by Choi and Bowerman in their analysis of English and Korean. They concluded that the structures of language may be influencing the acquisition of the meaning of spatial relations. Yet, Sinha et al. analyzed spontaneous productions whereas Choi and Bowerman analyzed elicited productions. Differences in the findings between the two studies are most likely due to the method of the data collected (Sinha et al.: spontaneous speech vs. Choi and Bowerman: elicited production task), and the size of the population reported in Choi and Bowerman (Bowerman, 1996a: 10 children for each language group, English, Korean and Dutch). In addition, the Danish and English children were raised by parents who are native speakers of the language whereas the one Japanese child was living in a bilingual environment of Danish and Japanese, although the child's dominant language was reported to be Japanese. It is crucial to test monolingual Japanese-speaking children living in a Japanese-only language environment. Clearly a more systematic approach is needed to investigate further the acquisition of spatial terms in Japanese.

As found in previous research by Sinha et al. (1994) it is reasonable for Japanese children to develop locative verbs first and next locative nouns, and locative particles last. This is because children are able to communicate without locative particles but locative verbs are at least necessary for children to express what they want in their daily lives. This may influence the sequence of acquisition of spatial terms in the Japanese language, and might also cause the formation of different spatial categories or language development.

What little research is available has not systematically examined the production of spatial terms. Japanese is often considered as quite similar to Korean in that both are 'path' languages. Previous research compared manner and path languages, however, we do not know whether or not speakers of all ‘path’ languages describe the spatial relations in the same or similar manner. By investigating Japanese spatial language among children and adults, it would allow us to compare them not only to English but also to Korean. Since Japanese uses verbs as spatial terms as the Korean language does, it is expected that more spatial terms will be used in Japanese than English. Choi and Bowerman compared the spatial categories of English and Korean and suggested that these differences in categorization of space should also be found in other languages (Bowerman, 1996a). But verbs in path languages contain dynamic information (e.g., path of action and manner of action (sometimes not included in verbs)) whereas prepositions/adverbs in English provide static information only. Prepositions/adverbs only provide a narrow picture of spatial categorization. It is suggested that coding both verbs and prepositions in English may provide more path and manner information, thus making the English data more comparable to path languages such as Korean or Japanese.

In sum, cross-linguistic comparisons of spatial categorization in English, Korean, and Japanese languages will be examined in the following chapters. The same technique used by Choi and Bowerman will be used to examine whether Japanese-learning children and Japanese-speaking adults use the same or highly similar words to describe their categorization of space, and whether children make overextension errors in terms of their semantic development (Bowerman, 1996a; Bowerman & Choi, 2001; Bowerman et al., 1995; Choi & Bowerman, 1991). The current study focuses on investigating the developmental changes in the production of spatial terms by 2- to 5-year-old Japanese-learning children, and how spatial language produced among the children may differ from those of Japanese-speaking adults. As mentioned earlier, the issues of variability of space and language as well as semantically comparable cross-linguistic comparison of spatial language will be examined and discussed in the following experiments.

Chapter 6

Overview of experiments

Different languages make different and sometimes unique distinctions in the way space is lexicalized. For example, Choi and Bowerman (Bowerman, 1996a) compared the spatial terms used by native English-, Dutch-, and Korean-speaking children and adults. They used an elicited-production technique in which they partially modeled a relation (e.g., holding a ring above a pole as if to place it on the pole) and asked the participant to describe the anticipated relation. The experimenter said, "See the ring and pole? What should I do? / What am I going to do?" In English, the normative response is "place/put the ring on the pole". In English, we would also use the term 'on' to say that a cup is on a table or a handle is on a door. Thus, even though these three relations differ in terms of shapes and orientations of objects as well as with the kinds of attachments, they are all described using the same preposition, 'on'. However, in Dutch, the relations cup on the table and handle on the door are denoted distinctively as 'aan' (relations that are hanging or other projecting attachments) and 'op' (relations that are resting on a horizontal surface). In Korean, ring tightly on pole is 'kkita' whereas cup on table is 'nohta.' These Korean spatial terms denote degree of fit, a quality that is not relevant when describing spatial relations in English or Dutch. English contrasts containment and support, a relation that is ignored in Korean when one is talking about objects that fit together tightly. In Japanese, a language that has not been systematically studied for how spatial relations are lexicalized, the pattern tends to depend more on the objects/items and contexts in which they are used.

Table 6.01 Examples of how English, Dutch, Korean, and Japanese languages lexicalized space differently.

Language	Ring tightly on pole	Cup on table	Handle on cup
English	on	on	on
Dutch	op	op	aan
Korean	kkita	nohta	pwuchabta
Japanese	hameru	oku	tsuiteiru

There are several goals in this series of experiments. The first goal is to address the issue of modeling, that is, whether using different modeling in eliciting spatial terms would influence which spatial terms are produced. In the previous study by Choi and Bowerman (1996a), they elicited spatial terms in English and Korean using the partial modeling of spatial relations (the modeling of spatial relations were demonstrated only half way through, and the participants were required to make an inference based on the information presented). To examine this further, Experiment 1 (Chapter 7) replicated Choi and Bowerman's study using the same incomplete modeling (Inference Group), and then compared the results to another condition using completed modeling (the modeling of spatial relations were fully demonstrated; Description Group). The procedure used by Choi and Bowerman as well as in the Inference Group in Experiment 1 requires the speakers to describe not only the static spatial relation itself (captured in English by prepositions/adverbs) but also the path to be followed when one object is placed in relation to another (captured in Korean and Japanese by verbs). By modeling the path of the activity, no inference is needed (see the Description Group in Experiment 1) thus responses should be more consistent among participants.

The second purpose of this research is to address the issue of differences between path and manner languages (see Experiment 2; Chapter 8). Like the Korean data collected by Choi and Bowerman (Bowerman, 1996a), the Japanese data primarily consists of verb information. Languages differ in the amount of information encoded into the verb forms. As previously pointed out, Japanese and Korean are considered path languages whereas English is considered a manner language. For example, in English one can say that the dog swam across the river whereas in Japanese it is more appropriate to say that the dog crossed the river swimming. Given that verbs can capture path (to go across the river) and manner information (to swim) and are often used in descriptions of spatial relations, modeling relations completely, rather than partially should provide a more accurate account or description of a spatial relation described using a verb. Experiment 2 compared the spatial terms of a manner language, English, to a path language, Japanese. It should also be pointed out that even though Korean is technically a path language, terms such as ‘kkita’ (meaning “tight fit”) appear to provide some information about the manner of the activity as well. However, this interpretation may be a translatory gloss, one that has been debated among linguists (Choi, personal communication, November 2003). Manner information appears to be also evident in Japanese verbs.

Because spatial information is carried by prepositions/adverbs in English and by verbs in path languages, the next chapter, Chapter 9 investigates how using different coding systems (coding prepositions/adverbs only, verbs only, and verbs plus prepositions/adverbs) may influence how we view linguistic spatial categories.

Another issue that is raised is the consistency in the modelings of spatial relations. One may claim that variability in responses are at least partially due to any inadvertent variability in the modeling of the spatial relations by the experimenter, and should become more consistent among participants provided that the experimenter is consistent in modeling the relations (see Experiment 3; Chapter 10). As a control for experimenter variability, previously recorded modelings of the relations were videotaped and burned onto DVDs to be used as experimental stimuli.

As seen in Choi and Bowerman's study (1996a), they made not only a cross-linguistic comparison but also a developmental comparison within as well as across languages. To make developmental as well as cross-linguistic comparisons of Japanese spatial terms with English and Korean, Experiment 4 (Chapter 11) first examined the developmental changes of spatial language acquisition during young childhood, from 2- to 5-years of age, and analyzed the various types of errors made by the children. The spatial terms produced by the Japanese-speaking 2-year-olds and adults were also compared to the English- and

Korean-speaking 2-year-olds and adults' data in Choi and Bowerman's study (see Chapter 12). This experiment investigated the acquisition of spatial terms by comparing 2-year-olds and adult speakers of Japanese to see whether the results observed in Choi and Bowerman's study will also be seen in a comparison between Japanese and English. In addition to the comparisons, the two path languages, Korean and Japanese were compared.

Chapter 7

Experiment 1: Replication and extension of Choi and Bowerman

The goals of Experiment 1 are first to replicate Choi and Bowerman's study (Bowerman, 1996a) by using the same technique and highly similar stimuli; and second to examine in greater detail the influence of modeling (completed activities vs. incomplete activities) on how people respond. The results of this experiment will provide the foundation for the next experiments.

One group of participants (Inference group) was tested in the same manner as those in Choi and Bowerman's experiment. The modeling used to demonstrate the spatial relations in their study was only partial demonstrations and the action was stopped before it was completed, and the participants were asked to describe the spatial relations that were demonstrated. A second group of participants (Description group) was shown completed actions that they were asked to describe. In this condition, the same spatial relations were tested but the modeling showed the activities completed so that participants did not need to make inferences about the experimenter's intentions. This manipulation is important for two reasons: 1) completed actions may provide less variable data than actions that must be inferred and 2) completed actions provide more precise information about the path and manner of the actions used to demonstrate spatial relations.

Since our next goal (to be discussed in Experiment 2) will be to compare English data with Japanese, Experiment 1 provides information so that one can examine which kind of modeling (partial or completed) provides more precise descriptions of spatial relations.

Method

Participants

Native English-speaking adults (N = 40; age range approximately 18-30 years old) enrolled in an Introductory Psychology course (Psy 1.1) were recruited from a subject pool in the Psychology Department at Brooklyn College. Experimental credit was awarded to satisfy partial course requirements.

Stimuli

Forty-one pairs of objects were used in the study. These objects are the same as or similar to those used by Choi & Bowerman (see Table 7.01). It should be noted that Choi and Bowerman originally tested 43 relations using various kinds of objects. However, due to the difficulty of obtaining the toys similar to what Choi and Bowerman used in the study, two testing items were eliminated from the testing items in the following experiments, 1 to 4. In the current series of experiments, a total of 41 relations were tested using toys or everyday objects that vary by color, size, shape, and texture.

Procedure

Participants were tested individually in a lab. Each was shown the 41 sets of objects, one set at a time, randomly ordered among participants. For one group of participants (N = 20: Inference Group), the experimenter partially demonstrated a relation with each object set after which the participant was asked to describe via inference the relation. For example, the experimenter held up one set of objects (e.g., a stacking ring and a pole) and said, “See, this is a ring and pole” to the participant. The experimenter partially modeled the spatial relation by holding the ring and moving it towards the pole as if she was going to place the ring on the pole. The experimenter then asked “What should I do?” If the participant did not respond, the figure object (i.e., the ring) then was moved closer to the ground object (i.e., the pole) and the experimenter asked, “What am I doing?” For the second group of participants (N = 20: Description Group), the actions modeled were completed, so the questions asked of the participants were changed slightly. For example, the experimenter held up the test objects from one set and said, “See, this is a ring and pole” to the participant. Then the experimenter modeled a completed action (i.e., by placing the ring completely on the pole) and then asked the participant “What did I just do with the ring?/ What happened?”

After the participant responded and the experimenter recorded the response, the next relation with the next set of objects was demonstrated in the same manner until all 41test items were administered. Index cards were used for recording each participant’s response in each task. After the tasks were finished, the experimenter explained the purpose of the task to the participant after which she or he was thanked for participating.

Results

The goals of the present experiment were to replicate the findings of Choi and Bowerman (Bowerman, 1996a) and to investigate how changes in the modeling of the relations might influence the way in which participants describe the relations. As will be seen below, the results replicate Choi and Bowerman for the relations described by English speakers overall.

Dependent Measure

For the comparison of the descriptions of the Inference Group and Description group to those reported by Choi and Bowerman, the data were coded by calculating the proportion of answers that corresponded to the spatial terms reported by Choi and Bowerman. For example, if 90% of their participants said "in" to a particular relation and 80% of the participants in the present study said "in" to the same relation, the two proportion scores (.90 and .80) were entered into the analysis for that relation. It should be noted that of the comparisons of the 41 spatial relations, two responses were provided for the 3 relations in Choi and Bowerman's study, therefore, 44 responses in their study were compared to the Inference and Description groups.

First, the descriptions of the Inference Group to those reported by Choi and Bowerman were first compared. It was predicted that the correlation should be statistically significant given that the same instructions and same or highly similar sets of objects were used. The results indicated that this was the case, $r = .56$, $df = 43$, $p < .001$ (see Figure 7.01). However, a closer inspection of the data revealed less agreement on the 5 relations commonly described using verbs (i.e., button dress, fasten velcro, close cassette case, close suitcase and close box). The data were then divided into descriptions consisting of verbs and those consisting of prepositions/adverbs and two more analyses were conducted. The results were clear. Verb responses showed no statistically significant correlation

($r = .36$, $df = 4$, $p = .55$) whereas the preposition/adverb responses showed high agreement, ($r = .60$, $df = 38$[1], $p < .001$). Our data replicate those of Choi and Bowerman when one examines the prepositions/adverbs but not the verbs.

Next, the data were examined to see whether the same pattern was true when comparing the responses of the Inference and Description groups in the present study. Correlational analyses were conducted[2]. The results showed that not only were the responses significantly correlated overall ($r = .77$, $df = 43$, $p < .001$) but also the correlations between both the verbs ($r = .92$, $df = 4$, $p < .05$) and the prepositions/adverbs were significant ($r = .74$, $df = 38$, $p < .001$). These findings suggest that the differences in modeling showed little influence on the participants' responses, that is, the relations showed high agreement between the Inference Group and the Description Group.

To be cautious, additional analyses were conducted to compare the proportions of the responses in the Description Group to Choi and Bowerman's results. As expected, the results showed the same pattern as the comparisons of the Inference Group with Choi and Bowerman. The responses were significantly correlated overall ($r = .66$, $df = 43$, $p < .001$) (see Figure 7.01) and by

---

[1] Note that two prepositions/adverbs ('together' and 'on') were reported for each of the 3 relations, join legos (1 lego is joined to 3), join pop beads (1 pop bead is joined to 3), and hook train cars by Choi and Bowerman, therefore, three additional proportions were added to the analysis.

[2] Note that complete modeling used in the Description group often elicited the past tense of verbs whereas the modeling used in the Inference group elicited the present tense of verbs. For the purpose of comparing the responses between the completed modeling (Description group) and the partial modeling groups (Inference group and Choi and Bowrman's group), the past tense of the verbs that were produced by the participants in the Description group using completed modeling were coded as present tense for the analyses.

prepositions/adverbs ($r = .70$, $df = 38$, $p < .001$) but the correlation of the verbs were not significant ($r = .57$, $df = 4$, $p = .311$). The two different modeling groups, the Inference Group and the Description Group replicated Choi and Bowerman's data overall. However, the verb responses did not replicate the responses produced in Choi and Bowerman whereas the responses in prepositions/adverbs in both groups replicated Choi and Bowerman's data.

Table 7.01 Object Descriptions and Activity Demonstrations

Ground object	Figure object	Activity and Demonstration
suitcase	lid attached to suitcase	close suitcase
cassette tape in cassette case	cover attached to case	close cassette case
small box	lid of small box	close box
button on dress	buttonhole on dress	button dress
velcro	velcro	fasten velcro
3 legos	1 lego	join legos (1 goes onto 3)
pan	lid	put lid on pan
wall	suction cup	attach suction cup on wall
hand	band-aid	band-aid on hand
pen	top of pen	place top on pen
3 pop beads	1 pop bead join	pop beads (1 goes onto 3)
train car with hole	train cars with hook	hook train cars together
towel ring	towel	place towel on ring
pole	small ring	place small ring on pole (tight)
unfinished puzzle	puzzle piece	put piece into puzzle
pillow	pillowcase	put pillowcase on pillow
pole	large ring	put large ring on pole (loose)

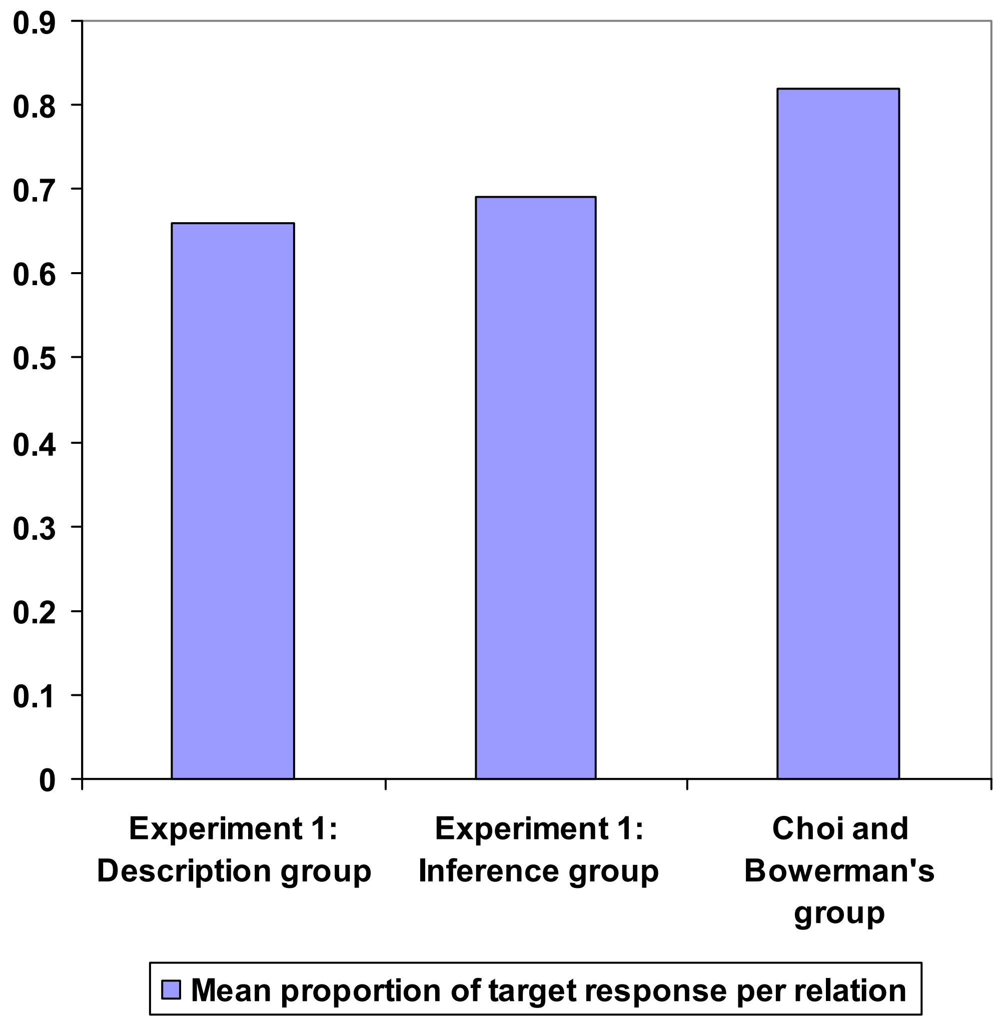
Table 7.01 Continued.

cassette tape case	cassette tape	put cassette into case
tote bag	lego pieces	place legos into bag
box	2 small toy cars	put cars into box
frying pan	blocks	put blocks into pan
miniature bathtub	doll	put doll into bathtub
bowl	toy boat	place boat into bowl
suitcase	various small toys	place toys into suitcase
person	wool hat	put wool hat on head
person	big brimmed hat	put hat on
a couple of rubber bands	small box	put rubber band on box
doll	sock	put sock on doll’s foot
doll	shoe	put shoe on doll’s foot
person	slipper	put slipper on (experimenter’s) foot
person	scarf	put scarf on (experimenter’s) head
person	strap attached to hat	fasten hat on (experimenter’s) head
doll	undershirt	put undershirt on doll’s body
doll	dress	put dress on doll’s body

Table 7.01 Continued.

doll	underpants	put underpants on doll's body
table	suitcase	put suitcase on table
towel spread out on surface	doll	place doll on towel
freight train car for logs	log	place log on train
Symmetrical activity	**Symmetrical activity**	**Bring both together simultaneously**
two pop beads	two pop beads	attach 2 beads to 2 beads
two legos	two legos	attach 2 legos to 2 legos
magnetic train car	magnetic train car	attach train cars together

Figure 7.01 The comparison of the proportions/adverbs of the overall mean number of spatial terms (N = 44) produced by Experiment 1 (Description and Inference groups) and by Choi and Bowerman's study. The Y-axis indicates the means of proportions per relation which were calculated based on the data reported by Choi and Bowerman (Bowerman, 1996a)



Further analyses were made by comparing the mean proportion of target responses per relation between Choi and Bowerman's group, the Inference Group, and the Description Group (see Figure 7.01). The results of t-tests indicated that there was no overall difference between the Inference Group (M = .69, SE = .05) and the Description Group (M = .66, SE = .05); (t (43) = -.86, p = .40). However, there were significant overall differences between the Description Group and Choi and Bowerman's group (M = .82, SE = .03); (t (43) = -4.73, $p < .001$) and the Inference Group and Choi and Bowerman's Group (t (43) = 3.12, $p < .01$). A closer examination of the data suggested that the Description group tended to give more unique responses overall than the Inference group (see Table 7.02).

Table 7.02. The mean of proportion of target responses per relation in Experiment 1[3].

Experimental Group	Overall Mean N = 44	Mean Prepositions /adverbs N = 39	Mean Verbs N = 5
Choi and Bowerman's data	.82	.82	.84
Inference Group	.69	.70	.58
Description Group	.66	.68	.48

Discussion

The first goal of this experiment, to replicate Choi and Bowerman, was successful overall. The results indicated that the participants' responses between the Inference Group and the data reported by Choi and Bowerman's group were significantly correlated when the responses were compared by prepositions/adverbs, but not verbs. It should be pointed out that the data from Choi and Bowerman indicate little variability. One possible explanation is that the participants in Choi and Bowerman's were more homogenous than the

[3] The total number of the relations tested was 41 but the number of responses was 44; the mean prepositions/adverbs were analyzed based on one response (preposition or adverb) for each of 33 relations and 2 different responses (prepositions/adverbs) for each of 3 relations (total = 39). Verbs were produced for 5 of the relations.

participants in the Inference Group (recruited in a college in Brooklyn, NY)[4]. Possible factors for more variable responses produced by the participants in the current experiment would be the differences among individuals, as well as language and cultural differences. Another possible reason is that different experimenters modeled the spatial relations in Choi and Bowerman's study and this present study. It is possible that there may be differences in demonstrations depending on the style of experimenters in administering the tasks (see Experiment 3 for consistency of modeling task using DVD format).

One difference between the participants in the present experiment and those tested by Choi and Bowerman, were the 5 spatial relations in which verbs were given as responses. The verb responses in the present experiment indicated a low agreement rate with Choi and Bowerman but a high agreement between the Inference and the Description Groups. One possible explanation is that the objects used in 4 out of 5 items for the verb responses were highly similar but not identical to these used by Choi and Bowerman. Another possible explanation is that the larger number of participants in the Inference group (N = 20) and Description group (N = 20) may have created more variable responses than in Choi and Bowerman's group (N = 10). By considering the characteristic of verbs (verbs indicated more variability in responses than prepositions/adverbs), it is possible that the difference may not be observed if the more various spatial

---

[4] It is typical that many people living in Brooklyn speak English as a second language, but the participants in this current study are native English speakers. However, by living in Brooklyn, they are frequently exposed to more than one language.

relations which elicit verbs were tested (verbs were coded for 5 spatial relations whereas prepositions/adverbs were coded for the rest of the 36 relations).

One might ask why only 5 spatial relations were described with verbs in Choi and Bowerman's study. The primary interest of Choi and Bowerman's study with English participants was the production of spatial terms, which are typically prepositions in English. It is possible that the items described using verbs may not be representative of certain spatial relations, particularly those in English. For example, the relation 'button dress' was a demonstration of placing a button into a buttonhole but that is not the way English speakers construe this relation. Another example is 'fasten Velcro'. The term 'fasten' can be used as 'fasten the seatbelt' but the term, 'fasten' describes different actions depending on the objects in the contexts. As seen in these examples, some of the items tested may not be as representative of a particular class of responses in the same way as the other items tested.

Of further interest was whether or not completed actions would provide more stable (less variable) responses in participants' descriptions of the spatial relations. It was predicted that there would be less variability in responses in the Description Group (completed modeling) than in the Inference Group (inference modeling). The completed modeling would potentially limit variable responses because they eliminate the possibility of guessing or making inferences about the endings of the dynamic spatial events. However, this prediction was not supported. The results indicated that the spatial terms produced by the participants in the Description Group were actually more variable than those in the Inference Group when the data were analyzed by prepositions/adverbs and by verbs. It is possible that completed modeling provides more rich information of spatial relations (path and manner information as well as the contexts) demonstrated to the participants, and it led the participants to produce more various spatial terms. Yet, the responses between the Description Group and the Inference Group were highly correlated. Interestingly, not only the comparisons of prepositions/adverbs or overall responses, but the verb responses were also highly correlated in this comparison of two different modelings. This suggests that most of the different spatial terms produced per relation between these two groups are consistent.

The issue of using different modelings was raised based on a preliminary study with a young age group of Japanese children. Ideally, one would wish to use the inference model because the responses were less variable. But when young Japanese children (approximately 24 months) were first tested using inference modeling, very few verbal responses were made, and some of the children tried to describe the spatial relations using gestures. However, when the completed modeling of the spatial relations was demonstrated, the children produced many more responses than when the inference modeling was demonstrated. Because one of the main goals of this series of experiments was to make cross-linguistic (English vs. Japanese (see Experiment 2; Chapter 8), English vs. Korean vs. Japanese (see Chapter 12)) as well as developmental comparisons (children vs. adults (see Experiment 4; Chapter 11)), the completed modeling was chosen for the demonstrations of the spatial relations for the remaining experiments (Experiments 2-4) with the understanding that the data maybe somewhat more variable than desired.

Chapter 8

Experiment 2: Japanese spatial terms

Traditionally, most of the research on the acquisition of spatial terms has been conducted on European languages, with an emphasis on English along with a few studies in French and German (Ammon & Slobin, 1979; Bloom, 1981; E. V. Clark, 1973a, 1973b). More recently, research has been conducted on South American (e.g., Tzeltal; P. Brown, 1998) and Asian languages (e.g., Chinese, Korean, or Japanese; Au, 1983; Bowerman, 1996a, 1996b, Bowerman & Choi, 1994, 2001; Choi, 1997; Sinha et al., 1994). Very little information on the acquisition and development of spatial terms in Japanese is available. The only known developmental study on Japanese spatial terms was conducted on just one child who was being raised in a bilingual environment (Sinha et al, 1994). But before developmental data are collected (see Experiment 4), a thorough investigation of adult use of Japanese spatial terms is desirable.

As previously mentioned, the results of cross-linguistic studies show that languages can widely differ in that the spatial categories of one language may cross-cut those of other languages (e.g., Choi et al., 1999; Levinson, 1994, 1996a, b). By examining many different languages, one can clearly see that languages differ more dramatically than can be easily accounted for by our traditional theories that posit a universal understanding and categorization of spatial relations. Few studies on adult Japanese spatial terms have been conducted (e.g., Bowerman & Choi, 2001; Munnich et al., 2001). Bowerman and Choi (2001) reported descriptions of 6 static spatial relations across 5 languages, English; Japanese;

Dutch; Berber; Spanish (See their figure 16.2, p. 485). The results showed that the patterns of spatial terms that were used for the descriptions of the 6 static relations vary across languages. The results also indicated that Japanese adults described 2 of the relations using locative particles (e.g., Japanese locative particle ‘ue’ meaning ‘on top’ was used for a ‘cup on table’ support relation; ‘naka’ meaning ‘inside’ was used for a ‘apple in bowl’ containment relation), but did not provide spatial terms for the remaining 4 relations.

Munnich and his colleagues (Munnich et al., 2001) also studied spatial language and spatial memory (representation) in English, Korean and Japanese speakers. A group of participants in each language was asked to name the locations of the figure objects relative to the reference objects in the spatial relations (either axial or contact/support relations). Another group of participants for each language group was asked to indicate the differences in the locations of figure objects between new stimuli and stimuli that were viewed before (the duration between the two tasks was within the frame of short-term memory). The results indicated that there were similarities in the organizations of axial relations but not in contact/support relations across the 3 languages in the language tasks. For example, in English, making the distinction between an object ‘on’ a platform or ‘above’ a platform is obligatorily in the language whereas in Korean or Japanese, the distinction is only made when it is required. The results of the spatial memory task showed similarities in organizing space across languages. Munnich et al. (2001) claimed that if language is influencing the encoding of spatial information, the results of the language task should be reflected in the memory task. The results indicated that there is no difference in encoding locations in space in the memory task regardless of the languages. They concluded that encoding spatial information is not influenced by which language we speak. However, comparisons between Japanese and other world languages may reveal yet another manner in which spatial terms are used to describe spatial relations, descriptions that according to Munnich et al. do not influence spatial memory (but see Choi & McDonough, in press; McDonough et al., 2003).

Experiment 2 tested the Japanese-speaking adults by using the same technique used for the Description Group (completed actions) in Experiment 1. The Japanese data were then compared to the English data in Experiment 1. First, the number of different spatial terms produced per relation by the English and Japanese speakers were compared.

For example, one English speaker might describe a relation as “place the ring on the pole” whereas another might say “shove the ring onto the pole” and a third might say “toss the ring and put the pole through the ring”. Although there may be a general consensus with more participants using one description than another, it is also informative to find out how many different descriptions are given for each relation modeled. This comparison provides information as to whether speakers of different languages, English and Japanese, produce more various terms for certain relations than others. However, we still do not know whether there is a difference in the variability of spatial terms produced by the speakers of Japanese and English. If so, we would like to know how wide of a variety of spatial terms would be produced by these two language groups.

The second goal is to compare the total number of different spatial terms produced across the 41 spatial relations by each of the Japanese-speaking adults to those produced by each of the English-speaking adults. For the present comparison, Japanese spatial verbs were compared to prepositions/adverbs in English produced by the participants in the Description group in Experiment 1. As seen in the results in Choi and Bowerman's data with Korean speakers, the Korean speakers used verbs whereas the English speakers mainly used prepositions/adverbs for describing the dynamic spatial relations (Bowerman, 1996a). Choi and Bowerman compared the verbs produced by the Korean speakers to prepositions/adverbs produced by the English speakers, and showed the number of spatial terms indicating the number of lexical categories produced by the Korean speakers was more than English speakers (13:6, respectively). However, as seen in the results of Experiment 1, more variable responses were produced by the English speakers. Korean and Japanese languages have similar structures and are considered by some to be from the same family of languages (although this theory remains controversial), and both use verbs to describe the dynamic spatial events. These verbs also contain information about the manner and/or path of action to describe spatial relations. In English, spatial relations are more often conveyed using prepositions/adverbs, not verbs. Since both Japanese and Korean are path languages and use verbs for describing dynamic spatial relations, it is predicted that the number of different spatial terms produced by the Japanese would be larger than that of the English speakers.

The last goal of Experiment 2 is to investigate how Japanese-speaking adults lexically categorize space, and to compare the Japanese data with English (Experiment 1). For example, English speakers may consider the majority of the relations modeled to be described by a single term (e.g., 'on') whereas the same relations may be described using many more terms in Japanese. Of particular interest is how the Japanese language categorizes space and whether it does so in similar or contrasting ways compared to English. As reported earlier by Choi and Bowerman (Bowerman, 1996a; Choi & Bowerman, 1991), Korean contrasts the spatial relations of tightly- or loosely- fitting objects regardless of containment or support, a relation that is contrasted in English. Although Korean and Japanese languages are considered to have similar language characteristics (e.g., both are path languages), the tight- or loose-fitting contrast relations in Korean does not seem to be clearly observed in the same manner in Japanese (for the details of spatial categorization in Korean, see Bowerman, 1996a; Bowerman & Choi, 1994; Choi, 1997).

Methods

Participants

Twenty native Japanese-speaking adults $M = 36.3$ years; range = 22 to 58 years old) were recruited in Tokyo, Japan through word-of-mouth, and they voluntarily participated in the study.

Stimuli

The same objects from Experiments 1 were used.

Procedure

Participants were tested individually in a quiet room at a school or at the participants' homes. The same elicited-production task was conducted using the completed modeling that was used in the Description Group in Experiment 1. The following instructions accompanied the modeling of the relations. First, the participant was shown the objects and the experimenter said, "Kore wa wakka desu (yone). Korewa po-ru desu (yone)." (translation: "This is a ring (, isn't it?) This is a pole (, isn't it?) "). Then a completed action was demonstrated with the objects, accompanied by the experimenter saying, "Ima watashi wa (kore wo) naniwo (dou) shimashita ka?/ Ima kore ga dounarimashita ka?" (translation: "What (How) did I just do (with this (these) object(s))?/ What happened?" This instruction seems slightly different when translated into English. According to Choi (personal communication April, 2003), in Choi and Bowerman's study the English-speaking participants were asked "What should I do?" to get them to infer the action demonstrated with objects. For Korean-speaking participants, the experimenter asked, "How should I do?" (the word meaning, 'how' in Korean was used instead of 'what' because the translation of the word, 'what' in Korean does not work with Korean participants). When a study is to be conducted in another language environment, translation of instructions for the study can be a concern. One may argue that cross-linguistic comparisons are only valid when all the instructions given to participants convey the equivalent information (same meanings) across languages. In this case, even if the Japanese instructions were translated back into English, the translated instructions still maintained the same meaning of the original instructions in English. That is, the English and Japanese instructions were equivalent although not identical.

Recoding the responses was done after each response using an index card for each relation. All communication with the experimenter was done in the participant's native language, Japanese. Debriefing sessions were held after the experimental sessions for the participants. All participants were thanked for their participation.

Results

Dependent Measure

Spatial terms in English (prepositions/adverbs) were compared to Japanese (verbs). The number of different spatial terms produced per relation and across the 41 relations by the English and Japanese speakers were compared.

The goal of Experiment 2 was to compare spatial categories between Japanese and English. The comparison of spatial categories in English speakers (prepositions/adverbs) and Korean (verbs) by Choi and Bowerman (Bowerman, 1996a) indicated that the number of spatial categories made by English speakers were only 6 whereas the spatial categories in Korean was 13. The present experiment investigates how the number of spatial categories made by the Japanese speakers would differ from the results in English (Experiment 1) and Korean (Bowerman, 1996a). To approach this, the number of different spatial terms produced per relation were first compared. Next, the number of different spatial terms produced by each of the Japanese- and English-speaking adults were compared.

The results indicated that there was no difference between the number of different spatial terms produced per relation between Japanese and English speakers. However, as expected, the results revealed that there was a significant difference in the number of different spatial terms produced by the Japanese speakers and the English speakers. This indicates that there were a larger number of spatial categories in Japanese than in English.

First, the number of different spatial verbs, produced per relation in Japanese was compared to the number of different spatial prepositions/adverbs produced in English obtained in Experiment 1. The results indicated that there was no significant difference between the mean number of the different prepositions produced for each relation tested in English (M = 3.59, SE = .22) and the mean number of different verbs produced in Japanese (M = 3.90, SE = .35, t (40) = -1.03, p = .31).

Second, the number of different spatial terms produced across all relations by each of the Japanese and English speakers was compared. The mean number of different spatial verbs produced by the Japanese speakers was 17.3 (SE = .59) whereas the mean number of prepositions/adverbs produced by the English speakers was 7.75 (SE = .48), t (38) = -12.55, $p < .001$. As predicted, the number of different spatial verbs produced by the Japanese speakers and the number of different spatial prepositions/adverbs produced by the English speakers was significantly different.

As seen in the results above when one considered the mean number of spatial terms produced by each participant, the Japanese speakers produced more various spatial terms than the English speakers. At the same time, there is no difference in the number of spatial terms produced per relation between the speakers of English and Japanese. However, it is still not clear how space is categorized by the speakers of these two languages. To investigate this, the Japanese lexical spatial categories were compared to those of English. To approach this, the most frequent spatial term produced per item by the English speakers and the Japanese speakers were first organized into the 6 spatial categories reported by Choi and Bowerman (Bowerman, 1996a; see Table 8.01). For example, for the relation, 'a log on train', 12 participants produced a term 'on', another 6 produced a term 'in', the remaining two participants produced a term 'together'. In this case, the term, 'on' was chosen as the most frequent response.

Table 8.01 A comparison of English spatial terms and Japanese spatial terms. The numbers within the parentheses indicate how many of the speakers produced the most frequent spatial terms indicated in the cells (see Appendix II for the definitions of the Japanese spatial terms).

English categories [5]	Most frequent spatial terms/English (N = 20)[6]	Most frequent spatial terms /Japanese (N = 20)	Relations
	Preposition responses	**Verb responses**	
join	together (6)	kuttsukeru (12)	join magnetic train cars
join	together (8)	kuttsukeru (5)	join pop beads (2 attach to 2)
join	together (6)	kuttsukeru (6)	join legos (2 attach to 2)
Join/on	to (5) /on /onto (5)	kuttsukeru (7)/ hameru (7)	join legos (1 attaches onto 3)
join/on	together (4)/ on/ onto (4)	hameru (6)	join pop beads (1 attaches onto 3)
join/on	to (6)	kuttsukeru (7)	hook train cars

[5] Six spatial categories were reported for English in the previous study by Choi and Bowerman (Bowerman, 1996a).

[6] The participants are the same as the Description group in Experiment 1.

Table 8.01 Continued.

on	to (10)	kuttsukeru (9)	suction cup hook on wall
on	on (5)	shimeru (8)	lid on pan
on	on/ onto (5)	shimeru (8)	top on pen
on	around (12)	kakeru (7)	rubber band on box
on	on/ onto (15)	haru (16)	bandaid on hand
on	through (11)	kakeru (18)	towel on hook
on	under (7)	kakeru (13)	strap on hat
on	on/ onto (16)	kaburu (20)	wool hat on
on	on (17)	kaburu (20)	big hat on
on	on (9)	kaburu (13)	scarf on head
on	on/ onto (17)	haku (20)	sock on
on	on/ onto (18)	haku (20)	shoe on
on	on/ onto (15)	haku (20)	slipper on
on	on/ onto (16)	haku (20)	underpant on
on	on/onto (14)	kiru (20)	undershirt on
on	on/ onto (17)	kiru (17)	dress on
on	on/ onto (18)	oku (16)	suitcase on table
on	on/onto (16)	nekaseru (15)	doll on towel
on	on/ onto (7)	ireru (8)/ kakeru (8)	pillowcase on pillow
on	on/ onto (14)	hameru (7)	small ring on pole
on	on/ onto (12)	ireru (9)	big ring on pole
on	on/ onto (11)	noseru (10)	log on train

Table 8.01 Continued.

in	in/ into (16)	ireru (17)	cassette into case
in	in/ into (16)	ireru (14)	legos into bag
in	in/ into (18)	ireru (17)	cars into box
in	in/ into (15)	ireru (19)	legos into pan
in	in/ into (16)	ireru (12)	doll into bath
in	in/ into (17)	ukaberu (16)	boat into bath
in	in/ into (14)	shimau (10)	toys into suitcase
in	into (6)	hameru (11)	piece into puzzle
	Verb responses	**Verb responses**	
button	button (9)	hameru (6)/ kakeru (6)	button dress
fasten	stick (together)(7)	kuttsukeru (12)	fasten Velcro
close	close (16)	shimeru (13)	close suitcase
close	close (16)	shimeru (13)	close cassette case
close	cover (6)	shimeru (11)	close box

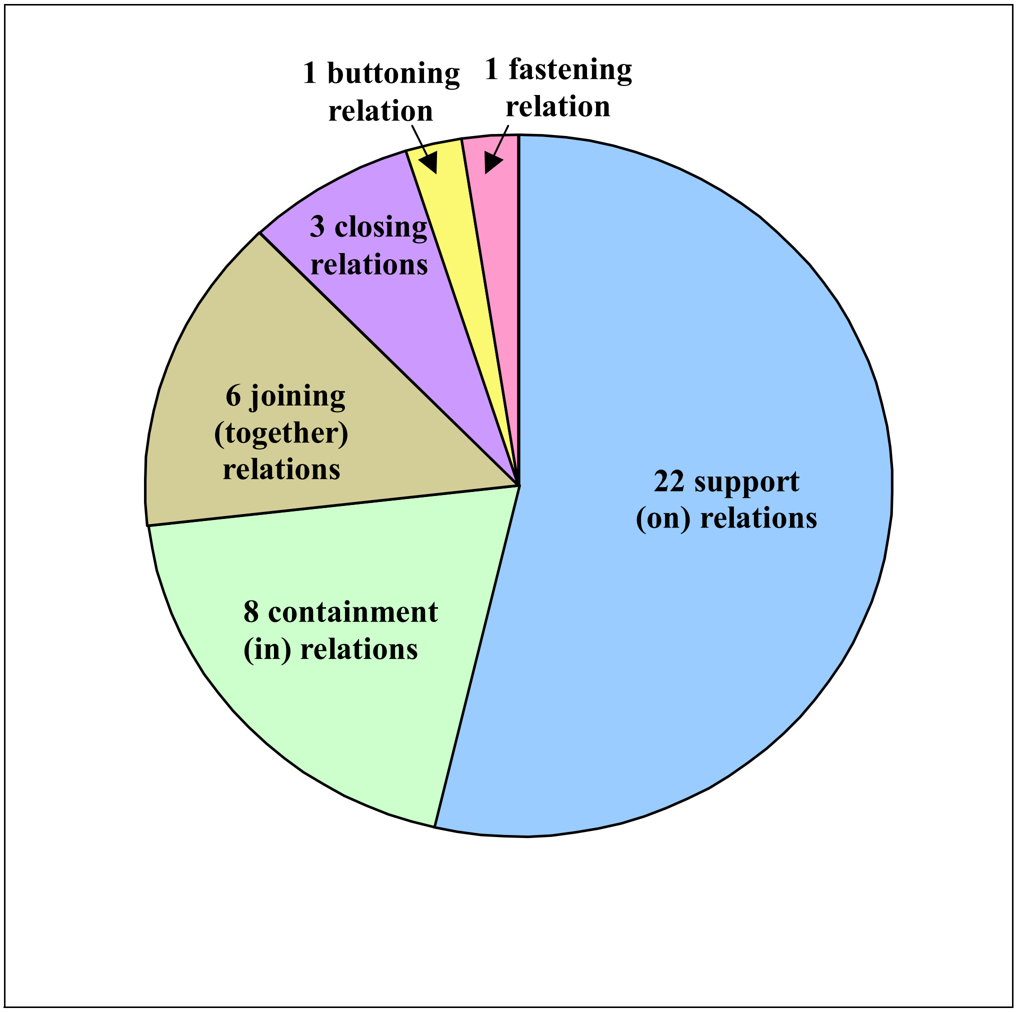
The Japanese spatial terms were examined to compare the spatial categories by the English-speaking adults. For this comparison, the proportions of the different spatial terms produced for 41 spatial relations were first mapped into a pie chart (see Figure 8.01). Based on the 4 main categories (support, containment, join, and close) in English, the different Japanese spatial terms produced for each of the 4 categories were subcategorized. Note that fasten and button categories include only one relation each and stand by themselves and they were not compared to the Japanese ones.

The larger, less differentiated categories typically provided by English speakers (i.e., ‘in’, ‘on’) were subdivided by the Japanese spatial terms (Figures 8.02a-d). The proportions of the most frequent responses by the Japanese participants were displayed in the 4 spatial categories. As indicated in Figures 8.02a-d, space is categorized in a more differentiated way in Japanese than in English. This is similar to the results of the comparison of spatial categories in English and Korean reported by Choi and Bowerman (Bowerman, 1996a).

Across the 4 categories (support, containment, join, and close) in English, there are about 30% of variable responses that were indicated as ‘other responses’. Besides the ‘other responses’ category, the total number of different spatial terms produced by the Japanese speakers were 12 for the ‘support’ category (e.g., on/onto), 4 for the ‘containment’ category (e.g., in/into), 2 for the ‘join’ category (e.g., together), and 1 for the ‘close’ category (e.g., close).

Although many different spatial terms were produced in the support relations, the participants’ agreement rate to the most frequent responses were the highest in the ‘support’ category (73.19%), and following were the ‘containment’ (72.51%), ‘close (61.67%), and ‘join’ (41.67%) categories. The agreement rates are relatively high in all of the categories except the ‘join’ category. As seen in Table 8.01, the items in the join category especially showed the lower agreements among the participants (the mean number of the most frequent words produced in the ‘join’ category was 8.33 out of the 20 participants). This would be due to the multiple spatial terms that were produced for each relation by the participants to describe those spatial relations. This indicates that the variable responses are due to the various spatial relations tested in the join category. As seen in the results, there is a different way to lexically categorize space in between English and Japanese.

Figure 8.01 Spatial categories of 41 spatial relations by the English-speaking adults reported by Choi and Bowerman (Bowerman, 1996a).



Figures 8.02a – d Spatial categories of 41 spatial relations by the Japanese-speaking adults (N = 20). See Appendix I for the definitions of the Japanese spatial terms (see Appendix II for the definitions of the Japanese spatial terms).

Figure 8.02a The 'on' category in English (22 support spatial relations) was subdivided by the Japanese spatial terms.

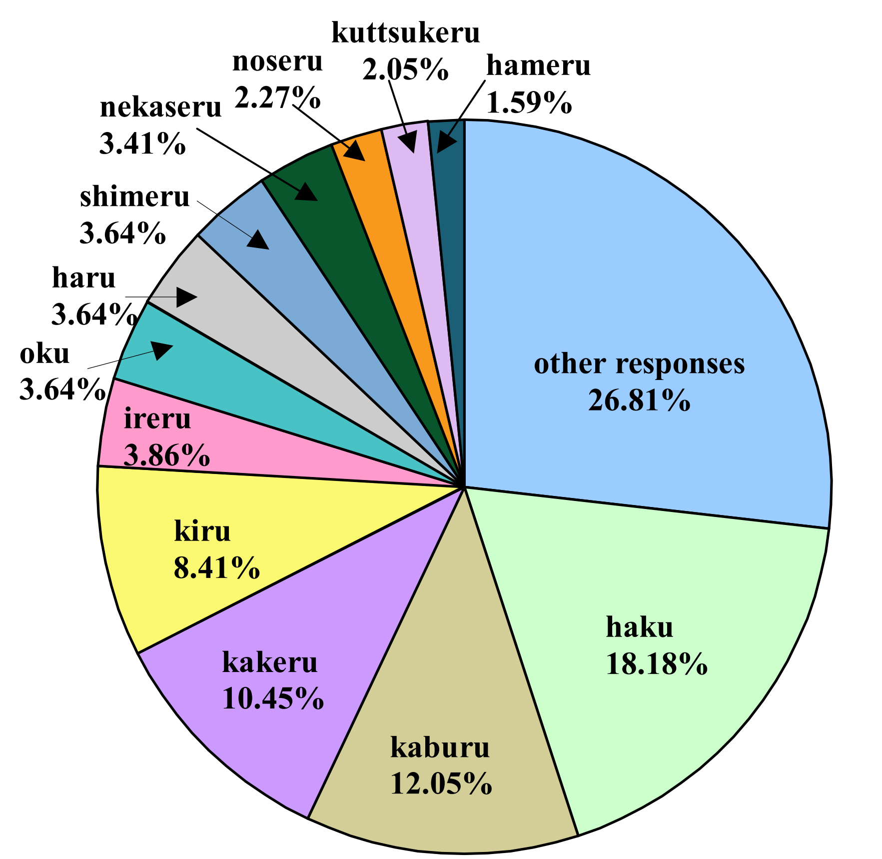


Figure 8.02b The ‘in’ category in English (8 containment spatial relations) was subdivided by the Japanese spatial terms.

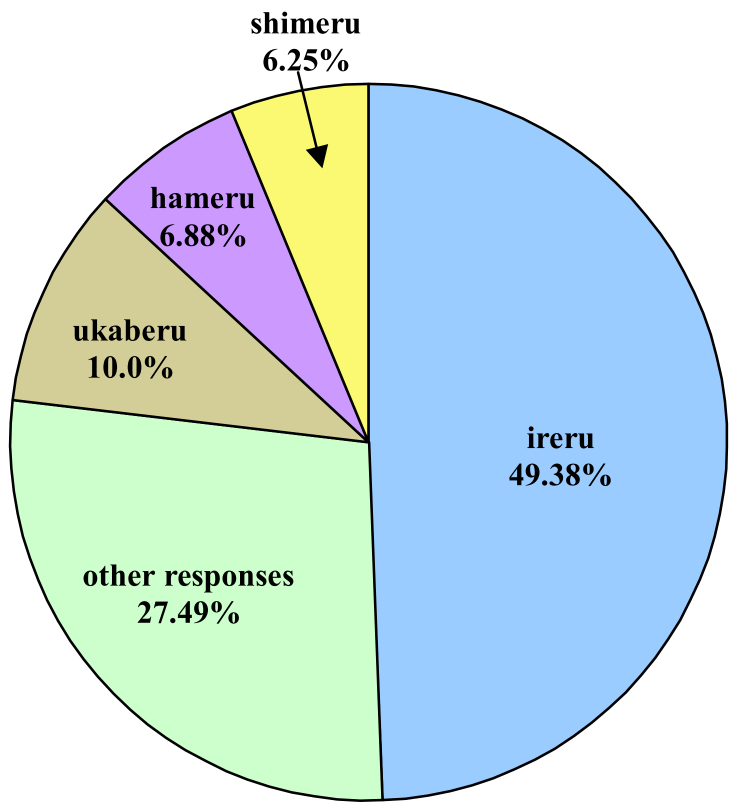


Figure 8.02c The 'together' category in English (6 joining spatial relations) was subdivided by the Japanese spatial terms.

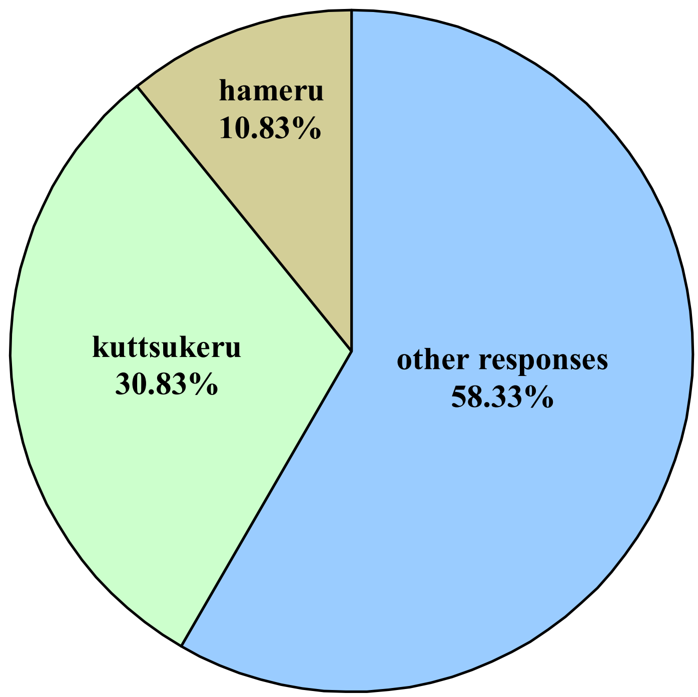
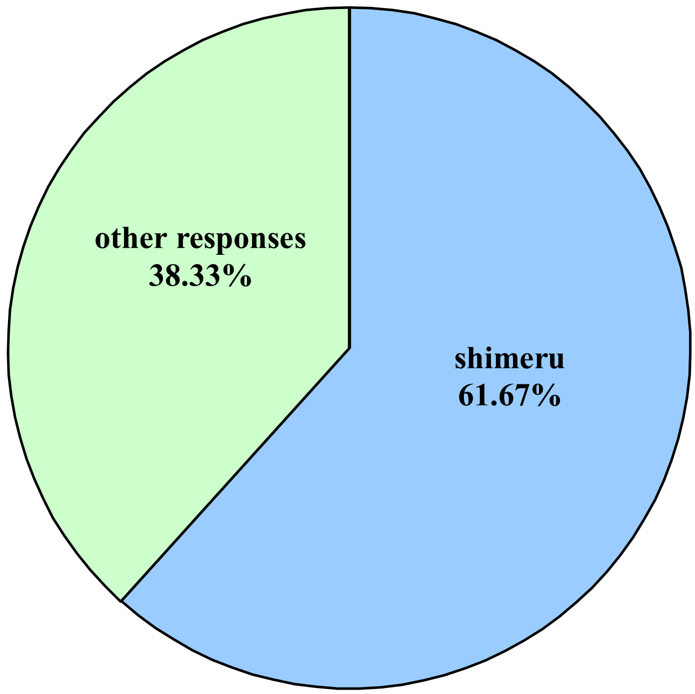


Figure 8.02d The 'close' category in English (3 spatial relations) were subdivided by the Japanese spatial terms.



Discussion

The first goal of Experiment 2 was to compare the number of different spatial terms that were produced for each of the 41 spatial relations in Japanese and English. The results indicated that there was no difference between the mean number of different spatial verbs produced by Japanese and spatial prepositions produced by English speakers. In other words, the variability of responses per relation of using different spatial terms, verbs in Japanese and prepositions in English, was the same.

The second goal was to compare the mean number of different spatial terms produced by the Japanese- and English-speaking adults. As we expected, the results revealed that there was a significant difference in the number of different spatial verbs produced by the Japanese speakers and the number of different spatial prepositions/adverbs produced by the English speakers. One way to explain the difference between the languages may be due to the coding system used for this comparison (English prepositions v. Japanese verbs). It is possible that the spatial information that was conveyed using prepositions may not be the same as when using verbs for describing spatial relations. As mentioned before, verbs contain richer information for dynamic actions (e.g., including the manner and/or path of action) whereas prepositions primarily provide static information. The limited information of static spatial relations by prepositions may only provide a narrow picture of spatial categorization. The issue will be discussed next.

The third purpose of this experiment was to examine whether or not the spatial categories between the two languages are the same. To answer this question, the 6 English spatial categories (see Figure 8.01) reported by Choi and Bowerman were examined for the distinctions made using different spatial terms produced by the Japanese adults. For the 'support', 'containment', and 'close' category, the agreement among the participants to the most frequent spatial terms were relatively high. On the other hand, the agreement rate in the 'join' category was lower than those of the other categories. This indicates that more various responses were produced for each relation tested in the join category. The possible explanation to this is that the number of relations tested for each category is relatively smaller except for the number of relations tested in the 'support' category. However, as seen in the agreement rate of the 'close' category, the agreement rate is higher than the 'join' category even though only three relations were tested in the 'close' category.

To explain more variable responses produced in the 'join' category, the issue of figure-ground object relations should be considered. For the spatial relations such as containment, support, or close relations, one object or a set of objects (i.e., the figure object(s)) was moved to the other (ground) object(s). Most of the time, the ground objects are static objects and as such are stable. The figure-ground relations would be clear in these cases. For some of the join relations (e.g., join together 2 legos to other two legos), both sets of objects were moved to demonstrate the relations. When spatial terms were produced for the join relations, we can immediately perceive objects are joining together, but the way we lexicalize the actions in space is different from one another. The variability found in the data would be due to the figure-ground problem as well as the gap between the way we perceive and describe the relations (e.g., analog vs. propositional format).

In this study, spatial verbs in Japanese were compared to spatial prepositions in English. As addressed earlier, there is a possible issue in comparing the spatial terms, English prepositions and Japanese verbs. In the next chapter, the issue of semantically comparable comparisons across languages will be discussed. The English data are then re-examined for verb-plus-preposition responses.

Chapter 9

Verb and preposition/adverb coding in English:

Comparisons between English and Japanese data

Differences among languages are found not only in terms of the organization of the spatial categories themselves but also in terms of how each language grammatacizes spatial relations. Experiment 2 compared the number of different spatial terms produced by the speakers of a manner language, English and a path language, Japanese. It also investigated the differences in the spatial categories of English and Japanese. The results found that although the number of different spatial terms produced per relation by the speakers of both languages indicated no differences, the number of different lexical categories was significantly different. The results of the comparisons of lexical categories indicated that Japanese categorizes space in more various ways than English. The study concluded that this difference may be due to the way the data were coded and compared (prepositions/adverbs in English vs. verbs in Japanese). This may not be a semantically comparable comparison and would influence the conclusions we draw about spatial categorization cross-linguistically.

The purpose of the next set of analyses is to re-examine the data collected in Experiments 1 and 2. First, the number of different spatial terms produced per relation and across relations in English and Japanese were compared by examining verb-plus-preposition/adverb combinations in English to verbs in Japanese. Coding both English verbs and prepositions/adverbs potentially provides path and manner information for English data, thus making the English data more comparable to the Japanese data in Experiment 2 and the Korean data collected by Choi and Bowerman (Bowerman 1996a). For example, if one produced the spatial terms ‘put on’ to describe the item, ‘lid on the box’, then not only the preposition ‘on’ but the verb ‘put’ was also coded as one set of verb-plus-preposition/adverb combination response. It was predicted that when both verbs plus prepositions/adverbs were coded, not only the number of different spatial terms produced per relation between the languages, but the number of different lexical categories produced by the English speakers would also approach the number of lexical categories produced by the Japanese speakers.

As seen in the results of Experiment 1, the number of responses produced for the 5 relations (i.e., button dress, fasten velcro, close cassette case, close suitcase and close box) which commonly described using verbs, influenced the lower overall correlation between the Choi and Bowerman and both the Description and Inference groups. It is possible that when verb-plus-preposition/adverb combinations are coded instead of prepositions/adverbs only, the correlation between the English and Japanese languages would increase. It is expected that the correlations of the 41 relations tested among the English data used two different coding systems and the Japanese verbs would be significantly correlated.

How would this influence the categorization of space? As seen in Figure 8.02a-d (see Experiment 2), the 4 main spatial categories (e.g., ‘support’ (on), ‘containment’(in), ‘join’(together), ‘close’) in English (Bowerman, 1996a) were divided into the varied spatial categories in Japanese. These figures may provide an impression of as if the English speakers are only able to lexicalize spatial relations in a broad manner, that this may be the reflection of the way we construe the space. Comparing English verb-plus-preposition/adverb combinations and Japanese verbs would provide a more semantically equivalent comparison of the two languages. It is predicted that when the semantic information is more comparable between languages, the number and richness of the spatial categories will be more closely aligned. However, it is not clear whether or not the boundaries of spatial categories would be the same between languages. This issue will be discussed in the following chapters.

Methods

Participants

The participants, stimuli, and procedure were the same as the Description Group in Experiment 1 and Experiment 2.

Stimuli

The same objects from Experiments 1 and 2 were used.

Procedure

An additional dependent measure was used for English speakers so that verb-plus-preposition/adverb combinations can be evaluated. The English data were then compared to the verbs produced by Japanese speakers.

The Japanese and English data were analyzed in two ways. First, the Japanese verbs (Experiment 2) were compared with English verb-plus-preposition/adverb combinations (Experiment 1-Description group) for both the number and scope of the spatial categories in each language (see Methods for Experiment 2). For this comparison, the data were analyzed using t-tests comparing the mean number of lexical categories produced by the speakers in each language. The results were also compared to the results in Experiment 2 which compared the responses of prepositions/adverbs only coded to Japanese verbs. It was predicted that the number of different spatial terms produced across relations will be similar when verb-plus-preposition/adverb combinations in English were compared to Japanese spatial verbs.

Next, the data were first analyzed by the correlation of the number of different spatial terms produced per relation between the two languages. For example, for the responses for the relation, 'log on train', one may describe the relation as "put the log on the train", and another may say "put the log inside the train", etc, then the different combinations of the verbs and prepositions/adverbs were counted as different responses. It should be noted that when only one spatial term, either verb or preposition/adverb was produced, those responses were also counted as one combination (verb plus no preposition/adverb or no verb plus preposition/adverb). It was hypothesized that the production of the number of different spatial terms will be highly correlated by item between the two languages.

To further address the issue of using different coding systems and to examine closely the semantically equivalent spatial categories in the cross-linguistic study, the following analyses were conducted.

The responses for 41 spatial relations were analyzed between the categories: containment, support, join, and close. The 'fasten' and 'button' categories consist of only one spatial relation. As found in Experiment 2, there was more variability in the responses among the joining relations. Since the main purpose of the present experiment is to examine whether using different coding systems would influence the interpretations of the results, the mean numbers of different spatial terms produced for the relations in each category were first compared among the responses in English (preposition/adverb only and combination of verbs and preposition/adverb coding) and Japanese. A few relations in the categories would then be chosen to address the importance of using semantically equivalent coding in cross-linguistic studies.

Results

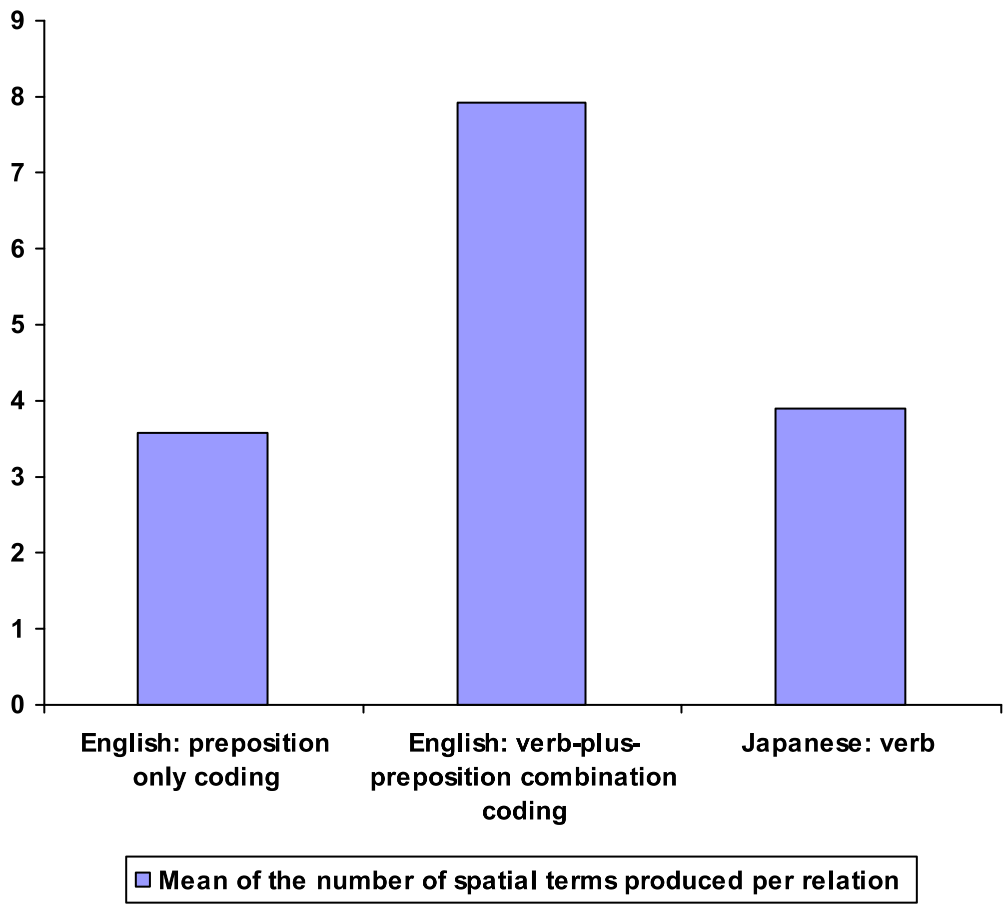
Dependent Measure

Spatial terms in English were coded in two different ways: prepositions/adverbs only, verb-plus-preposition combination and were compared to Japanese (verbs). The number of different spatial terms produced per relation and across the 41 relations by the English (prepositions/adverbs only and verb-plus-preposition combinations) and Japanese speakers were compared.

The purpose of the present experiment was first to compare the verb-preposition /adverb combinations of the English speakers to the verb responses of the Japanese speakers. This was considered to be a more semantically equivalent comparison because the spatial verbs produced in Japanese contain a path of dynamic action (with manner information provided in translation into English) in spatial relations whereas, in English, prepositions/adverbs only carry static information of spatial relations, so that a set of verbs plus prepositions/adverbs convey more precise information of manner and path of the spatial relations. For the responses of the English speakers, a number of different combinations of their responses were coded.

First, the results of the mean number of different spatial terms produced using the verb-plus-preposition/adverb combination coding was significantly more variable than the prepositions/adverbs only coding. This indicated that as predicted, there were more lexical categories (more numbers of different responses per relation) in the verb-plus-preposition/adverb coding in English (M = 7.93, SE = .50) than in the prepositions/adverbs only coding in English (M = 3.59, SE = .22) and in the verbs in Japanese (Japanese spatial verbs: M = 3.90, SE = .35, t (40) = 10.29, $p < .001$; see Figure 9.01). These data can be seen in Figures 9.02a-c. As seen in the results, combining verbs and prepositions/adverbs allow English speakers to make more variable descriptions of dynamic spatial events.

Figure 9.01 A comparison of the mean of the number of different spatial terms produced per relation by the groups (English: preposition/adverb only coding; English: verb-plus-preposition/adverb combination coding; Japanese: verb)



Figures 9.02a-c The proportions of a number of different spatial terms produced for 41 spatial relations by the English (used two different coding systems: preposition/adverb only; verb-plus-preposition/adverb combination coding) and Japanese speakers. The numbers on the upper right, for example, '3' next to the square box filled with color, 'blue', indicates the proportions of '3' different spatial terms that were used to describe the 41 spatial relations.

Figure 9.02a English verb-plus- preposition/adverb combination coding

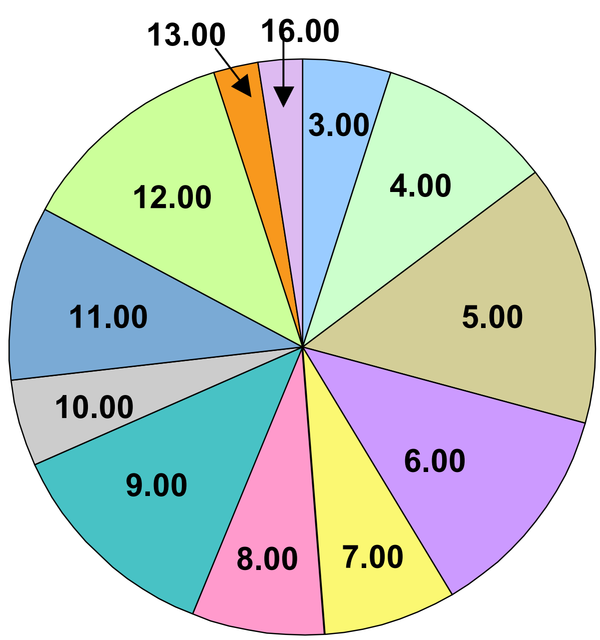


Figure 9.02b English: preposition/adverb only coding

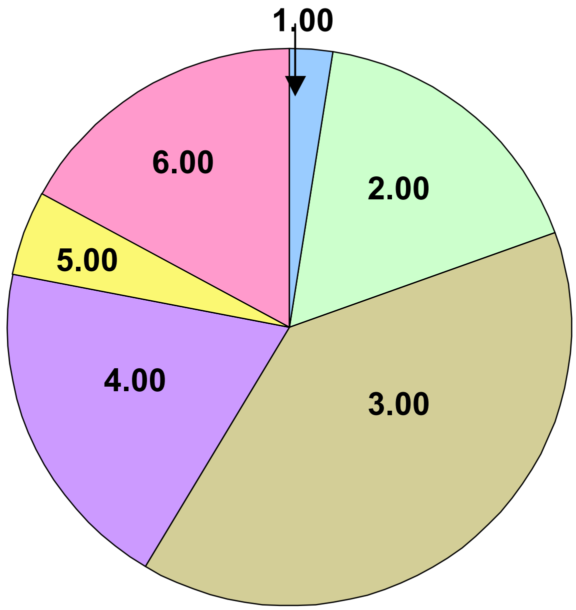
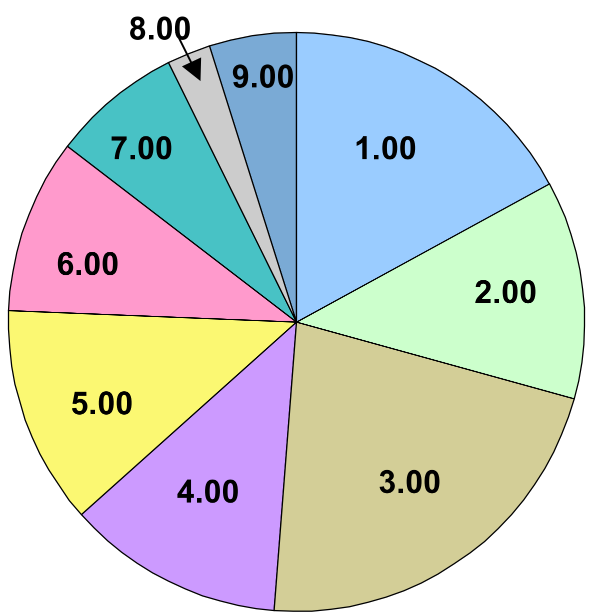


Figure 9.02c Japanese verbs



Next, the number of different spatial responses per relation was compared among the English verb-plus-preposition/adverb combination coding and prepositions/adverbs only coding, and the Japanese verbs. The results indicated that the comparisons of the correlations among the two differently coded English data and the Japanese data were highly correlated (see Table 9.01). Even though this is two words (verbs and prepositions/adverbs) in English versus one word (verbs) in Japanese, the number of spatial terms produced per relation are significantly correlated to one another.

Table 9.01 Correlations of the number of different responses per relation among 2 different coding systems (verb-plus-preposition/adverb combinations; prepositions/adverbs only coding) used for the English data and Japanese spatial terms (Dependent measure: the number of different responses produced per relation in each group).

Compared groups	Correlation	*p*
English: Verb-plus-preposition/adverb combinations vs. prepositions/adverbs only	$r = .66$	$p < .001$
English: Verb-plus-preposition/adverb combinations vs. Japanese verbs	$r = .63$	$p < .001$
English: Prepositions/adverbs only vs. Japanese verbs	$r = .50$	$p < .01$

The spatial categories of the adult speakers of Japanese and English were then compared (see Table 9.02) by examining the spatial verbs used in Japanese and spatial prepositions/adverbs only and verb-plus-preposition/adverb combinations used in English. The results of the comparison of Japanese verbs and English prepositions/adverbs suggest that Japanese has a more variously defined spatial lexicon than English. The mean number of lexical categories in Japanese were 17.3 whereas the mean number of categories in English were 7.8 ($p < .001$). The English speakers' responses were then compared in terms of their combinations of verb-plus-prepositions/adverbs in their descriptions to the Japanese spatial verbs. The results suggested that English speakers do indeed have a variety of ways to express a number of different relations. They expressed a mean number of 17.2 different spatial relations, a mean that is not significantly different from that obtained by Japanese speakers (M = 17.3; p = .94, n.s.). Furthermore, as seen above, the number of different responses per relation was highly correlated between the two languages: r = .63, $p < .001$.

Table 9.02 Comparisons of spatial categories using two different coding systems in English (verb plus preposition/adverb combination coding and preposition/adverb only coding) and Japanese spatial verbs (Dependent measure: the number of the most frequently produced spatial term per relation; see Appendix II for the definitions of the Japanese spatial terms).

English categories [7]	Most frequent spatial terms/ English (N = 20)	Most frequent spatial terms/ English (N = 20)	Most frequent spatial terms /Japanese (N = 20)	Relations
	Verbs + prepositions/ adverbs	**Preposition/ adverb responses**	**Verb responses**	
join	connect (4)	together (6)	kuttsukeru (12)	join magnetic train cars
join	connect (4)	together (8)	kuttsukeru (5)	join pop beads (2 attach to 2)
join	connect (6)	together (6)	kuttsukeru (6)	join legos (2 attach to 2)
join/on	connect to (3)	to (5), on /onto (5)	kuttsukeru (7), hameru (7)	join legos (1 attaches onto 3)

[7] Six spatial categories (see Figure 8.01) were reported for English in the previous study by Choi and Bowerman (Bowerman, 1996a).

Table 9.02 Continued.

join/on	connect together (2)	together (4), on/ onto (4)	hameru (6)	join pop beads (1 attaches onto 3)
join/on	attach to (4)	to (6)	kuttsukeru (7)	hook train cars
on	stick to (7)	to (10)	kuttsukeru (9)	suction cup hook on wall
on	cover (12)	on (5)	shimeru (8)	lid on pan
on	cover (5)	on/ onto (5)	shimeru (8)	top on pen
on	put around (7)	around (12)	kakeru (7)	rubber band on box
on	put on (9)	on/ onto (15)	haru (16)	bandaid on hand
on	put through (9)	through (11)	kakeru (18)	towel on hook
on	put under (5)	under (7)	kakeru (13)	strap on hat
on	put on/ onto (15)	on/ onto (16)	kaburu (20)	wool hat on
on	put on (15)	on (17)	kaburu (20)	big hat on
on	put on (7)	on (9)	kaburu (13)	scarf on head
on	put on/ onto (16)	on/ onto (17)	haku (20)	sock on
on	put on/ onto (15)	on/ onto (18)	haku (20)	shoe on

Table 9.02 Continued.

on	put on/ onto (14)	on/ onto (15)	haku (20)	slipper on
on	put on/ onto (12)	on/ onto (16)	haku (20)	underpants on
on	put on/ onto (13)	on/onto (14)	kiru (20)	undershirt on
on	put on (16)	on/ onto (17)	kiru (17)	dress on
on	put on (10)	on/ onto (18)	oku (16)	suitcase on table
on	place on/ onto (7)	on/onto (16)	nekaseru (15)	doll on towel
on	put in/ into (6)	on/ onto (7)	ireru (8)/ kakeru (8)	pillowcase on pillow
on	put on/ onto (11)	on/ onto (14)	hameru (7)	small ring on pole
on	put on/ onto (7)	on/ onto (12)	ireru (9)	big ring on pole
on	put on/ onto (8)	on/ onto (11)	noseru (10)	log on train
in	put in/ into (9)	in/ into (16)	ireru (17)	cassette into case
in	put in/ into (11)	in/ into (16)	ireru (14)	legos into bag

Table 9.02 Continued.

in	put in/ into (14)	in/ into (18)	ireru (17)	cars into box
in	put in/ into (11)	in/ into (15)	ireru (19)	legos into pan
in	put in (8)	in/ into (16)	ireru (12)	doll into bath
in	put in/ into (12)	in/ into (17)	ukaberu (16)	boat into bath
in	put in/ into (7)	in/ into (14)	shimau (10)	toys into suitcase
in	fit into(3) put together (3)	into (6)	hameru (11)	piece into puzzle
		Verb responses	**Verb responses**	
button	button (9)	button (9)	hameru (6)/ kakeru (6)	button dress
fasten	stick together (7)	stick together (7)	kuttsukeru (12)	fasten Velcro
close	close (16)	close (16)	shimeru (13)	close suitcase
close	close (16)	close (16)	shimeru (13)	close cassette case
close	cover (6)	cover (6)	shimeru (11)	close box

Note that only verbs were mostly produced in the spatial relations in the join, close, fasten and button categories.

As seen in Table 9.02, the agreements of the frequently produced spatial terms per relation among the participants were lower in the verb-plus-preposition/adverb combinations (M = 9.29) than the prepositions/adverbs only coding in English (M = 12.15) or verbs in Japanese (M = 13.39). Furthermore, it also indicated that less than 50 % agreement to popular responses (the number next to each spatial term less than 10/total N = 20) appeared in 17 relations in the verb-plus-preposition/adverb coding. However, less than 50 % agreement was also observed among 14 relations in English and among 10 relations in Japanese. This indicates the variability in the responses. There were significant correlations in the number of different responses per relation between the groups, English verb-plus-preposition/adverb combination, English prepositions/adverbs only, and Japanese verbs (see Table 9.03).

Table 9.03 The correlations between the number of the most frequently produced spatial terms per relation between the groups, English verb-plus-preposition/adverb combination, English prepositions/adverbs only, and Japanese verbs (Dependent measure: the number of the most frequently produced spatial term per relation).

Group contrasts	Correlations	*p*
English verb-and-preposition/adverb combination vs. English prepositions/adverbs	$r = .75$	$p < .001$
English verb-and-preposition/adverb combination vs. Japanese verbs	$r = .66$	$p < .001$
English preposition/adverb vs. Japanese verbs	$r = .66$	$p < .001$

Lastly, the spatial categorization of Japanese verbs was compared to the responses in English that were coded using two different ways, preposition/adverb only and verb-plus-preposition/adverb combination (Dependent measure: the number of different spatial terms produced per relation) in each of the categories: support, containment, join and close. The results of the mean comparisons using one-way ANOVAs revealed that there are significant differences in the number of different spatial terms produced per relation between the categories across the groups: by preposition/adverb only in English, by combination of verb and preposition/adverb coding in English, by Japanese verbs. As predicted, it also indicates that there are more variable responses in the number of different spatial terms produced for the joining relations regardless of the coding system used in English and differences between the languages. The results also indicated that there are significant differences among the three groups (English: prepositions/adverbs coding, verb-plus-preposition combinations coding, Japanese: verbs) for the relations in the support, containment, and joining categories but not the closing category.

Table 9.04 The mean comparisons of the number of different spatial terms produced within each category: by verb-plus-preposition/adverb combinations and by prepositions/adverbs in English and by verbs in Japanese.

Category	Number of relations	By verb-plus-preposition/ adverb combinations/ English	By prepositions/ adverb / English	By verbs/ Japanese	Comparisons of the 2 English groups and Japanese group
'Support' relations	22	$M = 7.14$	$M = 3.64$	$M = 3.32$	$F(2,63) = 22.67$ $p < .001$
'Containment' relations	8	$M = 6.75$	$M = 3.0$	$M = 3.38$	$F(2,21) = 9.77$ $p = .001$
'Join' relations	6	$M = 12.67$	$M = 4.50$	$M = 7.0$	$F(2,15) = 48.0$ $p < .001$
'Close' relations	3	$M = 5.67$	$M = 2.0$	$M = 3.0$	$F(2,6) = 3.56$ $p = .1$
Comparisons of the 4 categories		$F(3,35) = 9.41$ $p < .001$	$F(3,35) = 3.24$ $p < .05$	$F(3,35) = 6.23$ $p < .01$	

Figures 9.03 a – d show how support, containment, joining, and close relations were categorized differently when different coding systems were used to analyze the results. As seen in the figures, a greater number of spatial categories were observed in the spatial categories based on the verb-plus-preposition/adverb combinations coding than the preposition/adverb only coding.

Figures 9.03a-d Examples of spatial relations that were subdivided by the lexical spatial terms in English, preposition/adverb only coding, combinations of verbs and prepositions/adverbs coding and Japanese verbs (see Appendix II for the definitions of the Japanese spatial terms).

Figure 9.03a-1-2 Example of support relations: ‘on’ category in English: ‘rubber band on box’ and ‘scarf on head’

Figure 9.03a-1: rubber band on box

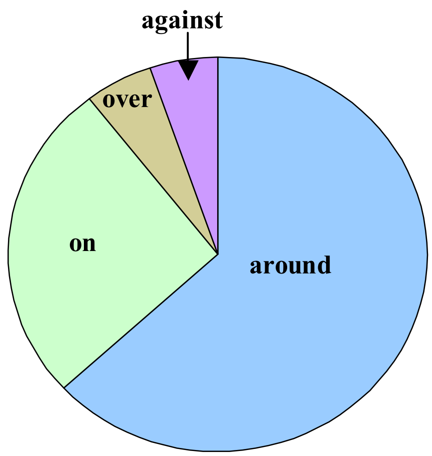
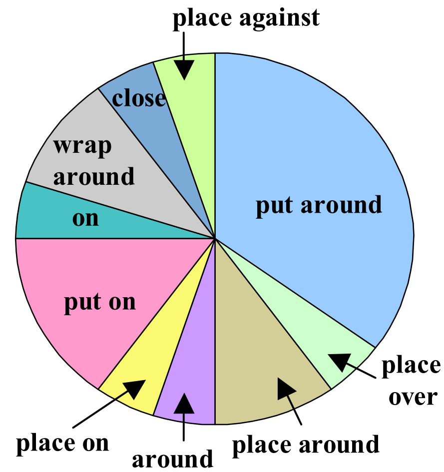
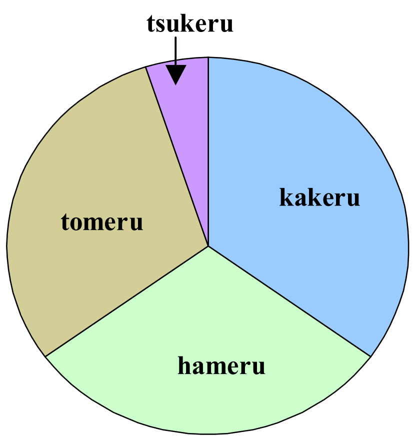
English: Preposition/adverb only	English: Verbs included in the coding
	
Japanese verbs	
	

Figure 9.03a-2: scarf on head

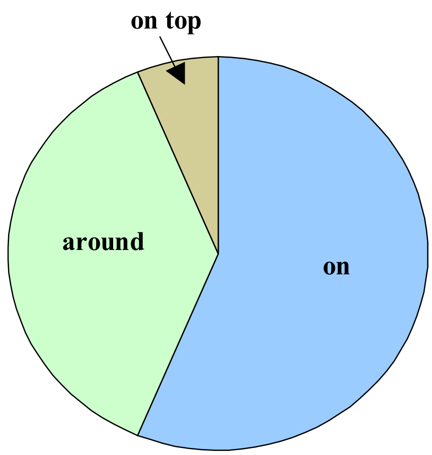
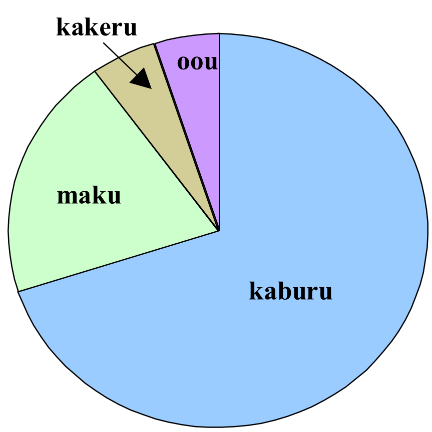
English: Preposition/adverb only	English: Verbs included in the coding
	
Japanese verbs	
	

Figure 9.03b-1-2 Examples of containment relations: ‘in’ category in English: ‘doll into bath’ and ‘piece into puzzle’

Figure 9.03b-1: doll into bath

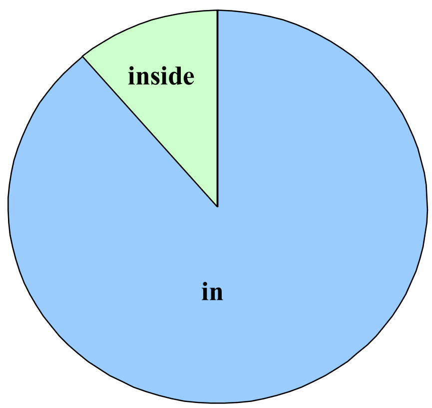
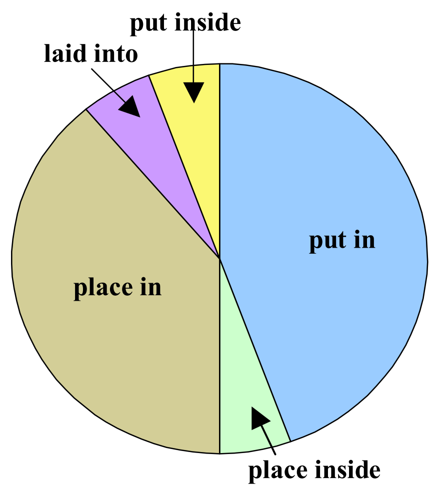
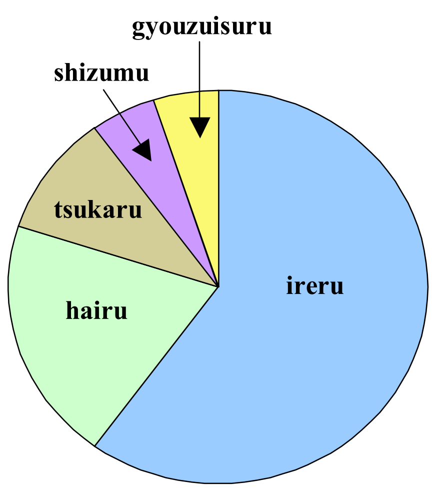
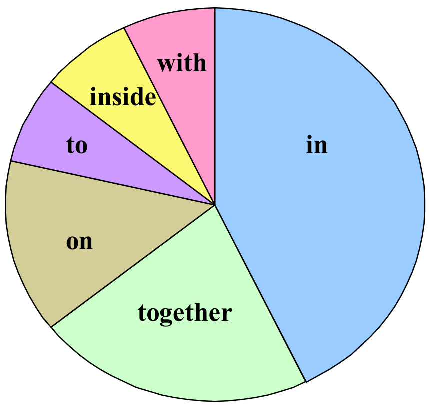
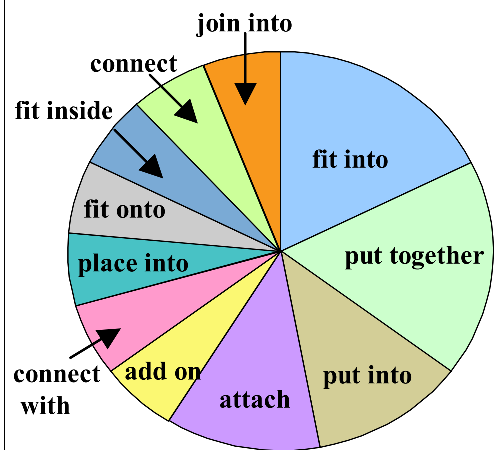
<table>
<tr><td>English: Preposition/adverb only</td><td>English: Verbs included in the coding</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Japanese: verbs</td><td></td></tr>
<tr><td>
</td><td></td></tr>
</table>

Figure 9.03b-2: piece into puzzle

English: Preposition/adverb only



English: Verbs included in the coding



Japanese: verbs

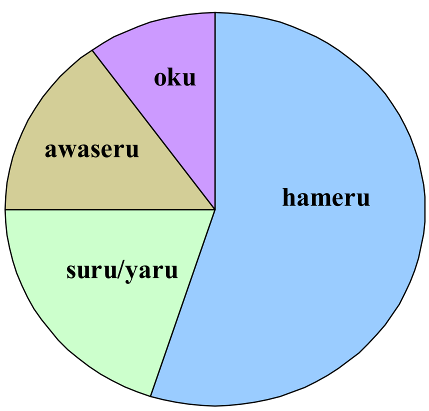


Figure 9.03c-1-2 Examples of join relations: 'together' category in English: 'join pop bead (2 attach to 2) and 'join magnetic train cars'

Figure 9.03c-1: join pop beads (2 attach to 2)

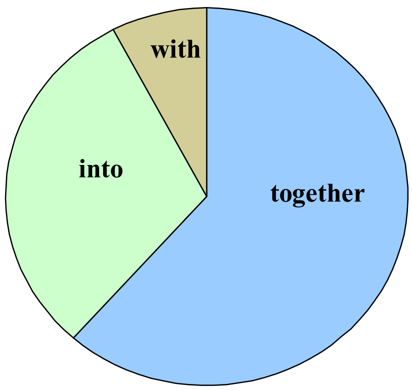
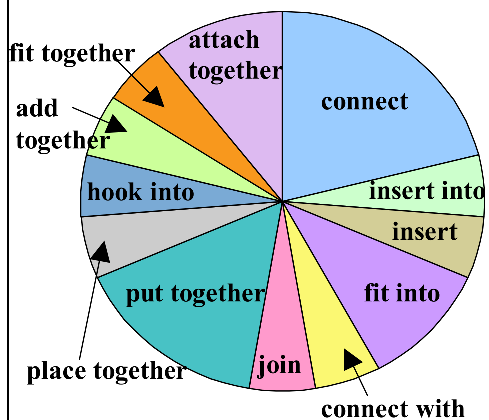
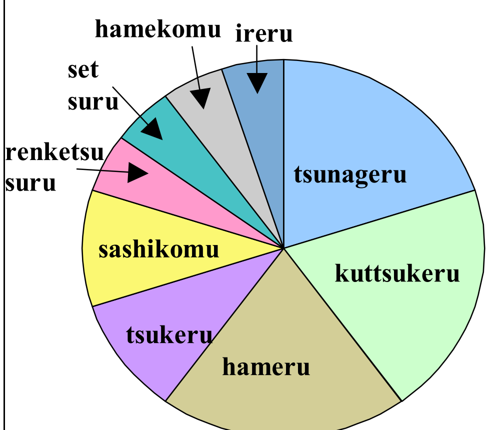
<table>
<tr><td>English: Preposition/adverb only</td><td>English: Verbs included in the coding</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Japanese: verbs</td><td></td></tr>
<tr><td>
</td><td></td></tr>
</table>

Figure 9.03c-2: join magnetic train cars

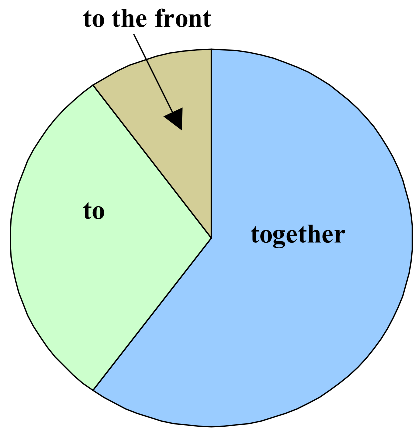
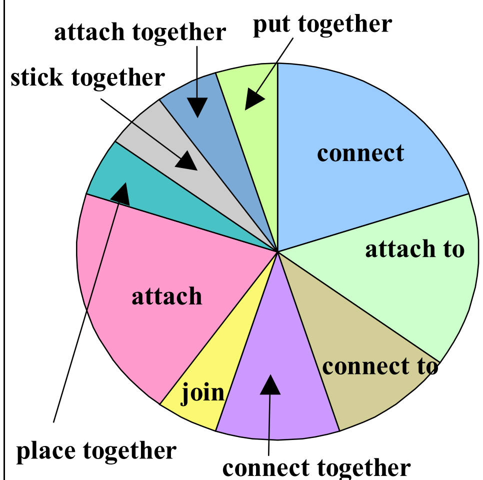
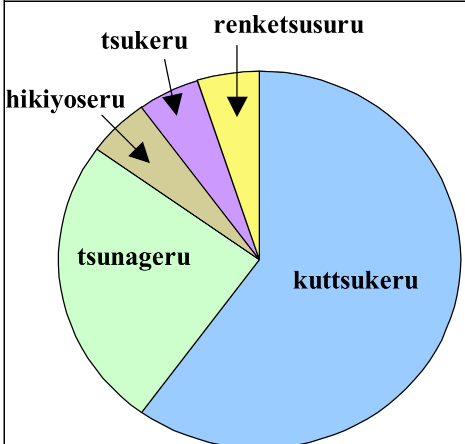
English: Preposition/adverb only	English: Verbs included in the coding
	
Japanese: verbs	
	

Figure 9.03d-1-2 Examples of close relations: ‘close box’ and ‘close suitcase’

Figure 9.03d-1: close box

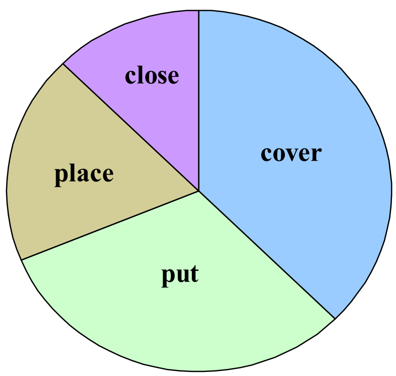
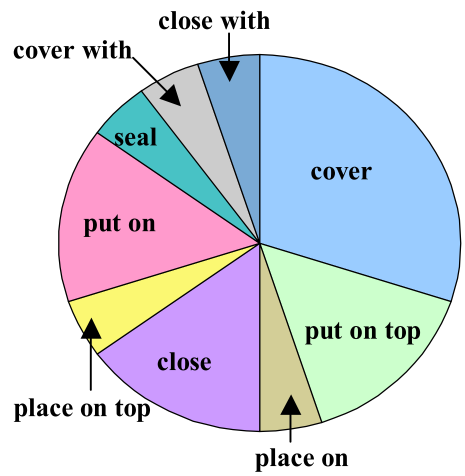
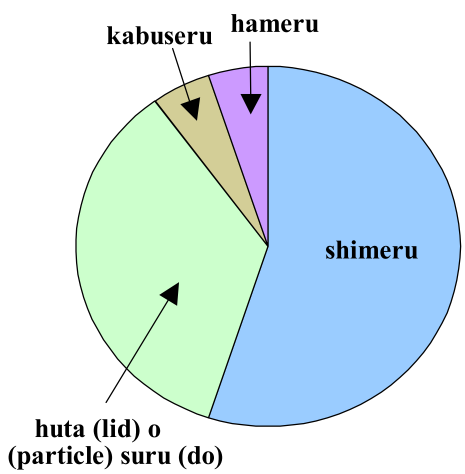
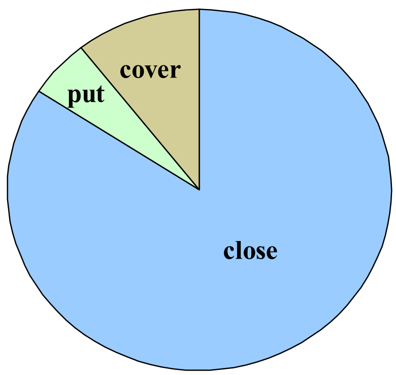
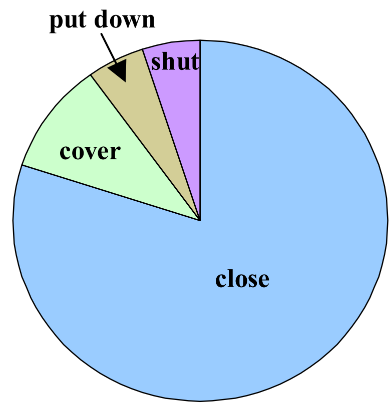
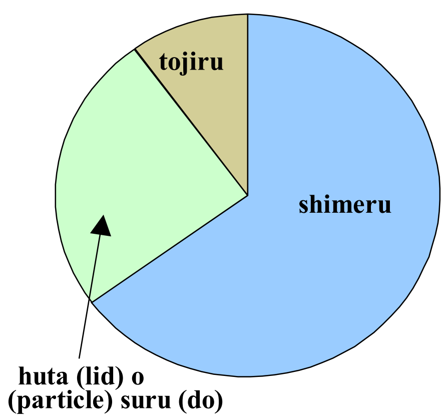
<table>
<tr><td>English: Verb only</td><td>English: Preposition/adverb included in the coding</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Japanese: verbs</td><td></td></tr>
<tr><td>
</td><td></td></tr>
</table>

Figure 9.03d-2: close suitcase

English: Verb only	English: Preposition/adverb included in the coding
	
Japanese: verbs	
	

As seen in the patterns of spatial categories between the two different coding systems used in English as well as those categories compared to the Japanese spatial categories in the previous charts, when the verb-plus-preposition/adverb combination coding system was used, more various spatial categories were produced than when the prepositions/adverbs were coded alone. When verbs were included in the coding for the data in English, the number of various spatial terms were observed not only in Japanese but also in English across different spatial relations (support, containment, join and close relations).

Discussion

When conducting cross-linguistic studies, the issue often raised is whether the comparison of individual lexical items between languages is comparable. Each language has a different structure and no language is identical. In the same manner that Choi and Bowerman compared Korean verbs to English prepositions/adverbs (as reported Bowerman, 1996a)[8], English and Japanese spatial terms (English prepositions/adverbs vs. Japanese verbs) were compared in Experiment 2 and significant differences among spatial terms produced between the languages were found. The question here is whether the English prepositions/adverbs and the Japanese or Korean verbs were semantically comparable. As discussed earlier, prepositions/adverbs convey the information of static spatial relations whereas verbs convey both manner and path information in the descriptions of dynamic spatial events. It is crucial to re-examine whether

[8] Note that Choi and Bowerman only indicated the 3 verbs for 5 items and indicated the spatial categories based on the verbs responses. For the 38 items they tested, they did not specify verbs used by the speakers and spatial categories were drawn based on the prepositions responses.

coding verbs plus prepositions/adverbs rather than prepositions/adverbs only in English may influence the way we draw the conclusions of spatial categorizations.

The purpose of this chapter was first to re-examine the English (Description Group) in Experiment 1 and the Japanese data in Experiment 2 and compare the combinations of verbs plus prepositions/adverbs in English to Japanese spatial verbs. As the results showed, semantically more comparable comparisons of the two languages showed that English speakers can describe the dynamic spatial events in more various ways. It should be noted that the purpose of the present experiment was only to examine whether the number of different spatial terms produced for dynamic spatial relations are similar among languages. The results also indicated that when verb-plus-preposition/adverb combinations were coded, it increased the degrees of freedom in the number of different responses that can be produced by the English speakers. For example, for the item, 'lid on pan', one can describe the relation as "put on top of the pan", and another says "put it (the lid) over it (the pan)". In this case, two different combinations of descriptions were created using the same verb, 'put', by changing the prepositions (e.g., on, over).

The differences in the number of different spatial terms produced between Japanese and English (verb-plus-preposition/adverb combinations) are partially attributable to the comparison of one word in Japanese versus two words in English. As seen in the results, the number of different terms produced for the 41 spatial relations between all of the groups (English preposition/adverb only coding; English verb-and-preposition/adverb combination coding; and Japanese verbs) was significantly correlated indicating that even though more various responses were found in the combination of verb-plus-preposition/adverb coding, there are similarities in the number of different terms produced per relation between the groups. Furthermore, when both verbs and prepositions/adverbs produced by the English speakers were coded rather than coding prepositions/adverbs only (see Experiment 1), the number of different spatial descriptions produced between English and Japanese did not show a significant difference (See Experiment 2 for the results of the comparison of the prepositions/adverbs only coding in English vs. Japanese verbs). It is possible that spatial information interpreted at a more comparable semantic level (meaning) is similar regardless of which language we speak, but once the information is lexicalized using words, the meaning is then formed to fit the characteristics of the language.

In addition, the means of agreement rates to the most frequent response among the speakers of both languages are low for certain relations. Comparing the data based on the 4 main categories (i.e., support, containment, join, and close), there are significant differences in the variability of the responses given by the participants. As also seen in the results of Experiment 2, the relations in the 'join' category indicated the highest variability in the participants' responses among the 4 categories. Again, the more variability in the responses for the joining relations is likely due to the figure-ground problems in the relations.

The examples of the spatial relations for each category in Figures 9.03a-d indicated how individuals use language in unique ways and how one particular spatial relation can be described in various ways. For example, the item, 'rubber band on box' showed more variability in the participants' responses in both languages than the item, 'scarf on head'. It seems that there are more variable responses for the previously mentioned relations (e.g., join), such as 'join magnetic train cars', 'piece into puzzle' 'rubber band on box' when verb-and-preposition/adverb combinations were coded. Using the coding system of verb-plus-preposition combinations provides a greater number of spatial categories in English than is seen in Japanese. This indicates that using different coding methods influences the results and interpretation.

As the results indicated, regardless of which language we speak, we perceive space in perhaps a more differentiated way than can be indicated by single lexical items in English. We make lexical spatial categories by coordinating the language we acquired to our spatial cognition. Therefore, organization of spatial relations is not as clear-cut as traditionally thought. This result would lead to the conclusion that we have flexible cognitive abilities. However, the crucial question is whether or not the spatial categories have the same boundaries. This will be discussed in the following experiments.

However, it should also be mentioned that even though space can be flexibly lexicalized, as previous research indicated, there are differences in the way we lexically categorize space between languages. Recent findings indicated that both the English and Korean young infants (14-month olds) were sensitive to tight- and loose- fitting spatial relations but starting around 24-months, the infants living in English-speaking environment become less sensitive to tight- and loose-fitting contrasts (Choi, 2006; Choi & McDonough, in press; McDonough et al., 2003). It is possible that once infants start to acquire words from their language environments, the linguistic input influences the way infants categorize spatial relations. Once language is fully acquired, it plays a role as a filter for organizing incoming information, so that the differences among languages would still appear in the categorization of space.

Chapter 10

Experiment 3: Using filmed demonstrations

One confound that may influence interpretation of the data in Experiments 1 and 2 is that there may have been inadvertent inconsistencies between the modeling of a relation from one participant to the next thus influencing the variability among participants' responses. For example, an English speaker may describe - 'ring on pole' relation as "dropping the ring on the pole" or "pushing the ring onto the pole"- descriptions that may lead one to believe that two different relations were modeled, one tight-fitting and the other loose-fitting. To address this issue, a digital video disc (DVD) was made so that every participant in the present experiment would be shown each relation performed in exactly the same way.

There are three main purposes in this present experiment. The first goal of Experiment 3 is to investigate whether responses from the DVD stimuli replicate the data from Experiment 1 as reported in both Chapters 7 and 9. One may claim that the variability found in the data was due to inconsistent modeling of spatial relations by the experimenter. The second purpose of testing the DVD stimuli is to determine its value as a tool that can potentially be used in future experiments investigating spatial relations in other languages. It was predicted that the DVD data would replicate the previous results. If the data replicates the previous experiments then the variability is not due to any inconsistencies in modeling from one participant to the next participant. Replication will also show that responses to the videotaped models can be used in the future to explore spatial relations as lexicalized in other languages. The DVD stimuli would be useful to other experiments, since it is easier to administer without having to manage all the objects or carry them from one location to another.

The last goal is to examine to see how our minds flexibly coordinate spatial language with the incoming spatial information. To address the issue, the participants in the present experiment were asked to describe the relations in at least three different ways. If more than one spatial term is produced for a given relation by the participants, the spatial descriptions will overlap for the relation. In Choi and Bowerman's study (Bowerman 1996a), the 3 joining actions in the join category were overlapped with the 'on' category. That is, some participants described a joining relation as "put together" whereas others simply said "put it on" when referring to joining one train car to another. Based on previous research, it is predicted that the participants will produce more than one spatial description for each relation. However, the crucial issue is whether or not the different responses will approximate the semantics of Japanese or Korean. That is, do English speakers provide information about the fitting relation (a relation that is not optional in Japanese or Korean) when given the opportunity to describe a relation in more than one way?

To approach the goals, the participants in Experiment 3 were asked to describe each spatial relation in at least three different ways. The participants' first spatial descriptions produced for each relation in Experiment 3 will be compared to the spatial terms produced in Experiment 1 (by preposition/adverb only and by verbs only) and the comparisons in Chapter 9 (verb-plus-preposition/adverb combinations). Note that since the data from the Inference and Description groups were significantly correlated in all types of comparisons (by verbs only, by prepositions/adverbs only, and verb-plus-preposition/adverb combinations) the data from both groups of the participants were combined into a single group (N = 40) and will be compared to the data collected from participants in the DVD task.

Methods

Participants

Native English-speaking adults (N = 40) who were students in an Introduction to Psychology course (Psy 1.1) were recruited from a subject pool in the Psychology Department in Brooklyn College. The students who participated in the study were given experimental credits to fulfill partial course requirements.

Stimuli

A DVD disk that included scenes of the modeled spatial relations with the 41 pairs of objects used in Experiments 1 and 2 was used. There were 5 differently sequenced versions on the DVD. As preliminary testing with Japanese young children revealed that they provided more responses when the actions were fully demonstrated rather than when the actions had to be inferred, completed demonstrations were filmed and chosen for the DVD.

Procedure

The sequence of the 41 scenes was presented in 5 random orders. Eight participants were assigned to each of the five versions in the DVD. One of the reasons for testing 40 participants for 5 random orders was to evaluate for any possible order effects. If, for example, spatial relations were tested in a sequence, then one response may prime subsequent responses among the similar items. By providing the different orders, any possible priming effects should be minimized. Participants were tested individually in a lab. Each participant was asked to describe the demonstrations of the actions in each scene on the DVD.

Coding

Participants were instructed to describe the relations shown in at least three different ways and more ways if they could. For example, for the item, ‘big ring on pole’, one may first describe the relation as “put the ring on the pole”, and then as “put the ring over it” and “make the pole go through the ring.” Participants’ responses were audio taped, then later transcribed by a coder naïve to the hypotheses of the experiment and then entered for statistical analyses by the author.

For the purpose of comparing Experiment 3 to the previous data (both the Inference and Description groups), the ‘first spatial’ responses were coded for the analyses. The data were coded in the same ways for the comparison of verbs only (e.g., ‘put’), prepositions only (e.g., ‘on’), and verb and preposition/adverb combination (e.g., ‘put + on’, ‘put + together’) responses.

For purposes of examining the flexible language and cognition in space, the numbers of unique responses were compared for each relation within each participant. In the case of the example in the previous paragraph, the participant produced 3 different responses. There are a few cases where the participants did not provide a spatial response in their first response but did so in their second responses. In this case, the second spatial response was coded. Some participants provided more details of the actions demonstrated in the scenes. For example, for the item, ‘hat on’, one may describe the action as “woman picked up the pink pretty hat then placed the hat on her head”. In this case, there are two spatial descriptions, ‘picked up’ and ‘placed on’, however, only the target spatial term, ‘placed on’ was coded.

No spatial response

Two participants did not consistently produce spatial terms. They focused on describing the properties of objects such as shape, number, color or function. One did not produce spatial terms in 26 of the 41 relations, the other for 15 of the 41 relations. As a result, there are some missing data in the final analyses. Zeros were entered for these missing data for purposes of the analyses.

Results

One goal of the present experiment was to replicate the results of the data collected in Experiment 1 and to investigate whether the variability in the previous participants’ responses was due to inconsistent modeling of spatial relations across participants. To approach this issue, verbal descriptions of the spatial relations coding for prepositions/adverbs as well as coding for verbs plus prepositions/adverbs and the DVD task in the present study were compared. As discussed in Chapter 9, differences in coding provide different pictures of spatial categories, thus the data were analyzed in three levels: verbs only, prepositions/adverbs only and verb-plus-preposition/adverb combinations. For the DVD task, the spatial descriptions coded were the first spatial responses.

Replication of Experiment 1 using the filmed DVD stimuli

Dependent Measure

The number of different spatial terms produced per relation and across the 41 relations were compared by prepositions/adverbs, by verbs, and by verb-plus-preposition/adverb combinations) between the present experiment and data from Experiment 1.

First, the first spatial terms produced for each relation by the 40 participants in this experiment were compared to the results of the Inference and Description groups (combined). The purpose of this analysis is to examine whether the responses of the English speakers tested using the DVD stimuli would replicate the previous results. The results of Independent sample t-tests showed that there are no differences in the number of unique responses per relation produced by the participants in Experiments 1 and 3 (see Table 10.01). In addition to the analyses, the correlations between the groups were tested. The result indicated that the number of unique spatial responses for each relation were significantly correlated between the two groups (by prepositions/adverbs: $r = .48$, $df = 40$, $p < .01$; by verbs: $r = .53$, $df = 40$, $p < .001$; by verb-plus-preposition/adverb combinations: $r = .72$, $df = 40$, $p < .001$). As predicted, there are no differences in the results of the previous and present data.

Table 10.01 The comparisons of the mean number of spatial terms produced per relation by the participants in Experiments 1 and 3 (N = 40 in each group).

Comparisons	*t*	*p*	Means and Standard Errors
By prepositions/ adverbs	t = - .63, df = 80	p = .53	Experiment 1 vs. 3: M = 4.37 vs. 4.12; SE = .32 vs. .22, respectively
By verbs	t = 1.71, df = 80	p = .09	Experiment 1 vs. 3: M = 5.02 vs. 5.83; SE = .28 vs. .37, respectively
By verb-plus-preposition/ adverb combinations	t = .93, df = 80	p = .35	Experiment 1 vs. 3: M = 10.46 vs. 11.34; SE = 4.36 vs. .4.16, respectively

Table 10.02 The comparisons of the mean number of spatial terms produced by each of the participants in Experiments 1 and 3 (N = 40 in each group). Note that the first spatial response in Experiment 3 was the dependent measure for the purpose of these comparisons.

Comparisons	*t*	*p*	Means and Standard Errors
by prepositions/ adverbs	$t = -1.87$, $df = 78$	$p = .07$	Experiment 1 vs. 3: $M = 7.93$ vs. 7.13; $SE = .32$ vs. .29, respectively
By verbs	$t = .39$, $df = 78$	$p = .70$	Experiment 1 vs. 3: $M = 8.35$ vs. 8.63; $SE = .52$ vs. .47, respectively
By verb-plus-preposition/ adverb combinations	$t = 1.65$, $df = 78$	$p = .10$	Experiment 1 vs. 3: $M = 16.20$ vs. 17.83; $SE = .68$ vs. .72., respectively

As seen in the results, the means of responses per relation as well as per participant did not show significant differences between the groups. This result indicates that the DVD task replicated the results in Experiment 1, and the DVD can be a useful tool to make future cross-linguistic comparisons of spatial languages.

Flexible language and flexible lexical categories

To investigate our ability to coordinate the spatial information and spatial language, the numbers of different spatial terms produced for each relation were compared. For example, when each participant provides 2 or more different spatial terms for one relation, this finding indicates that we have the flexibility to coordinate spatial language with spatial information in various ways.

Dependent Measure

The number of different spatial terms (verb-plus-preposition/adverb combinations) produced for each relation were compared in two different ways: by relation (across participants) and by participant (across relations). The data by relation provides the mean number of different responses by participants for each relation. The data by participants reflects how many responses on average were given by an individual for each relation in the task. The means for these analyses should be the same but the range of scores should differ because the data are being examined either by relation (across participants) or by participant (across relations).

The mean numbers of different descriptions per relation which used verb-plus-preposition/adverb combinations were 1.42 (range: 1.15 to 1.78). The mean numbers of spatial descriptions by each of the participants which used verb-plus-preposition/adverb combinations were 1.42 (range: 0.41 to 2.44). This result of the multiple responses made by the participants indicates that we can flexibly describe the various spatial relations by using different terms. As seen in this experiment, lexical spatial categories are not clearly delineated and are rather overlapped in between the flexible boundaries of categories. As previously mentioned, the challenge of describing spatial relations is applying a consistent propositional framework, that of language, onto an analogue format.

In addition to the main purposes of the study, the data were further analyzed to investigate whether more variable responses would be observed in one spatial relation than the others. According to Choi and Bowerman's study, the 3 spatial relations in the 'join' category overlapped to the 'on' category. To examine whether the same results would also appear in the present experiment, the mean number of spatial terms among the categories were compared by verbs, by prepositions/adverbs, and by verb-plus-prepositions/adverbs. Based on the findings reported by Choi and Bowerman (Bowerman, 1996a) as well as the variability appeared in the combination of verb-plus-preposition/adverb comparisons in the join relations in Chapter 9, it is predicted that more variable responses would be produced by those relations in the 'join' category.

Categorical comparisons

Dependent Measure

The number of different spatial responses produced per relation were compared between the relations in 4 categories (close, containment, join, and support).

The number of different spatial responses produced per relation was first examined among the English-based categories: containment, support, join, and close. To examine whether there would be more variability in the number of spatial terms among the categories, the mean number of spatial terms (by verbs, by prepositions/adverbs, and by verb-plus-preposition/adverb) produced for these relations were compared by conducting one-way ANOVAs (Dependent measure: the number of different spatial terms produced per relation for the relations between the 4 categories (close, containment, join, and support)). The results indicated that there was a significant difference in the mean number of different verbs produced between the 4 categories (F (3, 35) = 5.38, p = .01). No significant differences were found by prepositions/adverbs or by verb-plus-preposition/adverb comparisons between these categories (see Table 10.03-a).

Table 10.03-a The means of different spatial terms, by verbs, by prepositions/adverbs, and by verb-plus-prepositions/adverbs (Dependent measure), were compared between the English categories: close, containment, join, and support.

Category	Number of relations	By verbs	By prepositions/ adverbs	By verb-plus-preposition/ adverb
'Close'	3	*M* = 5.67	*M* = 4.33	*M* = 10.33
'Containment'	8	*M* = 4.75	*M* = 4.00	*M* = 10.75
'Join'	6	*M* = 8.83	*M* = 3.67	*M* = 15.00
'Support'	22	*M* = 5.36	*M* = 4.32	*M* = 10.68
The results of the ANOVAs		F (3,35) = 5.38 $p < .01$	F (3,35) = .36 $p = .79$	F (3,35) = 1.90 $p = .15$

To further investigate, whether the spatial relations in the 'join' category would be different from the other categories, the post hoc test, Tukey HSD ($p = .05$), was conducted. The results revealed that the mean differences in between the join category versus containment and support categories are significantly different from one another. However, no significant difference was found in the comparisons of the mean differences in between the join category and close category in both of the Tukey HSD tests (see Table 10.3-b for the comparisons of verbs in the post hoc tests).

Table 10.3-b The results of post hoc test, Tukey HSD for the comparisons of the mean of the verb responses among the categories (Dependent measure).

Comparisons	Contrast category to 'join' category	Mean difference between categories	Standard Error	Significance
				Tukey
By verbs	Close	3.17	1.45	$p = .15$
	Containment	4.08	1.11	$p < .01$
	Support	3.47	.947	$p < .01$

As reported earlier, there are 3 spatial relations in the 'join' category which overlapped with the 'on' category in Choi and Bowerman's study (Bowerman, 1996a). When those 3 relations were treated as part of the 'on' category, the comparison of the Tukey HSD post hoc test indicated the significant differences between the 'join' and the 'close' category (join (M = 10.33) vs. close (M = 5.67); mean difference = 4.67, SE = 1.66, $p < .05$) which did not show a statistically significant difference ($p = .15$).

To examine the unique characteristics of responses in each of the categories, the three different forms, verb only, preposition/adverb only, and verb-plus-preposition/adverb combinations, used to describe the 41 relations were compared among the categories. For this analysis, the number of the participants that used one form more than the other two forms was examined. As seen in Table 10.04, the combinations of verb-plus-preposition/adverb form were used most for the relations in 4 of the 6 categories, fasten, join, containment and support. For the fastening and joining relations, the participants who used the verb-plus-preposition/adverb form were less than 70% of the participants and the rest of the approximately 30% of the participants used the verb only form. None of the participants used the preposition/adverb only form for the buttoning, fastening, and joining relations (in English, such phrasing would be ungrammatical and awkward) whereas few participants were still able to describe the closing, containing, and supporting relations using the preposition/adverb only form. For example, a description, ‘a baby in a tub’ was produced for the item, ‘doll into bath’. On the one hand, the verb only form was used most to describe the closing and buttoning relations. However, even within the close category, there are wide ranges in the agreement of the form used to describe the spatial relations. For example, for the items, ‘close suitcase’ or ‘close cassette case’, there are higher agreements in the use of the verb only form whereas for the item, ‘close box’, the participants responses were split into the verb only and verb-plus-preposition/adverb form (verb only: 41.03; verb-plus-preposition/adverb: 58.97); for example, the descriptions, ‘put the lid on top of the box’, ‘place the lid on the box’ (verb plus preposition/adverb combination) were produced for the item, ‘close box’ instead of describing the item as ‘close it’, ‘cover it’). All of the participants produced the verb-plus-preposition/adverb form for the relation, ‘bandaid on hand’. These results have supported the two points made previously. One is that the boundaries among the spatial relations are flexible and can be described in various ways which is based on how viewers perceive and interpret the spatial information in terms of the language we use in our everyday lives (Huttenlocher & Lui, 1979). The other point is that we humans have the flexible ability to coordinate the spatial information with language.

Table 10.04 The mean of percentages the different types of forms used to describe the spatial relations in each category by the English-speaking adults (N = 40) (Dependent measure). The means indicated in bold is the highest mean observed in a category and among the three forms (verb only, preposition/adverb only, and verb-plus-preposition/adverb combination), this particular form was used most to describe the relations in the category.

Category (the number of relations)	Different types of forms used in descriptions		
	Verb only (%)	Preposition/ adverb only (%)	Verb+ preposition/adverb combinations (%)
Close (3)	***M* = 67.19** Range: 41.03 - 80.56	*M* = .83 Range: 0-2.5	*M* = 31.14 Range: 15-58.97
Button (1)	***M* = 74.36**	0	*M* = 25.64
Fasten (1)	*M* = 30.77	0	***M* = 69.23**
Join (6)	*M* = 31.11 Range: 24.32-37.84	0	***M* = 68.45** Range: 62.16 – 75.68
Containment (8)	*M* = 5.83 Range: 0-17.95	*M* = 1.92 Range: 0-5.13	***M* = 92.26** Range: 82.05 - 97.44
Support (22)	*M* = 8.72 Range: 0-38.46	*M* = 2.46 Range:0-7.69	***M* = 88.82** Range:61.54 - 97.37

Note that the number within the parentheses indicates the ranges: from the lowest to the highest percentages (%) in the category)

In addition, the spatial descriptions provided by the participants were reexamined to see whether the degree of tight-fitting relations (such as spatial relations described with the spatial term, 'kkita' (meaning of tight-fit, mesh) in Korean) were captured by the English-speaking adults when they describe the spatial relations in more than one way. To evaluate this, all of the spatial terms provided by the participants were examined across the relations tested. As can been seen in Table 10.05, the results indicated that the degree of tight-fit in the descriptions was observed for 18 of the 41 relations in at least two of three languages. Few spatial descriptions indicating 'tight-fit' were made in English whereas many more tight-fit relations were described as such by the Korean and the Japanese speakers (see Bowerman, 1996a for Korean spatial terms; see Experiment 2 for Japanese spatial terms).

Table 10.05 The number of the English-speaking participants (N = 40) which indicated the degree of tight-fit relations using the terms, push, fit, and/or stick for the 18 relations indicated below. Corresponding spatial terms were also indicated for the relations. The bold indicates those spatial terms in the language that do not include the degree of tight-fit.

Spatial relations	Category	Number of English spatial terms which indicate the degree of tight-fit			English terms which indicated the degree of tight-fits	Corresponding responses in Korean	Corresponding responses in Japanese
		push	fit	stick			
lid on pan	on	0	1	0	fit on	**tepta (cover)**	shimeru
fasten velcro	fasten	0	0	19	stick together	pwuchita	kuttsukeru, tsukeru
button dress	button	**0**	**0**	**0**	**n/a**	kkita	hameru, kakeru
join pop beads (2 attach to 2)	join	2	1	1	push onto, fit together, stick in	kkita	kuttsukeru, hameru
join legos (2 attach to 2)	join	2	1	0	push/fit together	kkita	hameru, kuttsukeru, awaseru
join legos (1 attaches onto 3)	join	2	1	0	push to, push/fit together	kkita, pwuchita	hameru, kuttsukeru
join pop beads (1 attaches onto 3)	join	2	1	0	fit into, push together/in	kkita	hameru, kuttsukeru, tsunageru
join magneti c train cars	join	0	0	1	stick together	pwuchita	kuttsukeru
hook train cars	join	0	0	1	stick together	**kelta (hook, hang)**	kuttsukeru, hameru, tsunageru, kakeru
suction cup hook on wall	on	1	0	23	stick on/onto/to, push	kkita, pwuchita	kuttsukeru, haritsukeru

Table 10.05 Continued.

bandaid on hand	on	0	0	1	stick to	kkita, pwuchita	haru
top on pen	on	**0**	**0**	**0**	**n/a**	kkita	shimeru, hameru
small ring on pole	on	2	3	0	push (down), fit around/ together	kkita	hameru, ireru
Pillow-case on pillow	on	0	2	0	push/fit in	kkita	kakeru, ireru
big ring on pole	on	0	2	0	fit around/onto	nehta, kkita	**ireru (put in), kakeru (hook, hang)**
rubber band on box	on	0	3	0	fit on/around	(no data provided*)	kakeru, tomeru, hameru
piece into puzzle	into	2	5	0	push into, fit on/in (into)/ together	kkita	hameru
cassette into case	into	3	2	0	push/fit in (into)	nehta, kkita	**ireru (put in)**

* no data were provided due to the inconsistent responses

Discussion

The first goal of this experiment was to replicate the findings in Experiments 1 and 3. As was predicted, the task with the already filmed demonstrations on the DVD replicated the results of Experiments 1 and 3, even though in Experiments 1 and 3 the stimuli were demonstrated in the real time modelings using toys and objects from everyday life by the experimenter. The results indicated that there were no significant differences between the present experiment and Experiments 1 and 3 and that the groups of the participants in both experiments were significantly correlated with one another. Since the prediction was met, the DVD stimuli proved acceptable to use in testing spatial relations in other languages. The DVD stimuli can be demonstrated on the laptop computer screen, thus allowing testing of other languages in various geographical locations. The variability in the production of spatial terms was not due to the inconsistent modeling in previous data but rather due to the unique responses produced by each of the participants. The other way to explain this is that the participants tested in Brooklyn, New York are possibly from a more multicultural environment and were more likely to have been exposed to more than one language in their every day lives than the participants tested by Choi and Bowerman.

Another goal was to investigate how we flexibly coordinate our language in our descriptions of spatial relations. To approach this, the number of different spatial descriptions (verb-plus-preposition/adverb combinations) were examined by relation and by participants. This indicated that we can flexibly coordinate the spatial information with language and describe the space in a flexible manner. It should be noted that even though the participants were asked to describe the activity in each scene in a minimum of 3 different ways, not every relation was described in three or more different ways. Furthermore, as seen in the ranges, there was variability in the number of responses provided among the relations and among the participants. The way we coordinate spatial information with language is flexible, but how we coordinate them also depends upon each person and/or stimuli.

Additionally, the current experiment investigated whether the relations in one category may have produced more variable responses than the relations in the other categories. This was examined to approach the issue of variable responses more closely. As was predicted, the results showed that there is a significant difference in the number of different spatial verbs produced for each of the relations between the join and close categories in the context of the present stimuli. As previously discussed, figure-ground ambiguity can give rise to more unique ways of describing a spatial relation.

To investigate whether there were patterns of choosing one particular form over the others in a category, the participants' responses for the 41 relations that used one of those 3 different forms (verb only, preposition/adverb only, verb-and-preposition/adverb combination) were compared among 6 English based categories. As seen in Table 10.04, motion events depicting spatial relations can hardly be described by prepositions/adverbs alone. Except for close and button categories, verb-plus-preposition/adverb combinations were used to describe the motion events. Based on the results, it can be assumed that spatial categories for the motion events are flexible and the categorical boundaries are more complex than it was originally reported.

Lastly, the present experiment examined whether there are similarities/differences in the way the speakers of different languages semantically capture the space. To investigate this, all of the spatial descriptions provided by the participants were reexamined to see whether the English speakers were able to capture the degree of tight-fit when they talk about spatial relations. As seen in Table 10.05, only a very small number of the English speakers were able to capture the degree of tight fit compared to Korean or Japanese. It should further be noted that the speakers of each language did not capture the degree of tight-fit for 2 of the 18 relations. In other words, speakers of all three languages captured the degree of tight-fit for the 12 relations, however, each of the three languages did not describe the tight-fit for 2 of the 6 relations. For example, the terms, 'ireru' (meaning of put in) and 'kakeru' (meaning of hook or hang) were produced for the item 'big ring on pole'. For the same item, the Korean speakers showed higher agreement in the response, and produced the terms, 'nehta' (meaning of put in) or 'kkita' (meaning of fit, mesh). For the same item, a very small number of the English speakers also produced the terms, fit onto/around. These results indicate that semantic categorization of space is different from one language to another.

A close examination of the responses for the tight-fit relations, showed that spatial terms such as connect, attach, or join, were frequently produced by English speakers especially for the joining relations. It is possible that these spatial terms may semantically overlap with 'kkita' (fit, mesh) or 'pwuchita' (stick on, put together) in Korean and 'hameru' (fit, put) or 'kuttsukeru' (stick, put together) in Japanese. Even though there seems to be some semantic overlap in the terms used across languages, the differences among English, Korean, and Japanese clearly appear in the semantic spatial categories.

Chapter 11

Experiment 4: Developmental comparison of Japanese spatial language

The main purpose of the present experiment is to investigate the developmental changes in the acquisition of spatial language among Japanese children from 2- to 5-years old. As discussed in Experiment 2, very little developmental research has been conducted on the acquisition of Japanese spatial terms. We do not know when spatial terms are produced by Japanese-speaking children, or when they extend words correctly. Only one study is found in the literature. As previously discussed, Sinha et al. (1994) studied the acquisition of spatial terms in Danish (N = 2), English (N = 2), and Japanese (N = 1). They reported that the numbers of locative verbs were produced as frequently by the Japanese-speaking child as Danish children's locative particle productions. The Japanese-speaking child produced less frequent locative particles than verbs because locative particles need to be used with locative nouns to express spatial meanings. The data suggest that the Japanese-learning child learns locative particles and locative nouns slowly, whereas locative verbs were acquired faster due to the highly frequent inputs. Note that Japanese locative particles have a similar role as English prepositions have. Using Japanese locative particles and locative nouns, they only provide the information of static spatial relations (e.g., location of objects). To describe dynamic spatial relations, verbs need to be used to fully describe the manner and path of motions. Differences in acquisition may be due to the frequency of input as well as the linguistic characteristics for describing spatial relations. Sinha et al. (1994) suggested that regardless of the language being learned, children are using 'conservative learning strategies' to apply meanings to particular linguistic forms. They concluded that the structures of language may be influencing the acquisition of the meaning of spatial relations.

However, the data analyzed in the Sinha et al. (1994) study were based on spontaneous speech by a very small number of children. Furthermore, the Danish and English children were raised by parents who are native speakers of the language whereas the one Japanese child was living in a bilingual environment of Danish and Japanese but the child's dominant language was reported as Japanese. It is crucial to test monolingual Japanese-speaking children living in a monolingual environment.

The main goal of the present experiment is to explore the development of spatial language among monolingual Japanese learning children from age 2 to 5 years old. Spatial terms produced by the young children will also be compared to the adults' spatial language. It is predicted that the number of different spatial terms produced by the younger group will be smaller than that of the older groups. It is also predicted that the acquisition of spatial terms by the older group will also be smaller than those of the adults. This prediction is based on the hypothesis that the older group of children is still acquiring language and due to the complexity of spatial terms in Japanese, these terms may not yet be fully acquired. If children produce more precise spatial terms as they develop (as would be predicted based on vocabulary growth), their overgeneralizations and other errors should decrease with increasing age. If no differences in the production of numbers of spatial terms accompany age differences, the children may still overgeneralize the words they learned.

If the children produce a smaller number of spatial terms for the same 41 spatial relations tested with the adults, it is possible that children are making overgeneralizations of the words (in this case, spatial verbs) that they have already learned. If the children produce the same number of spatial terms as adults (that is, they describe relations using the same variety of terms adults use), then they are likely to be comprehending the terms they have learned in the same manner adults do. After all, children learn language (linguistic categories) from adults, so one might expect that their linguistic categories to be the same. However, children also have smaller vocabularies and may make errors in service of communicative goals.

Method

Participants

A total of 46 two- to five-year-old monolingual Japanese-learning-speaking children were tested at a day care center in a suburb of Tokyo, Japan. To investigate the developmental changes in the acquisition of spatial terms, the children were divided into two groups: twenty-three younger children (age range: 2 years 4 months to 3 years 5 months; mean age: 2 years, 11 months, 26 days) and twenty-three older group children (age range: 3 years 6 months to 5 years 0 months, mean age: 4 years, 1 month, 2 days). (For the information regarding Japanese adult participants, see Experiment 2; English-and Korean-speaking children's age range: 2 years 0 months to 2 years 5 months, for more details see Bowerman, 1996a).

Stimuli

The same forty-one pairs of objects used in Experiments 1- 2 were used in the study. These objects are familiar to children as young as 2 years of age. There is a rather large advantage for using actual toys and modeling the relations over using the DVD (used in Experiment 3) with children. Actual toys or objects can be useful because children can play with the toys or objects so that this leads the children to become more engaged in the task. This technique also allows the experimenter to pace the experiment so the child is not overwhelmed or tired. Breaks were given as needed or requested by the child.

Procedure

All children were tested individually in a separate quiet room of the day care center. Most of the children were given a brief familiarization period to help them understand the procedure. The elicited-production task was conducted by demonstrating one of these relations with one of the 41 items. The sequence of administration of the spatial relations was randomized. Children were asked to tell to the experimenter how they describe the actions demonstrated by the experimenter. A preliminary study with young Japanese children indicated that the children provided many more responses when the relations were demonstrated using complete modeling than the partial modeling of spatial relations. Therefore, the complete modeling method was used.

The methods were highly similar to Experiment 2 with the exception that child-directed speech accompanied the task. For example, by showing objects and saying “Kore wa nanikana? Wakka dayone. Korewa po-ru dayone” (the direct translations to English are “What is this? This is a ring (, isn’t it?) This is a pole (, isn’t it?) ”), allows a child to be familiarized with the test objects. Then a completed action modeling (completed modeling that is the same modeling used in the Description Group in Experiments 1 (English-speaking adults) and 2 (Japanese-speaking adults)) was demonstrated with the objects. The child was then asked “Ima (watashi wa) (kore wo) naniwo (dou) shita ?/ Ima (kore ga) dounatta?” (the direct translations to English are “What (How) did I just do (with this (these) object(s))?/ What happened?”. These instructions may seem slightly different when translated into English but the meanings are as similar as possible. If the child did not respond, the experimenter completed the action again and asked, “ima kore dounatta ?/ima nanishita?” (The direct translations to English are “What just happened to these objects?/ What did I do?”). The experimenter waited for a child’s response, or repeated the action and the question. After the child responded, the next relation with the next set of objects was demonstrated until all 41 test items are administered. When the child did not respond for the item shown, the item was skipped and the experimenter continued to show the next item to the child. Some of children were tested across a few days because all of the experiment tasks had not been finished within the time allowed in their schedule for the day or because of the child’s attentional limitations at the time.

A set of 41 index cards was used for recording each response in each task by each child by the experimenter. All communication with the experimenter was done in the experimenter's and child's native language, Japanese. A summary of the study was explained to the principal and teachers of the day care center at the end of the study. All participants were thanked for their participation.

Results

The goal of this experiment was to examine how children acquire spatial terms as they develop. As predicted, the results indicate that the number of spatial terms produced by the younger group was significantly less than that of the older group. The older group produced significantly fewer spatial terms than adults. As will be seen in the details below, the child unique responses (errors) appeared more frequently among the younger children.

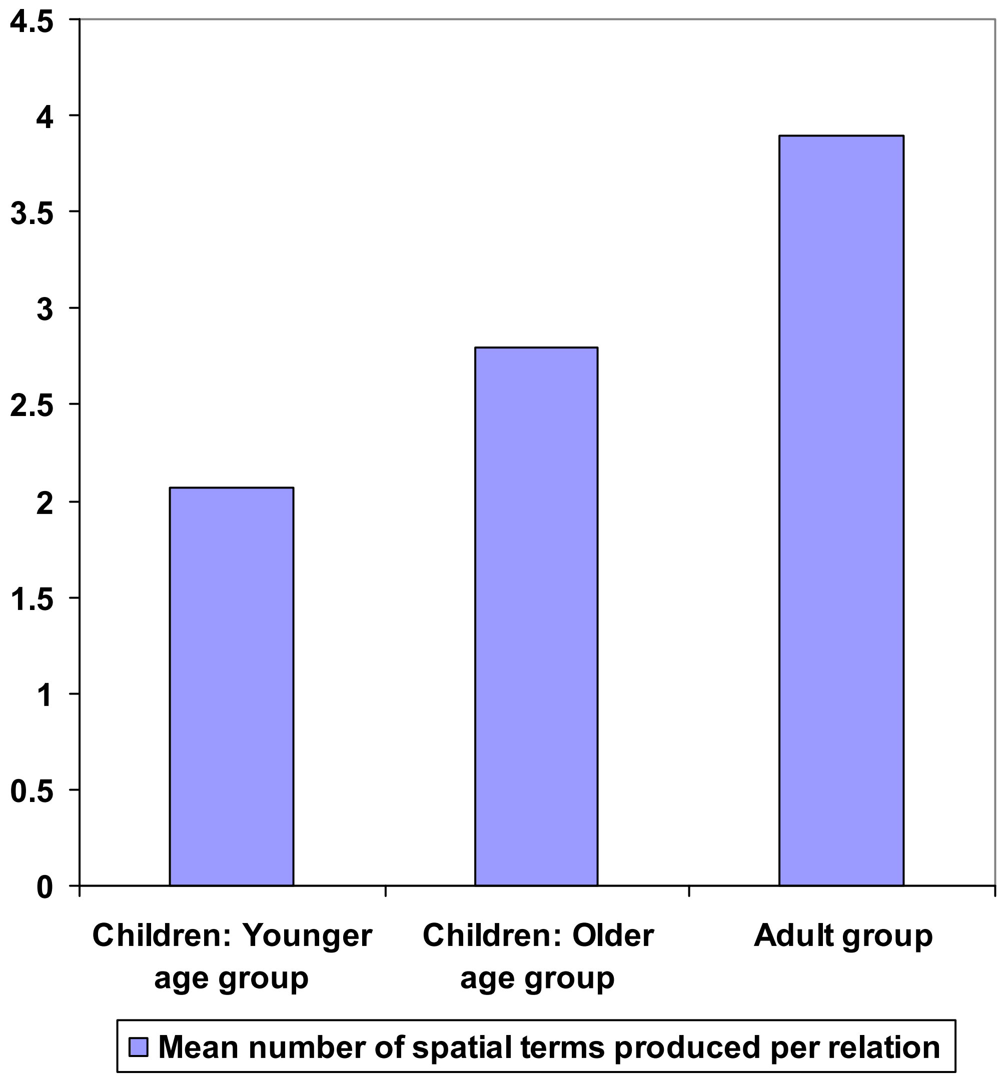
First, the number of different spatial terms produced per relation by younger and older groups of children was compared, and the number of different spatial terms produced per relation by both groups were then compared to those of Japanese-speaking adults (Experiment 2).

Dependent Measure

Spatial verbs in Japanese were compared among the younger and older groups of children and the adults (Experiment 2). The number of different spatial verbs produced per relation by each of the groups were compared.

As seen in Figure 11.1, the results indicated that the older group (M = 2.80) produced more spatial terms than the younger group (M = 2.07) (t (40) = -3.6, $p < .01$.). The adult group has a much larger spatial vocabulary (M = 3.90) than the children (younger group vs. adult group: t (40) = 5.79, $p < .001$; older group vs. adults group: t (40) = - 4.03, $p < .001$). The results showed that the younger group of children's vocabularies dramatically increase to describe spatial relations during the course of development.

Figure 11.1 The mean number of different spatial terms produced per relation (Dependent measure) by the younger and older groups of children and by the adults.



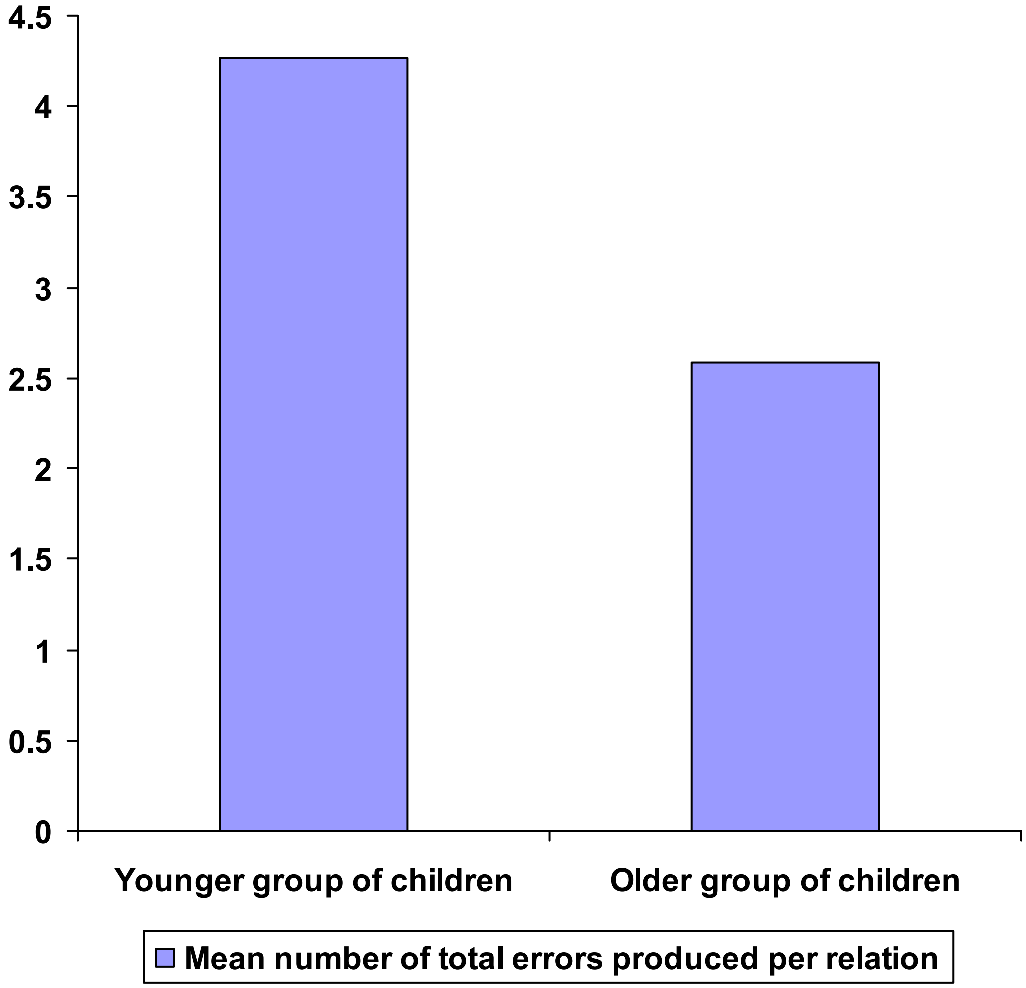
Next, the children's unique responses were analyzed.

Dependent Measure

The children's data were first separated into valid responses (those also produced by native Japanese adult speakers) and invalid responses produced for each relation. The invalid responses (or errors) produced per relation were categorized into 9 different types of responses: 1) overextension,2) onomatopoeia, 3) child-directed speech (baby talk), 4) imagination (the response comes from the child's imagination), 5) noun (the response is a noun, a non-spatial term), 6) general terms (the words have the meaning of either 'to do something' or 'to complete something'), 7) irrelevant terms (the response is not relevant to the action demonstrated), 8) non-spatial terms (the response is for the target action, not spatial term), and 9) non-target action words (not understanding the intention of the target actions in the context). Child-directed speech (baby talk) errors were only produced by the younger group of children.

The nine different types of responses are considered as child specific errors and each type of error was compared between younger and older age groups as well as to the adult group (see Figure 11.2 for the mean number of error responses produced per relation by each of the younger and older age groups). There were significant differences in the mean number of total errors produced per relation between younger ($M = 4.27$) and older ($M = 2.59$) children groups (t (40) = 5.15, $p < .001$; see Figure 11.2).

Figure 11.2 The mean number of errors produced per relation (Dependent measure) by the younger and older groups of children.



Among the different categories of error types, no significant differences were found between the two groups of children except for two types, 'general terms' (e.g., 'yaru' and 'suru' have the meaning of 'to do something'), and 'irrelevant responses' (the response does not describe the target action and it seems totally irrelevant to the spatial relation demonstrated). This will be discussed later.

A comparison of the number of overextension errors revealed that the older group (*M* = 1.51) produced more overextension errors than the younger group (*M* = .98) per relation (t (40) = -1.84, p = .07). This would be because the younger group produced other types of error responses such as child-directed speech (baby talk) responses. Onomatopoeia is another type of child unique response and was produced by both the younger and older groups of Japanese-learning children. For example, the term, 'patchin' is onomatopoeia, the sound like noise, was produced for the item, 'legos together'). The mean numbers of onomatopoeia produced per relation by younger children is .39 and by older children is .12 (t (40) = 1.84, p = .07). The details of onomatopoeia responses are indicated in Tables 11.1a and 11.1b. It should be noted that two children in the younger group also responded as 'oto ga shita' (meaning 'made a noise' in English) for the item, 'rubber band on box'. The children did not produce either of the onomatopoeia or appropriate spatial terms produced by the adults for the item.

Table 11.1a Nine out of 23 children in the younger group produced onomatopoeia responses for 10 spatial relations.

1	close cassette case	patchin ireta	patchin	
2	button dress	kachi		
3	join legos (2 attached to 2)	pettan shita		
4	fasten Velcro	bettan shita	pen pen suru	
5	suction cup hook on wall	pettan shita	bettan	
6	bandaid on hand	pettan shita		
7	piece into puzzle	pettan shita	patchin sita	pettan yatta
8	big ring on pole	pekon shita		
9	cassette into case	patchin	pachi	
10	doll into bath	jabu sita		

Table 11.1b Four out of 23 children in the older group of produced onomatopoeia responses for 6 spatial relations.

1	fasten Velcro	petanko sita	
2	join legos (1 attached onto 3)	patchin natta	
3	sunction cup hook on wall	pettan sita	
4	join pop beads (1 attached onto 3)	pettan te sita	
5	piece into puzzle	kattchin yatta	patchin sita
6	rubber band on box	kattchin yatta	

The third error type is child-directed speech (baby talk). Child-directed speech (baby talk) was produced only by the younger group (*M* = .15 per relation) but no baby talk was observed in the older children responses. For example, 'nai nai suru' was produced in the context of closing cassette case meaning, 'putting away'; 'itai itai tukau' was produced for band aid on hand which means, 'use for pain', and 'nenne suru' (meaning of going to sleep) was produced for the action, 'doll on towel'.

The fourth type is imagination errors. The children used their imaginations when they described some of the spatial relations (younger *M* = .10; older *M* = .12, *t* (40) = -.44, *p* = .66). For example, children described the 'join pop beads (1 attached onto 3)'action as hebi (or shippo) ni natta' (means 'became a snake (or tail)'). It is possible that children used their imagination because they did not understand the intention of the actions or names or properties of the objects.

The fifth type is the noun responses produced for the dynamic spatial relations. Noun responses (e.g., 'ohuro' means 'bathtub' for the relation 'put the doll into bathtub') was another unique response by the children. The mean numbers of nouns produced per relation by the younger group is .12 and by the older is .02 (*t* (40) = 1.67, *p* = .10). Producing nouns may relate to an understanding of the intention of actions but such responses are not clear. They may have simply named the objects within their linguistic knowledge.

The sixth type is the general terms (e.g., 'suru' or 'yaru', the words have the meaning of either 'to do something' or 'dekiru''to complete something') produced by the children. A significant difference was found in the general terms produced per relation by younger (*M* = 1.95) and older children (*M* = .44) (t (40) = 6.57, $p < .001$). Because the younger group of children are still learning the spatial terms, they were not able to describe the spatial relation by using particular spatial terms. This result may be due to the differences in the size of the vocabulary children have.

Another type of error is called an irrelevant response (the response does not describe the target action and is irrelevant to the target spatial relation demonstrated). For example, a term 'shimeru' (means 'to close' was produced when the relation 'blocks into pan' or 'piece into puzzle' was demonstrated). In this case, the response is completely off the target action and considered as an irrelevant response. The mean number of irrelevant responses was .24 for the younger children was significantly greater than the .05 for the older children per relation (t (40) = 2.24, $p < .05$).

The seventh error type is non-spatial words (the response describes the target action, but it was a non-spatial term. For example, a term 'neru' (going to sleep) was produced for the item 'doll on towel'. The response was for the target action but the response was not a spatial term. The mean of non-spatial words was 0.20 for both the younger and older groups.

The last error type is called non-target action words (the words produced were not for the target action), and which were also not observed among the Japanese adults' responses. The mean numbers of non-target action words produced per relation by the younger group was .15 and by the older children was

.05 (t (40) = 1.28, p = .21). These kind of errors appeared when more than one action was contained in a demonstration. For example, when the item, ‘strap on hat’ was demonstrated, the adult participants did not have any problems in understanding the intention of the action, which is putting the strap on a hat rather than putting a hat on a head. However, some children produced the term, ‘kaburu’ (‘putting the (hat) on’ in English) instead of ‘kakeru’ (put on, hang on in English) for the action ‘strap on hat’.

Figure 11.3a The mean of proportions by error types: Younger age group.

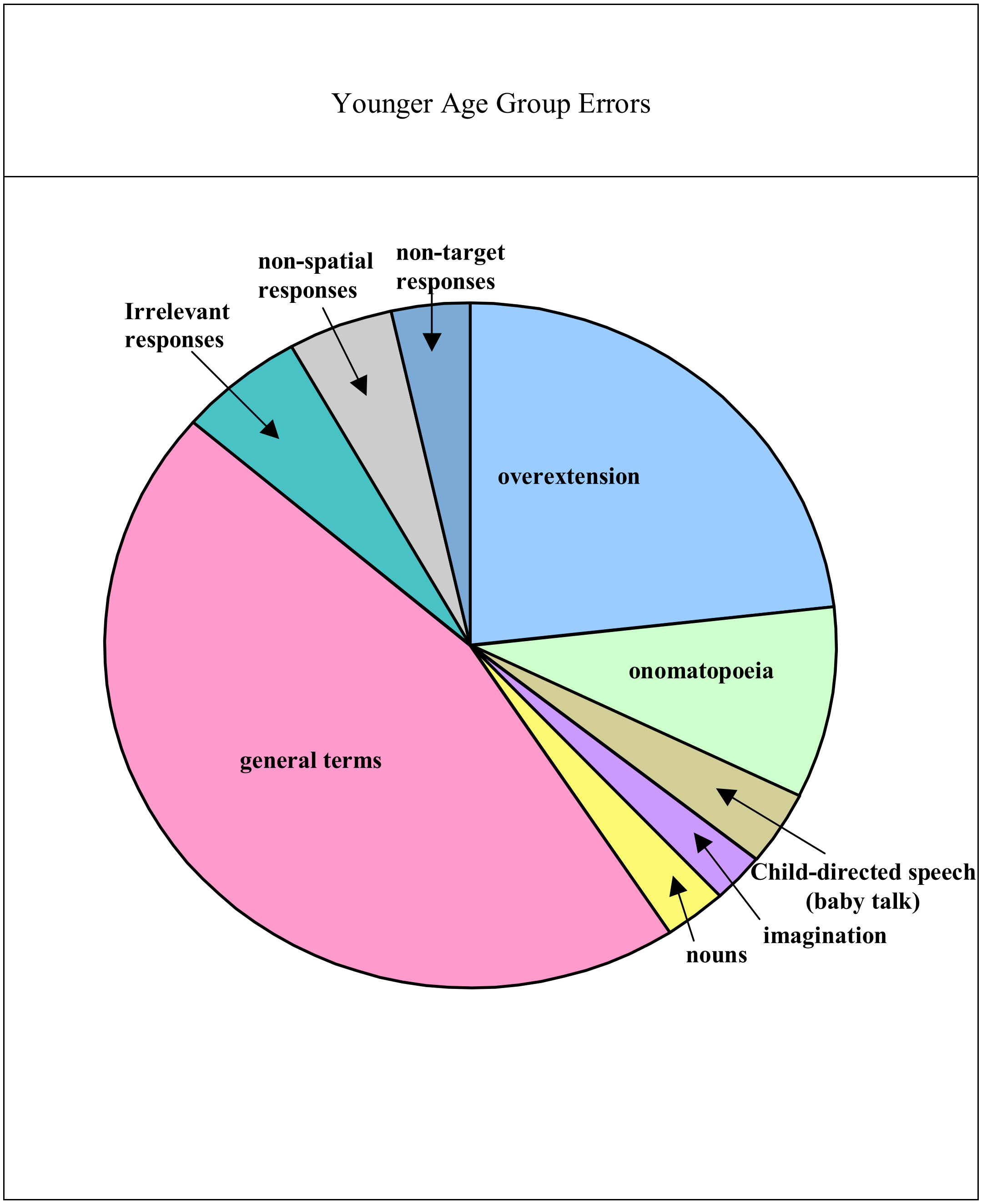
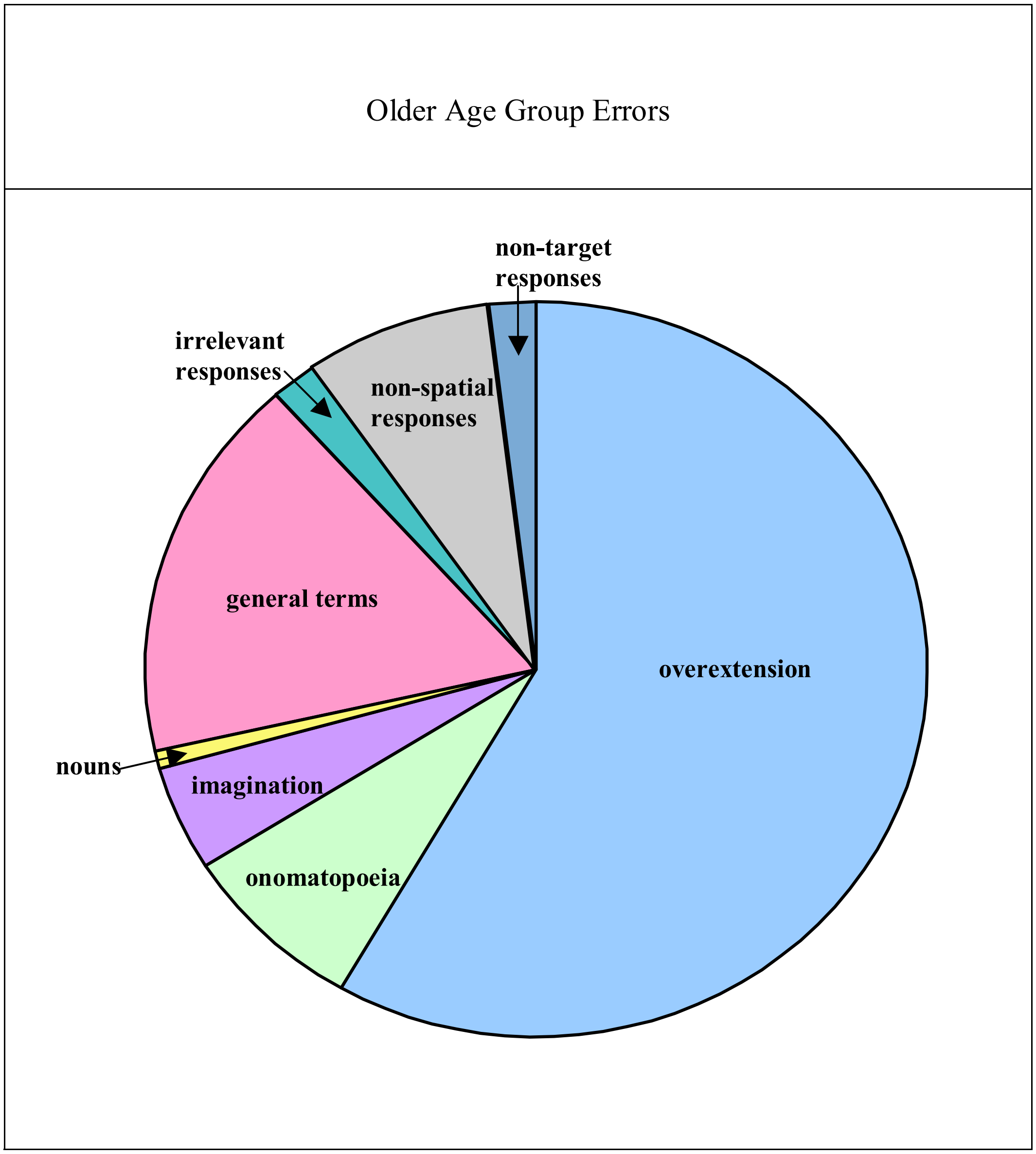


Figure 11.3b The mean of proportions by error types: Older age group.



Discussion

The main goals of the present experiment were to investigate developmental changes in the acquisition of spatial terms in Japanese 2- to 5-year-old children compared to Japanese adults. The mean numbers of different spatial terms produced per relation by younger and older groups of the Japanese children and adults were compared between the groups. The present experiment examined the child unique responses produced by the children in the younger age and older age groups. The child unique responses were then analyzed by the error types.

The results of the comparisons of Japanese children ages of 2 to 5 (younger and older group) as well as adults indicated that there are significant developmental changes in the acquisition of spatial terms. The comparison of the younger and older groups of children indicated that the children in the older age group produced more correct/acceptable spatial terms than the children in the younger age group. Compared to adults, both the younger group of children and the older group of children produced fewer spatial terms. Thus the acquisition of spatial terms for dynamic spatial relations will continuously increase after the age of 4 to 5 suggesting that even the older children are still learning to use/extend spatial terms in the same manner as adult speakers through their everyday experiences. As seen in the results, younger children still have a lot of spatial language to learn. For example, if a child responded to a demonstration of ‘Velcro together’ as ‘cho-cho’ (means ‘butterfly’), they may not know what the Velcro is for, and how the Velcro works, therefore the child relies on the information of the shape of the Velcro (the shape of the Velcro looked like a butterfly) rather than the action demonstrated with the Velcro. Another possible reason is that even if the child understands the action, ‘Velcro together’, the child may not be sure about what exact word they should use for this particular action.

Children’s unique responses were also examined in the present experiment as compared to the adults’ responses. The data of children’s errors indicated that the younger age group made more different types of errors than the older group of children did. The present experiment revealed that child-directed speech (baby talk) is only produced by the younger age groups of children but not by the older age group of children. As previous research suggested, this is because a child acquires language through their environmental input and this would help a child’s vocabulary growth.

As seen in the results, there are significant differences in two types of errors between the younger and older age groups of children. One error type is the ‘general term’ error (e.g., ‘yaru’ or ‘suru’ has the meaning of ‘to do something’), and the other is the ‘irrelevant responses’ error (the response does not describe the target action and is irrelevant to the spatial relation demonstrated). The general terms can not really be considered as the part of the overextension error but since the terms are too general and can be used to describe various actions in various contexts, a distinction was made between these general terms and overextensions errors in the current experiment. Although children acquire many words through their every day lives, they are still practicing and trying out the words they have learned into new contexts. Since the present experiment used the elicitation technique to produce words, even though they may understand the context and know the meaning of the spatial relation, not all of the spatial relations were expressively described through using spatial terms. The difference between the younger and older age group in the production of the number of general terms can be an indicator of the expressive vocabulary growth.

It should be noted that some Japanese adults also use one of the general terms, 'suru' for the same spatial relation tested. When the adults used the term, 'suru', it was used with nouns (names of the objects in the relations tested), and this is the acceptable form in the Japanese language and commonly used in everyday lives. This form also appears in other languages such as Korean or Chinese languages. Some actions cannot be described with only one verb so that the speakers of the languages either use compound verbs or combine noun and verb to indicate one action. For example, in Japanese, one of the Japanese words equivalent to the word for 'swimming' is 'suiei (noun meaning 'swim') suru (to do something)'. Another example of a noun plus 'suru/yaru' that the participants produced is 'huta (noun, meaning of 'lid') o (particle) suru (to do something)' for the item, 'lid on box'. Another type of compound word is a verb plus 'suru/yaru' which is also commonly used by Japanese speakers. For example, the participants produced a term, 'hari (haru means to stick) tuskeru (means to join, to fix, to attach, to fasten) for the item, 'suction cup on wall' and both words are verbs but are used as a compound word. The word 'diving' in English can be described as 'tobi (verb, 'tobu' means to jump) komu (verb 'komu' means (go) into)' in Japanese. The noun plus 'suru/yaru' as well as the verb plus 'suru/yaru' are commonly used in Japanese. However, when the children used the general term, ‘yaru’ or ‘suru’, they often used the term by itself and it does not convey the specific action in a particular context, therefore they were considered as errors.

The other type of the response, which indicated the significant difference between the younger and older groups of the children was the irrelevant response error. The irrelevant response errors are the responses that were not relevant to the spatial relation demonstrated. These kind of errors may not only be due to the children’s language (vocabulary) level, but it may be attributable to other cognitive developmental factors such as the children’s attention to the spatial demonstrations or children’s understanding of the intention of the actions. On the other hand, the rest of the error types were not significantly different between the younger and older age groups of children.

In addition, one of the unique error types observed among children was onomatopoeia. Onomatopoeia is considered as a unique characteristic of languages. We still do not know how acquisition of onomatopoeia is related to word-learning (especially verb-learning). For example, when a child produced a term, ‘patchin shita’ for the item ‘close cassette case’, the term ‘patchin’ is the onomatopoeia, the sound of the cassette case closing. The onomatopoeia ‘patchin’ was used with the general term, ‘shita’ (the past tense of ‘suru’ meaning ‘to do something’). This is different from the compounding words of noun plus general term, ‘suru’ (e.g., ‘suiei suru’meaning ‘do swimming’. In this case, the onomatopoeia ‘patchin’ contains the meaning of not only the sounds of ‘closing the cassette case’ but with the combination of onomatopoeia and the word, ‘suru’, it can convey the information of the action, ‘closing the cassette case’.

The children also produced descriptions using their imaginations (describing the pop beads joined as a tail or snake, for example) for some of the spatial items. One explanation is that children may not have construed the dynamic spatial relations as adults did. Another explanation is that the children had difficulties in understanding the intention of the actions demonstrated by the experimenter. Noun errors were also probably due to the same reasons for imagination errors. Having knowledge about objects such as purpose and function of objects may be helpful for children to understand the goal of the demonstrations of spatial relations. Without having the knowledge, children may have to rely on the objects' appearance and property such as shapes. The lack of this knowledge may have led the children to pay attention more to the objects' property than the actions demonstrated with objects. This may be why the children produced nouns for the object (e.g., a term, 'butterfly' was produced for the item, 'fasten Velcro' based on the shape of the Velcro).

The non-target action words are the words produced for the action but not toward the target action demonstrated. This error could be due to not knowing the spatial terms or the difficulty in understanding the intention or goal of the actions. Another error type is when the responses described the target action, but they were non-spatial terms. For example, the term 'neru' (going to sleep) was produced for the item 'doll on towel'. In this case, depending on whether the doll was treated as an object or a living being by the participants, the item can be described using different terms. The item can be described as 'oku' or 'noseru' (meaning 'putting on') or 'neru' or 'nekaseru' (meaning putting to sleep). Note that the adults also produced these two different types of responses, and this is not only unique to children.

In addition, children used more intransitive verbs than transitive verbs for such items, ‘a doll into bath’ or ‘a doll on towel’. Whereas the adults used the term ‘ireru’ (putting in), many children used the term, ‘hairu’ (going in) for the ‘a doll into bath’ item. For the item, ‘doll on towel’, whereas the children used the term, ‘neru’ or ‘nainai suru’, the adults used the term, ‘nekaseru’ (meaning putting the doll to sleep).

In sum, as the comparison of the number of spatial terms produced by the younger and older groups of children showed, the children in the younger group have a smaller vocabulary size than the older children. The mean number of spatial terms produced and extended by the older children is still significantly different from that of the adults. Because children are still learning spatial terms, they had to use the substitute terms (errors) to describe dynamic spatial relations instead of producing specific spatial terms for the items tested. Even though children can rapidly acquire many words from environmental inputs through their everyday life, the acquisition of spatial terms may not be as fast as acquiring words for objects or simple actions. It is also possible that producing a spatial term for a particular spatial relation may be difficult because the viewer needs to consider various factors such as multiple objects and orientation of objects, actions, and context/situation/environment. When there is more than one object/subject in a scene, it provides more choices for viewers to select an appropriate word (or word combinations) in the particular context. Children have to understand not only the meaning of the words but also the pragmatics of the language. Based on the results of the present experiment, understanding the intention of action in a context is crucial to this current task.

Chapter 12

Cross-linguistic comparisons of spatial terms in English, Korean, and Japanese

Choi and Bowerman (Bowerman, 1996a) compared spatial categorization in English- and Korean-speaking children and adults. They found that there are different ways to categorize space linguistically and that children made errors by overextending the spatial terms they know. They proposed that the kind of overextensions found in their studies should also occur across languages. But Choi and Bowerman also concluded that categorization of space is largely influenced by language. They based their conclusion on their findings showing that young children initially extended spatial terms in a highly similar manner as adults who speak the same language. They reasoned that if preverbal space is conceptualized without the influence of language, then children should extend their first spatial terms in the same way regardless of their linguistic environments. However, a more recent study by McDonough at al. (2003) found that preverbal children can indeed categorize spatial relations in highly flexible ways. It would appear that before learning language, children have some spatial concepts they can use to understand some of the spatial terms they are learning. Coordinating these spatial concepts with the language they are learning is one challenge to acquiring spatial terms. In this sense, overextensions of spatial terms is expected. The purpose of the following analyses is to compare further the Japanese-speaking two year-old children and adults data with the English- and Korean-speaking two-year-old children and adults data collected by Choi and

Bowerman. It should be noted that because of the difficulty obtaining children in the New York area who are exposed to only one language, a comparison between the Japanese data and the previous data with English- and Korean-learning children collected by Choi and Bowerman was made. The difficulty obtaining monolingual children in the New York area is generally due to the children's exposure to multilingual environments.

In this chapter, the spatial terms of three languages, English, Korean (the data were collected by Choi and Bowerman (Bowerman 1996a)) and Japanese (see Experiment 2 for the adults' data; see Experiment 4 for children's data) are first examined from developmental as well as cross-linguistic perspectives. Previous studies have compared manner and path languages (e.g., English vs. Korean, see Bowerman, 1996a; English vs. Japanese, see Chapter 7); however, a review of the current literature indicates that no comparisons have been made between two path languages (e.g., Korean, Japanese) in a systematic manner. This chapter will make two comparisons of path and manner languages, English versus Korean and English versus Japanese, and one comparison of two path languages, Korean versus Japanese.

To investigate the issues discussed above, an examination was made to determine whether the developmental differences in the acquisition of spatial terms found between the English and Korean two-year-old children and adults (Bowerman, 1996a) would also be found in the Japanese two-year-olds and adults. Next, the data were then compared cross-linguistically, among the children and among the adults across the languages. Prior to comparing the spatial categories, variability of the data within and between the languages is also discussed in this chapter.

More specifically, to examine the developmental differences, the two-year-old children's mean number of agreements with the most popular spatial term produced per relation was first compared to the adults' most popular term for each language. Based on the developmental differences found in the categorizations of space in English and Korean two-year-olds and adults (Bowerman, 1996a), it is predicted that there would be significant differences in the mean number of agreements to the popular responses between the children and adults in Japanese as well as in English and Korean. For the cross-linguistic comparisons, the number of agreements with the most popular spatial term produced per relation were compared among the children and among the adults across all three languages. Based on the previous finding of the comparison of English and Korean (both children and adults), as well as the findings in Experiment 2 and the comparisons made in Chapter 9 (Japanese-speaking adults vs. English-speaking adults), it is predicted that the number of the different spatial terms produced by the speakers of both Korean and Japanese are more variable than that of English. Since both Korean and Japanese are path languages and use verbs to describe dynamic spatial relations, the number of the agreements to the most popular responses produced per relation between Korean and Japanese was predicted to be similar to one another.

Next, lexical spatial categories as well as the variability of responses were compared among children and among adults across the languages. According to

Choi and Bowerman, (Bowerman, 1996a), the spatial categories of the English- and Korean-speaking two-year-olds are larger than those of adults who speak the same language. This is due to the overextensions of spatial terms produced by the two-year-old children who are still acquiring language. To investigate whether the developmental differences in the spatial categorizations found in the English- and Korean-speaking children would also be found in another language, the spatial categories in both children and adults in Japanese were compared. Regardless of which language children acquire as a native language, they try to match the concepts with new words they acquired through their experiences as well as through environmental inputs. Therefore, as seen in the comparisons of spatial category maps between two-year-olds and adults in English and Korean by Choi and Bowerman (Bowerman, 1996a), developmental differences should appear in the number of spatial terms as well as the breadth of spatial categories between the two-year-olds and adults across the 3 language comparisons of English, Korean, and Japanese. As discussed earlier, one of the purposes to examine the Japanese spatial terms was to make a comparison of path languages, the Japanese to the Korean spatial terms. Both Korean and Japanese use verbs to describe the motion events and verbs can convey the information of both path and manner of dynamic spatial relations. Therefore, it is expected that more similarity will be found in the number of spatial categories between the two languages.

If the present study finds a similar number of spatial categories between the Korean and Japanese languages, does this mean that the way we categorize space is also similar between the languages? The similar number of spatial categories does not provide the information of how space is categorized, and whether or not the boundaries of spatial categories are similar between the Korean and Japanese. To answer this question, the variability seen in the responses across languages were closely examined. It is predicted that even though more similarity in the number of the agreements to the popular responses between the Korean and Japanese languages might be found, there still are language unique spatial terms that might appear in the comparisons of the data in the three languages. The chapter will end by discussing the flexible boundaries of spatial categories.

Methods

Participants

Ten Japanese-speaking children (mean age: 2 years, 8 months, 18 days; age range: 2 years 4 months to 2 years 11 months) and ten Japanese-speaking adults (M = 33.9 years; range = 22 to 52 years old) participated in the study. The two year-old children were those who also participated in Experiment 5 for investigating Japanese language acquisition. The 10 adult participants were the first 10 adults who were tested in Experiment 2 for the comparison of spatial terms in English and Japanese. The Japanese two-year-olds and adults' data were compared to the English and Korean data previously collected by Choi and Bowerman. The English and Korean children who participated in their study were age ranged from 2 years 0 months to 2 years 5 months and the adults ages were not reported (see Bowerman, 1996a).

Stimuli

The same forty-one pairs of objects used in Experiments 1 to 2 and 4 were used in the study for the Japanese participants. All stimuli are the same or similar to those used in Choi and Bowerman's study (Bowerman, 1996a). Due to the difficulty of finding the same stimuli that were used in Choi and Bowerman's study, two items were not tested in the present experiment.

Procedure

The testing procedure was the same as the one that was used in Experiments 2 (for the Japanese adults) and 4 (for the Japanese children). The spatial relations were demonstrated incompletely so they were inferred for the English and Korean participants. However, as mentioned earlier, because of the preliminary study with young Japanese children indicating that the children provided many more responses when the relations were demonstrated using complete modeling than the partial modeling of spatial relations, fully completed modelings were demonstrated for the Japanese participants.

Results

Dependent Measure: Developmental comparisons across the three languages

The number of agreements to the most popular spatial term produced per relation by the 2-year-olds and the adults in English, Korean, and Japanese (within language comparisons).

Dependent Measure: Cross-linguistic comparisons by the 2-year-olds and by the adults

The number of the agreements to the most popular spatial term produced per relation were compared by the children and by the adults across the English, Korean, and Japanese languages

The first purpose of the present study was to investigate whether the developmental differences between 2-year-olds and adults in the acquisition of spatial terms by two-year-old children would appear across all three languages, English, Korean, and Japanese. To investigate this, the two-year-old children's number of agreements to the most popular spatial term produced per relation were compared to the adults' most popular term within each language. The second purpose is to compare the number of the agreements to the most popular spatial term produced per relation among the children and among the adults in the English, Korean, and Japanese languages.

Lastly, lexical spatial categories as well as the variability of spatial terms were compared across the languages. The details of this analyses will be discussed later.

To achieve the first two goals, t-tests were conducted to examine whether the number of agreements to the most popular response per relation were compared between the children and adults within the languages for the developmental comparison, and they were also compared by the children and the adults across the languages for cross-linguistic comparison.

Developmental comparisons across the three languages

First, the number of the most agreed on spatial term per relation was compared within each of the languages, English, Korean, and Japanese using the paired sample t-tests. As indicated in Table 12.1, there are significant differences in the number of the most agreed spatial term for each relation between children and adults across the languages. The adults showed the higher number of agreements to the most popular term produced per relation than the children in all three languages. The ranges across the three languages indicated that the highest number of the agreement was 10, and the lowest number of the agreement was higher in the adults than the children in English and Japanese.

Table 12.1 Developmental comparisons: Two-year-olds vs. Adults in English, Korean, and Japanese in the number of most agreed response per relation.

Groups	Mean and standard errors	Ranges: number of participants who gave the same response per relation	*t*	*p*
English-speaking adults vs.	$M = 8.61$ $SE = .27$	Range: 5-10	$t = 4.58$, $df = 40$	$p < .001$
English-learning 2-year-olds	$M = 6.88$ $SE = .43$	Range: 1-10		
Korean-speaking adults vs.	$M = 8.07$ $SE = .39$	Range: 1-10	$t = 3.78$, $df = 40$	$p < .01$
Korean-learning 2-year-olds	$M = 6.04$ $SE = .48$	Range: 1-10		
Japanese-speaking adults vs.	$M = 7.10$ $SE = .32$	Range: 4-10	$t = 5.21$, $df = 40$	$p < .001$
Japanese-learning 2-year-olds	$M = 5.17$ $SE = .43$	Range: 1-10		

Cross-linguistic comparisons by the 2-year-olds and by the adults

Next, the data of the number of the most agreed spatial term per relation was then compared between the two-year-old children and between the adult speakers across English, Korean, and Japanese languages (See Table 12.1 for means of responses for each group). The comparison of the adults' number of the agreement to the most popular responses in 3 languages indicated that the Japanese adults' number of the agreement per relation was different from English (t (40) = 5.10, $p < .001$) and Korean (t (40) = 2.67, $p < .05$). On the other hand, there are no differences between the adults' responses in English and Korean (t (40) = 1.61, p =.12). As seen in the means of responses in the languages, the Japanese adults have a lower number of the agreement to the most popular response than the English or Korean-speaking adults. The only difference that appeared was the comparison between the English and Japanese two-year-olds' responses (t (40) = 3.70, $p < .01$), but not between Japanese and Korean or English and Korean children's responses (t (40) = 1.74, $p < .09$; t (40) = 1.52, p =.14). But it should be pointed out that the same pattern of results was found in the adults' data although the differences were not statistically significant.

By comparing the mean number of responses in both children and adults in English, Korean, and Japanese, the least number of agreements to the most popular spatial terms for the relations were observed in Japanese. However, the mean number of the agreements for one spatial term per relation by both the children and adults in English indicated the highest number of agreement among the three languages. The differences in the results in both children and adults of

English and Japanese languages may be due to comparisons of the least variable responses made with mainly prepositions/adverbs in English and the most variable responses produced with verbs in Japanese. Interestingly, these comparisons revealed that there are no differences in the agreement to the most popular spatial term produced per relation between the 2-year-old children in Japanese and Korean whereas the difference appeared between the adults in Korean and Japanese.

Variability in responses across three languages

To discuss further the variability of data across the languages, the data were examined from a different angle.

Dependent Measure

The percentages of the total responses, which agreed on the most popular spatial response per relation, were compared across languages (see Table 12.2).

As mentioned earlier, Choi and Bowerman tested 43 spatial relations for the English and Korean adults (see Chapter 7: Experiment 1 method section). Among the 43 items, there was no information provided about the responses for a few items in the English-speaking two-year-olds and Korean-speaking two-year-olds and adults (N = 2, 5, and 1, respectively). To calculate the percentages, those items which were missing the data were excluded from the total items tested in their study. As seen in Table 12.2, the percentage of the agreements to the most popular response were higher in the order of English, Korean, and Japanese for both adults and children.

As previously discussed, looking closely at the most variable language, Japanese, 95% of the total responses provided by the 10 Japanese adults were counted as valid spatial responses. Within the valid spatial responses, 75% of the responses agreed to the most popular responses. In other words, the rest of the 25 % of the spatial responses vary among the participants. Whereas all the adults provided for all the 41 relations, the number of responses provided by the Japanese two-year-olds (N = 10) was 78 % of the adults. Of the total responses provided by the children, 72% of them were valid spatial responses which means that 6% of the responses were errors or child-unique responses. In other words, the valid spatial responses given by the children was only 59% of those of adults. This indicates that adults are more variable because they need to make a lexical decision of which spatial term is more appropriate depending on the context and situation. On the other hand, children are in the midst of the development, and learning new concepts and language in their everyday lives. As seen in the results above, it clearly indicated that children still have more to learn in the course of development.

Table 12.2 Percentages of the total spatial terms which agreed on the most popular spatial response per relation were compared across languages.

	Adults		Two-year-old children	
Languages	Number of items reported	Percentage of the most agreed response	Number of items reported	Percentage of the most agreed response
English	43	86%	41	71%
Korean	42	82%	38	69%
Japanese	41	71%	41	52%

Categorizations of space in English, Korean, and Japanese

Lastly, the data were investigated for how lexical spatial categories may be different within and between the languages, English, Korean, and Japanese. In this section, how the speakers of different languages might categorize space differently was examined, and an investigation of the developmental differences in spatial categorizations was also made. It also investigated the variability of responses provided by children and by adults across the languages. This was to approach the issue of boundaries in the categorizations of space.

To approach this, the number of spatial categories were compared within language (children vs. adults groups) and across languages (English vs. Korean vs. Japanese). As seen in the spatial terms produced by the Korean-speaking adults as well as by the Japanese-speaking adults, more than one spatial term was often produced for each of the relations tested.

Dependent Measure

The most frequent spatial terms produced per relation were compared. As discussed earlier, Japanese indicated the least agreement to the most frequent or popular spatial term per relation among the three languages, English, Korean, and Japanese. One of the main purposes of the present experiment was to make the comparison of spatial categories between Japanese and Korean (two path language comparisons). Therefore, it is crucial to consider other popular/frequently produced spatial terms by the Japanese participants to make semantically close comparisons of spatial categories between the languages. For example, when the most popular response, 'noseru' (meaning of place on) was produced by the 5 adults, and the 4 adults produced the term, 'oku' (meaning of 'put on') by the Japanese adults (N = 10), both of the terms were considered as popular spatial terms. Another case might be the 3 spatial terms were produced by the 10 participants (e.g., kuttsukeru (meaning of attach to): 3; hameru (meaning of put, fit): 4; tsunageru (meaning of connect):3). In this case, all three spatial terms were included as popular/frequently produced responses.

To compare the spatial categories across the three languages, the 41 spatial items were first organized based on whether or not the popular responses provided by both children and adults made an agreement for each item within the languages. If one of the three languages showed the inconsistent responses for a relation, the spatial relation was excluded from the 41 relations. Table 12.3 indicates the categorizations of space by the adults in English, Korean, and Japanese, and Table 12.4 indicates the categorizations of space by the children in English, Korean, and Japanese. It should be noted that the English spatial categories reported by Choi and Bowerman was also included in the tables to provide readers a better sense of the spatial categories. As seen in Table 12.3, the Japanese speakers produced more different spatial terms than the speakers of Korean or English (English: 6; Korean: 13; Japanese: 20). The number of spatial categories made with the single spatial term in English, Korean, and Japanese are 6, 10, and 9 respectively. Additional categories were made with more than one spatial term produced per relation. The numbers of those categories are 1, 4, and 18, respectively.

As indicated in Table 12.4, the number of different spatial terms provided by the two-year-old children in English, Korean, and Japanese are 3, 7, and 9, respectively. The number of spatial categories made with single spatial terms in English, Korean, and Japanese are 3, 7, and 8 and the additional spatial categories made with more than one spatial term were 1, 1, and 4, respectively. Table 12.5 showed the total number of spatial categories made by the children and the adults in each language. These tables indicate that adults produced more spatial terms and spatial categories than the children. It also showed that the Japanese speakers produced more spatial terms and categories than Korean or English.

As Choi and Bowerman (Bowerman, 1996a) found, Table 12.3 indicated that speakers of different languages categorize space differently. As predicted, space was categorized in more various ways for both of the 2-year-old children and the adults between Japanese and Korean. As seen in the results, the variability in the spatial terms produced between the languages created the differences in the boundaries of the spatial categories.

Table 12.3 Categorizations of space by the adults in English, Korean, and Japanese. The bold cells indicate the lexical categories of space. See Appendix I for the definitions of the Korean spatial terms and see Appendix II for the definitions of the Japanese spatial terms.

	Relations	English: adults (Bowerman, 1996a)	Korean: adults	Japanese: adults
1	legos into bag	in	nehta	ireru, shimau
2	cars into box	in	nehta	ireru
3	legos into pan	in	nehta	ireru
4	doll into bath	in	nehta	ireru, hairu
5	boat into bath	in	nehta	ukaberu, ireru
6	toys into suitcase	in	nehta	shimau, ireru
7	**cassette into case**	in	nehta/kkita	ireru
8	**piece into puzzle**	in	kkita	hameru
9	**pillowcase on pillow**	on	kkita	kakeru, ireru
10	**top on pen**	on	kkita	shimeru, hameru
11	small ring on pole	on	kkita	hameru, ireru
12	**big ring on pole**	on	nehta/kkita	ireru, kakeru
13	**suction cup hook on wall**	on	kkita/pwuchita	kuttsukeru, haritsukeru

Table 12.3 Continued.

14	**band aid on hand**	on	kkita/pwuchita	haru
15	**lid on pan**	on	tepta	shimeru
16	wool hat on	on	ssuta	kaburu
17	big hat on	on	ssuta	kaburu
18	scarf on head	on	twuluta/mayta	kaburu, maku
19	strap on hat	on	talta/mayta	kakeru, tsukeru
20	**towel on hook**	on	kelta	kakeru, toosu
21	sock on	on	sinta	haku
22	shoe on	on	sinta	haku
23	slipper on	on	sinta	haku
24	underpants on	on	ipta	haku
25	undershirt on	on	ipta	kiru
26	dress on	on	ipta	kiru
27	suitcase on table	on	nohta	oku, noseru
28	doll on towel	on	nohta	oku
29	log on train	on	nohta	noseru, oku
30	hook train cars	together/on	kelta	kuttsukeru, kakeru hameru,tsunageru,

Table 12.3 Continued.

31	join pop beads (1 attaches onto 3)	together/on	kkita	hameru, kuttsukeru, tsunageru
32	join pop beads (2 attach to 2)	together	kkita	kuttsukeru, hameru
33	join legos (1 attaches onto 3)	together/on	kkita/pwuchita	hameru, kuttsukeru
34	join legos (2 attach to 2)	together	kkita/pwuchita	hameru, kuttsukeru, awaseru
35	join magnetic train cars	together	pwuchita	kuttsukeru
36	fasten Velcro	fasten	pwuchita	kuttsukeru, tsukeru
37	button dress	button	kkita	hameru, kakeru
38	close suitcase	close	tatta	shimeru
39	close cassette case	close	tatta	shimeru
40	close box	close	tatta	shimeru

Note that spatial relations indicated in bold in Table 12.3 are the relations that were not compared among the children in English, Korean, and Japanese in Table 12.4. This is due to the inconsistent responses provided by the children in one of the languages.

Table 12.4 Categorizations of space by the children in English, Korean, and Japanese. The bold cells indicate the lexical categories of space.

	Relations	English: children (Bowerman, 1996a)	Korean: children	Japanese: children
1	legos into bag	in	nehta	ireru
2	cars into box	in	nehta	ireru
3	legos into pan	in	nehta	ireru
4	doll into bath	in	nehta	ireru, hairu
5	boat into bath	in	nehta	ireru
6	toys into suitcase	in	nehta	ireru
7	log on train	in/on	nehta,kkita	noseru,oku,ireru
8	big ring on pole	on	nehta,kkita	ireru
9	small ring on pole	on	kkita	ireru, hairu
10	join legos (2 attach to 2)	on	kkita	kuttsukeru/shimeru
11	join magnetic train cars	on	kkita	kuttsukeru
12	join pop beads (2 attach to 2)	on	kkita	kuttsukeru

Table 12.4 Continued.

13	join legos (1 attaches onto 3)	on	kkita	kuttsukeru
14	join pop beads (1 attaches onto 3)	on	kkita	kuttsukeru
15	hook train cars	on	kkita	kuttsukeru
16	rubber band on box	on	kkita	kuttsukeru
17	strap on hat	on	kkita	kakeru
18	wool hat on	on	ssuta	kaburu
19	big hat on	on	ssuta	kaburu
20	scarf on head	on	ssuta	kaburu
21	sock on	on	sinta	haku
22	shoe on	on	sinta	haku
23	slipper on	on	sinta	haku
24	underpants on	on	ipta	haku
25	undershirt on	on	ipta	kiru
26	dress on	on	ipta	kiru
27	suitcase on table	on	nohta	oku, noseru
28	doll on towel	on	nohta	noseru
29	close suitcase	close	tatta	shimeru
30	close cassette case	close	tatta	shimeu
31	close box	close	tatta	shimeru

Note that the English-speaking adults' responses, in, on, together were produced with = verb + in/on/together and for the English-speaking two-year-olds: in, on = (verb) + in/on. In Bowerman (1996a), only 3 verbs (button, fasten, close) were reported for 5 items and for the join, containment, and support relations, only a couple of verbs were introduced as an example and 'verb' was not specifically reported.

Table 12.5 The total number of spatial categories made by the children and the adults in each language.

Total number of spatial categories	English	Korean	Japanese
Adults	7	14	27
Children	4	8	12

Boundaries of spatial categories and flexible language

As found in the section above, lexical categorizations of space is different among the languages. The multiple spatial terms observed in many of the relations tested in Korean and Japanese showed that the spatial boundaries for these terms are not clear-cut. To examine further the boundaries of spatial categories across the 3 languages, the variability of the data were investigated further.

Dependent Measure

For the English and Korean data, the agreement to the spatial terms produced by both of the children and adults (Bowerman, 1996a) were compared for each of the 41 relations within each language. If the exact spatial terms were not produced between the children and the adults, the item was then included in Table 12.6 which indicates the disagreement in responses between children and adults for all three languages. For example, if English-speaking adults produced the term ‘together’, and children produced ‘on’ for the item, ‘join magnetic train cars’, this was considered as a disagreement of the responses for the item and was included in Table 12.6.

For the Japanese data, as mentioned earlier, because only 10 participants were compared across the three languages, not only the most agreed spatial terms but the other frequently produced spatial terms were also considered for the comparison of the responses between the children and adults. For example, for the item, hook train cars, the responses by the adults were kuttsukeru (3; meaning of ‘attach’, ‘stick’), kakeru (2; meaning of ‘hook’, ‘hang’), hameru (2; meaning of ‘fit, put’), tsunageru (2; meaning of ‘connect’, ‘join’), and one other response. In this case, all 4 spatial terms were considered since 3 of the spatial terms were equally produced by two people. However, when the responses were inconsistent and were not agreed upon by more than one person, the responses for the relation were indicated as ‘inconsistent’ (see Table 12.6). It means that when more than one spatial term was provided per relation, this indicates that the relation is more variable than the other relation which provided only one spatial term. It should be noted that for the item, doll on towel, there were other popular responses, nekaseru (put to sleep, by adults) and neru (to sleep, by children). These terms are not considered as spatial responses and are excluded from the comparisons.

As seen in Table 12.6, the total number of the disagreements to the popular responses provided between the adults and the two-year-old children was 25 relations in all three languages. There are differences in the number of disagreed relations to the popular responses between the children and adults depending on the language (English: 8 relations; Korean: 15 relations; Japanese: 24 relations).

There are three types of disagreements made by the children and the adults. One type is that either the children or adults produced very inconsistent responses or error responses. They were indicated as ‘no specific data’ for the English and Korean data, and indicated as ‘inconsistent’ for the Japanese data in Table 12.6 (English children: 2; Korean adults: 1; Korean children: 4; Japanese children: 5). This is called Disagreement Type-1. The second type of disagreement is that the adults’ most popular responses did not match the children’s most popular responses. For example, as seen in Table 12.6, the English-speaking adults provided a term, ‘together’ whereas the children provided ‘on’ for the item, ‘join magnetic train cars’. This is called Disagreement Type -2 and is indicated in italic. The third type of disagreement is that adults or children had more than one popular spatial term. This is due to more than one popular spatial term provided by either the adults or the children. For example, two spatial terms, ‘together’ and ‘on’ were produced for the item, ‘hook train cars’ by the English-speaking adults, but only the term, ‘on’ was produced by the English-speaking children. In this case, the term, 'together' was the extra spatial term produced for the item in English. These extra terms which indicate the variability in responses for the spatial relations, were produced for 4 of the relations in English, 4 of the relations in Korean, and 16 of the relations in Japanese. Across the languages, adults produced more extra terms than the children did. This is called Disagreement Type-3 (Bowerman, 1996a).

Table 12.6 Disagreements in between the popular responses produced for each relation between the two-year-olds and the adults in English, Korean, and Japanese. The terms in bold are either the extra terms provided by either the children or adult group in addition to the terms which both groups produced. The italics indicate the terms produced by both groups that did not show any agreements. The blanks indicate that the spatial terms produced for the items were in agreement between the children and adults in each language.

Disagreed relation	English: adults	English: 2-year-olds	Korean: adults	Korean: 2-year-olds	Japanese: adults	Japanese: 2-year-olds
Button dress	button	(no specific data)			hameru, kakeru	(inconsistent)
Fasten Velcro	fasten	(no specific data)	pwuchita	(no specific data)	kuttsukeru, **tsukeru**	kuttsukeru
Join magnetic train cars	*together*	*on*	*pwuchita*	*kkita*		
join pop beads (2 attach to 2)	*together*	*on*			kuttsukeru, **hameru**	kuttsukeru

Table 12.6 Continued.

join legos (2 attach to 2)	*together*	*on*	kkita/ **pwuchita**	kkita	**hameru,** kuttsukeru, **awaseru**	kuttsukeru, shimeru
Join legos (1 attaches onto 3)	**together** /on	on	kkita/ **pwuchita**	kkita	**hameru,** kuttsukeru	kuttsukeru
join pop beads (1 attaches onto 3)	**together** /on	on			**hameru,** kuttsukeru **tsunageru**	kuttsukeru
hook train cars	**together** /on	on	*kelta*	*kkita*	kuttsukeru, **kakeru,** **hameru,** **tsunageru**	kuttsukeru
towel on hook			*kelta*	*kkita*	kakeru, toosu	(inconsistent)
strap on hat			*talta/ mayta*	*kkita*	kakeru, **tsukeru**	kakeru
scarf on head			*twuluta/ mayta*	*ssuta*	kaburu, **maku**	kaburu
band aid on hand			kkita/ pwuchita	(no specific data)		
suction cup hook on wall			kkita/ pwuchita	(no specific data)	kuttsukeru, **haritsukeru**	kuttsukeru

Table 12.6 Continued.

rubber band on box			(no specific data)	kkita	*kakeru, tomeru, hameru*	*kuttsukeru*
pillowcase on pillow			kkita	**nehta** /kkita	kakeru, ireru	(inconsistent)
top on pen			kkita	(no specific data)	shimeru, **hameru**	shimeru
doll on towel					*oku*	*noseru*
log on train	on	**in**/on	*nohta*	*nehta /kkita*	noseru, oku	noseru, oku, **ireru**
small ring on pole					**hameru,** ireru	ireru, **hairu**
big ring on pole					ireru, **kakeru**	ireru
piece into puzzle					hameru	(inconsistent)
cassette into case			nehta/ **kkita**	nehta	ireru	(inconsistent)
legos into bag					ireru, **shimau**	ireru
boat into bath					**ukaberu,** ireru	ireru
toys into suitcase					**shimau**, ireru	ireru

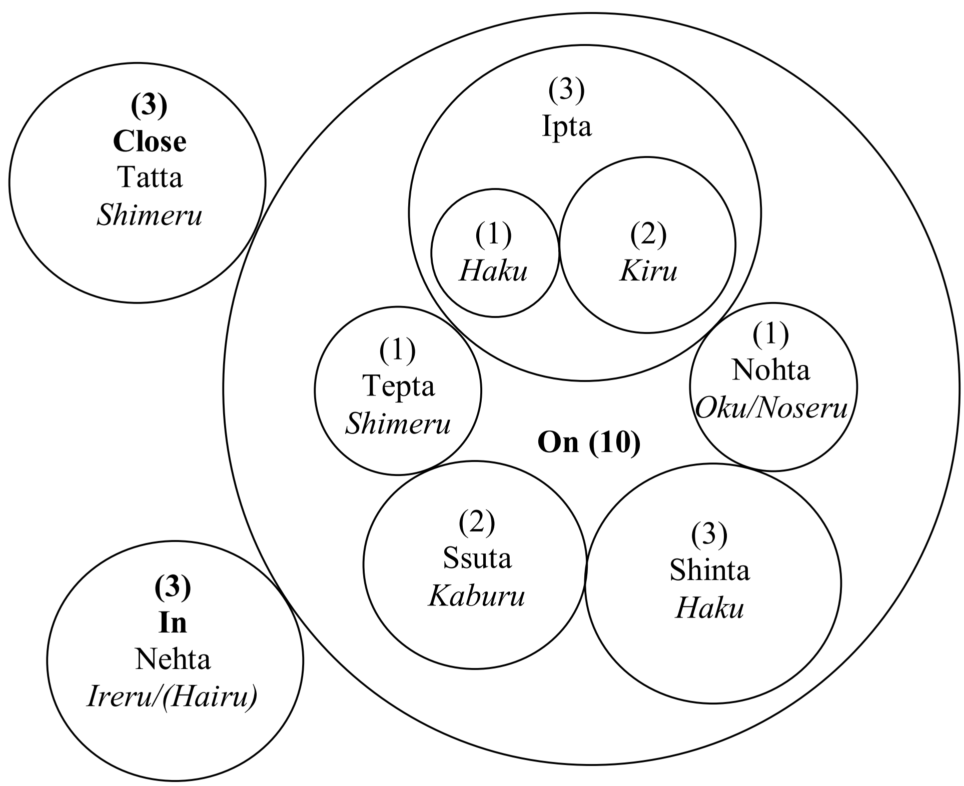
It should also be noted that the 'no specific data' indicated in the cells in Table 12.6 is that no specific data were reported for the items by Choi and Bowerman due to the very inconsistent responses provided by the participants or children's error responses (see Experiment 4 for the Japanese children's error responses). Therefore, it was treated as the same as 'inconsistent' responses (see the cells in Table 12.6) given by the Japanese 2-year-olds.

Spatial categories maps

The spatial categories across all three languages were then mapped after the spatial items were excluded. In another words, if there is a disagreement in one of the three languages, the items were excluded from the 41 items tested. As seen in Table 12.6, 25 items indicated variability in the responses, and the spatial terms provided in the remaining 16 spatial relations were compared across English, Korean and Japanese.

As seen in Figure 12.1, because of the variable responses produced for the joining relations across all three languages, only 3 main categories (closing, containment, and support categories) for 16 relations were reported in Figure 12.1. All the closing relations, 3 out of 8 containment relations, and 10 out of 22 support relations were reported in the 3 categories. Because the English speakers' responses were reported mainly in prepositions of 'in' and 'on', there were only three categories for English, 7 categories for Korean, and 8 categories for Japanese. The relations in the 'support' category, 'on', was subdivided into 5 categories by the Korean and the Japanese verbs (for 4 categories they were subdivided by both the Korean and Japanese spatial terms, and for the one category, it was further subdivided into two categories by the Japanese spatial terms). Even though the most agreed upon spatial items were selected, space was not perfectly categorized in the same exact ways across the languages, as seen in Figure 12.1.

Figure 12.1 Spatial categorization of 16 spatial relations of 41 relations tested. For these 16 relations, the speakers of each language agreed on the popular responses produced within and across all three languages. The numbers in the circles indicate how many of the relations are included within the categories. See Appendix I for the definitions of the Korean spatial terms and see Appendix II for the definitions of the Japanese spatial terms. The English terms were indicated in bold, the Japanese spatial terms were italicized, and the Korean terms were indicated in regular fonts.



In addition to the three language comparison of categorization of space, to achieve the goal of comparing the two path languages, Korean and Japanese, popular responses produced by the Korean- and Japanese-speaking adults were mapped onto 3 spatial categories (joining, containment, and support) reported by Choi and Bowerman (Bowerman, 1996a). Six joining relations, eight containment relations, and 20 support relations in English were included in the comparisons (see Figure 12.2 for Korean spatial categories; Figure 12.3 for Japanese spatial categories). As seen in Figures 12.2-12.3, space was categorized in more different ways in the Japanese-speaking adults than the Korean-speaking adults.

Figure 12.2 Categorization of joining, containment, and support spatial relations by the Korean-speaking adults based on the data reported by Choi and Bowerman (Bowerman, 19996a). The bold circles indicate the spatial categories of joining (together), containment (in), and support (on) relations by the English-speaking adults. The regular circles are the spatial categories of Korean. Each term within the regular circle indicates a spatial category in Korean. When the regular circle overlaps with another regular circle(s) or bold circle(s), that means that the category is embedded in other categories of Korean and/or English (see Appendix I for the definitions of the Korean spatial terms).

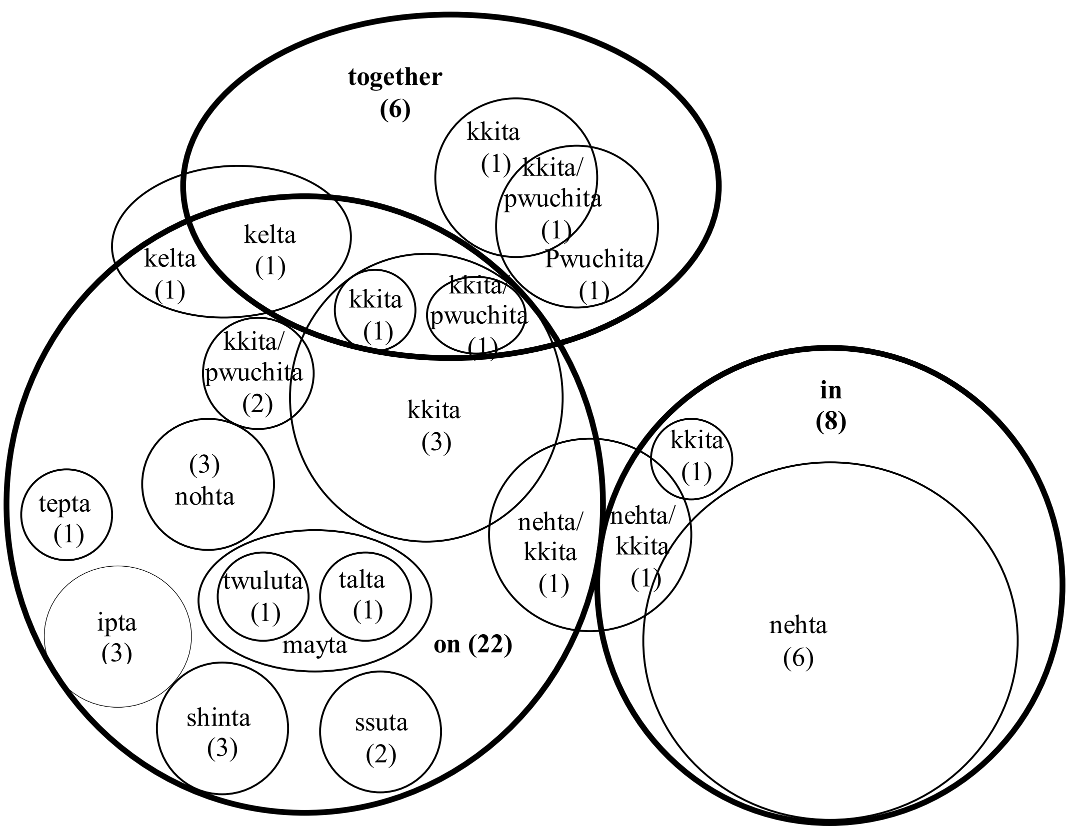
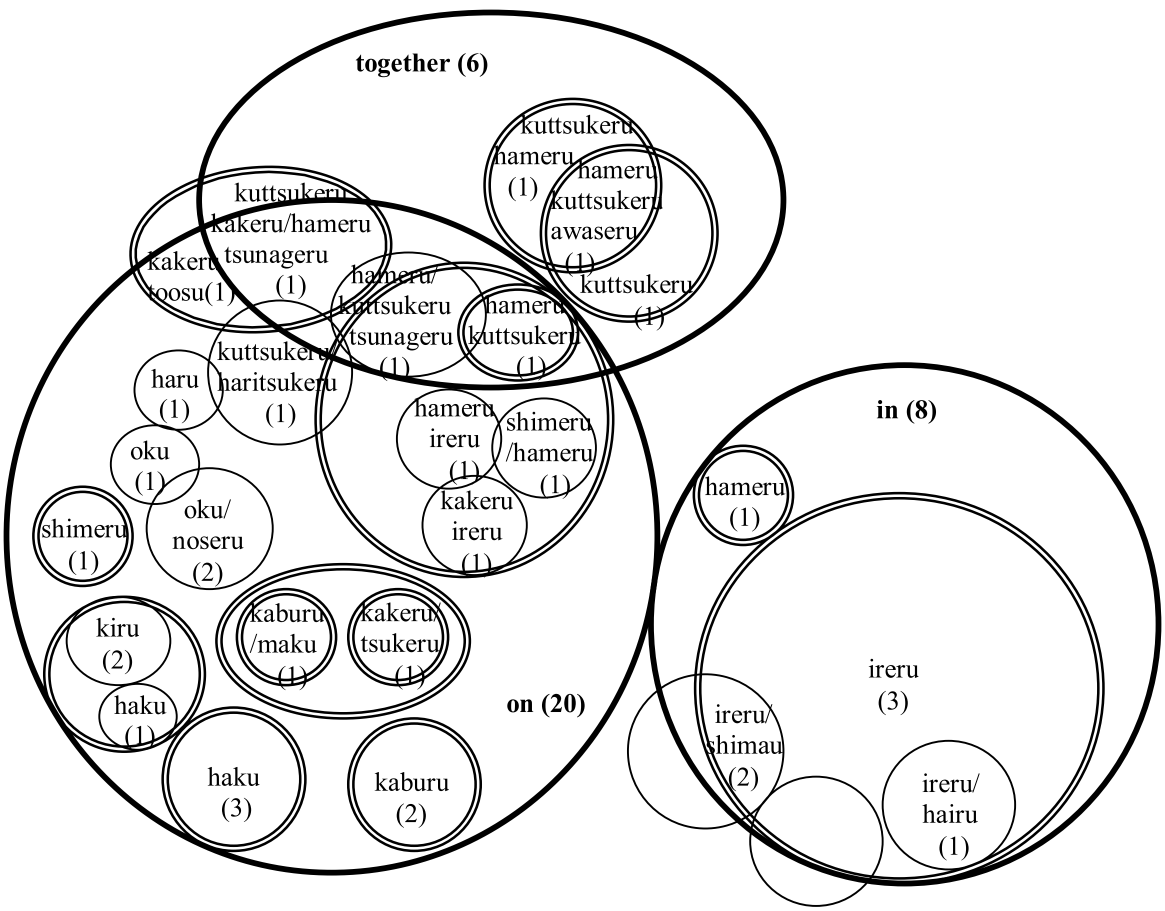


Figure 12.3 Categorization of joining, containment, and support spatial relations by the Korean-speaking adults and by the Japanese-speaking adults. The bold circles indicate the spatial categories of joining (together), containment (in), and support (on) relations by English-speaking adults. The double-line circles are the circles that remained the same way as they were in the Korean spatial categories in Figure 12.2. The regular circles are the extra spatial categories of Japanese. The spatial categories of Japanese were mapped based on the Korean and English spatial categories. See Appendix I for the definitions of the Korean spatial terms and see Appendix II for the definitions of the Japanese spatial terms.



Discussion

The first purpose of the present study was to investigate whether the developmental differences in the acquisition of spatial terms by two-year-old children and adults found in English and Korean (Bowerman, 1996a) would also be found in Japanese. The two-year-old children's agreements to the most popular spatial term produced per relation were compared to the adults' most popular term within each language. The second purpose is to make the cross-linguistic differences in the acquisition of spatial terms. The agreements to the most popular spatial term produced per relation were compared among the children and among the adults in the English, Korean, and Japanese languages. Lastly, lexical spatial categories as well as the variability of responses were compared across the languages. The previous study compared the spatial categories of English and Korean which is the manner and path language comparison. In the present experiment, the categorization of space was compared among English (manner language), Korean (path language), and Japanese (path language). The focus of this cross-linguistic comparison is to investigate whether there are similarities in the numbers of lexical categories of space as well as the boundaries of spatial categories between the two path languages, Korean and Japanese.

To achieve the first two goals, the number of agreements to the most popular response per relation were compared between the children and adults within the languages for the developmental comparison. The data were also compared among the children and among the adults across the languages for cross-linguistic comparison.

Developmental comparisons across English, Korean, and Japanese

As predicted, the comparisons of the number of agreements to the most popular response produced per relation between the children and adults in English, Korean, and Japanese indicated that the children in all of the three languages produced less spatial terms than adults. Choi and Bowerman reported (Bowerman, 1996a) that the spatial categories by the children were larger than the spatial categories of the adults in English and Korean. Their findings indicates that the children are still acquiring language, and that they overextended the spatial terms they know.

Bowerman (1996a) noted that because of the very inconsistent responses, child unique error responses, and/or the small number of responses given by the two-year-olds, no specific information was provided for those items. Inconsistent responses as well as child unique errors were also observed among the Japanese children, however, the children provided responses for many of the items. The possible reason for the small number of responses observed in English and Korean children but not in Japanese children, may be due to the age differences among the groups. The Japanese two-year-olds are a bit older than the English or Korean two-year-olds.

As seen in the means of the responses in the children and adults, the adults have a higher agreement to the most popular spatial term produced for each relation than the children across all three languages. It indicated that children have produced more variable responses than the adults, since children are still learning language and concepts, and this may have resulted in the other responses being produced by the children. It is possible that verbs may require more practice and experience in using them in various contexts/situations. To be a sophisticated user of languages as an adult, learning not only the spatial terms, but also grammar, structure, and pragmatics of language is crucial for children to fully master verbs.

Cross linguistic comparisons in English, Korean, and Japanese

Next, the cross-linguistic differences in the acquisition of spatial languages were compared among the children and among the adults across all three languages. More specifically, the number of agreements to the most popular response produced per relation among the adults as well as the children were compared across the languages. As seen in the results, significant differences were found between the Japanese- and the English-speaking adults, and the Japanese- and the Korean-speaking adults, but not between the English-and Korean-speaking adults. Non-significant differences were also found between the English- and Korean-speaking children as well as between the Korean- and Japanese-speaking children. However, a significant difference was found between Japanese and English or Korean. One way to explain this is that Japanese has a lower agreement than English or Korean in the most popular responses. This indicates that Japanese is the most variable language among the three languages. The difference that was not seen between the Japanese-and Korean-two-year-olds may be due to the ‘no specific data’ provided for the 5 items (due to inconsistent or small number of responses) which made the Korean children's mean lower.

Looking at the data more closely, the proportions of the agreements to the most popular response was higher in the order of English, Korean, and Japanese in both the adult's and children's group. Japanese adults indicated higher agreement to the popular responses than the Japanese children but they also provided more other spatial responses than the children. This is due to the differences in the vocabulary sizes of the two-year-olds and the adults.

Combining the developmental as well as the cross-linguistic examinations in all three languages, there still remains the issue of variable responses as seen in the mean of the agreement to the most popular responses.

Categorization of space

Lastly, this chapter examined the lexical spatial categories within and between the languages, English, Korean, and Japanese. Choi and Bowerman compared the spatial categories of the manner and path languages, English and Korean. The purpose of comparing spatial categories in the present study is not only to make the manner and path language comparisons but also to make the comparisons of two path languages. This was to examine whether there are differences in the numbers of lexical categories of space made by the speakers of the manner language, English, and the path languages, Korean and Japanese.

It first examined whether differences appeared in the way speakers of different languages categorize space. It also examined whether the developmental differences in the categorization of space would be consistently found between the children and adults across the languages. In addition, the variability of responses were compared by children and by adults across the languages. This was to examine the boundaries of spatial categories in English, Korean and Japanese.

The developmental comparisons of the number of spatial terms and spatial categories indicated that adults produced more spatial terms and spatial categories than the children. The results also revealed that the number of different spatial terms and categories produced by the Japanese speakers were the highest, and the Korean and the English followed. As predicted, the number of the spatial terms and categories by the Korean speakers are much higher than the English speakers, and they also produced precise spatial terms as the Japanese did. It should be noted that the large number of categories made by the Japanese speakers may be due to the possible differences in the coding systems used in Choi and Bowerman's study (Bowerman, 1996a) and in the present experiment. Again, these results were based on the comparisons of the prepositions/adverbs in English with the verbs in Korean and Japanese. It is possible that when more semantically comparable spatial terms of English (as suggested in Chapter 9) are compared to Korean or Japanese, the number of spatial categories of English may be more similar to those languages.

The variability in the responses in English, Korean, and Japanese were also examined in this chapter. To approach this, the spatial relations which indicated the disagreements to the popular responses in one of the three languages were first separated from the other relations tested. The results indicated that more than half of the items tested (25/41 relations) did not make agreement with the popular responses by more than one language. The order of the languages, from most to least, that made the most disagreement to the popular responses within the children and the adults are Japanese, Korean, and English. This result is consistent with the results of the cross-linguistic comparisons discussed earlier. Closely looking at the disagree items, inconsistent responses (no dominant response, error responses) are observed more among the children, and more variable spatial terms produced per relation were observed among adults. As also seen in the responses both among the children and among the adults, there are disagreements in the way we describe space among the speakers who speak the same languages. As seen in the bold cells in the figure, there are differences in the way space is lexicalized between the Korean and Japanese speakers. When there was more than one response provided, this creates the overlaps between the categories.

The spatial relations which indicated the agreement to the popular responses were then examined to make comparisons of spatial categories across all three languages. This spatial map provides the most simple spatial categories since other spatial relations which provided variable responses were excluded from this spatial map. The spatial categories indicated that three kinds of relations, closing, containment, and support relations, were highly agreed responses within and across all three languages. The main three categories were mapped based on the lexical agreements made within and across three languages.

The support category, 'on' was then subdivided by the Korean and Japanese spatial terms.

The results of the spatial categories based on the 16 spatial relations which showed the agreements to the popular responses within and across all three languages indicated that even though the Japanese language is often considered as very similar to the Korean language, there are differences in the way space is categorized in between the Korean and Japanese languages.

The comparison of the number of spatial categories made by the two path languages (Korean and Japanese) and the manner language (English), indicate that both Korean and Japanese show a greater number of categories than English. These results may be due to the Korean and Japanese languages using verbs to describe the dynamic spatial relations where as only prepositions/adverbs were used in the comparisons. As discussed earlier, spatial verbs often convey more precise information such as both path and manner of information whereas prepositions/adverbs only convey static manner information. The findings in the present experiment made clear that these differences in the spatial categorizations were due to the way we lexicalized the information of spatial relations. It seems that linguistic characteristics (such as language conveying path and/or manner information, or language using prepositions/adverbs and/or verbs to describe dynamic spatial relations) contribute to the way spatial categories are mapped.

As seen in Figures 12.2 and 12.3, not only the number of spatial categories but the categories between Korean and Japanese clearly indicated the differences in categorizing spatial relations. At the same time, as shown in Figures 12.1 to

12.3, some similarities of categorizing space were observed. For example, some items related to body parts (e.g., dress on, shoe on) were categorized in quite similar ways between the Korean and Japanese speakers. It is possible that some spatial relations can be categorized in similar ways consistently across languages (e.g., close relations).

Although many of the disagreements to the popular responses that were provided by the Japanese and Korean speakers overlapped (see Table 12.6), the meanings conveyed through the words in Japanese and Korean are not quite the same in between the languages. For example, the item, 'join legos (1 go into 3)', the two spatial terms, 'kkita' (fit, mesh) and 'pwuchita' (stick on, put together) were produced by the Korean-speaking adults. For Japanese, the terms, 'hameru' (fit, put (in/on)) and 'kuttsukeru' (join, put together, attach, stick) were used for the spatial terms. The meanings expressed through these two spatial terms in Korean and Japanese are not exactly the same (see Glossary for the definitions of Korean and Japanese spatial terms). There are two ways to explain this difference between two languages. When a spatial event is observed, people who observe the scene choose a word from their lexicon to express the event. However, the lexical choices are dependent on the viewer's lexical access and lexical decisions, and this depends on the language. In another words, organization of space is limited by the functions of the language which the viewer speaks. Another way to explain the differences between languages is that the spatial relations observed by the viewer is dependent on the context and situation that the viewer is in. These two factors, language and context/situation, can not be separated when spatial relations are observed. This indicates how both spatial language and spatial thinking are often confounded in terms of the various factors that contribute to and are shared by both.

In sum, since the number of different spatial responses as well as the different error responses produced by the English and Korean speakers are not available in the data provided by Choi and Bowerman (Bowerman, 1996a), the present experiment was unable to conclude whether the variable responses produced by the Japanese-learning two-year-olds and adults can also be observed in other languages.

Chapter 13

General discussion

The main purpose of the present experiments was to investigate Japanese spatial language and to compare it developmentally as well as cross-linguistically to English and Korean. To approach this, four experiments and two additional comparisons (i.e., Chapters 9 and 12) were conducted to investigate methodological issues (i.e., modeling technique and coding verbs, prepositions/adverbs or both); to make comparisons among two path languages, Japanese and Korean, and one manner language, English; and then to investigate the acquisition of Japanese spatial terms across ages in early childhood.

Methodological issues

Modeling

Experiment 1 first examined the use of two different modeling techniques in the context of the elicited production task: partial modeling of actions (Inference Group) vs. complete modeling of actions (Description Group). The results replicated and extended Choi and Bowerman's findings with two groups of native English-speaking adults. It was reasoned that the completed modeling would provide more information about the spatial relations by showing participants the complete information about the manner and path of the actions. For example, there is a difference between a) bringing a small ring above a pole and then pushing it down onto the pole and b) bringing a big ring above a pole and letting the ring go down easily to the bottom of the pole. In this example, the tightness of spatial relations (e.g., small ring on pole) can be more clearly observed when the demonstrations were fully completed.

As seen in the results, the responses of the Inference and Description groups were highly correlated overall. This indicated that changes in modeling (partial modeling vs. complete modeling) had little effect on the responses in the elicitation task. However, a closer examination of the data showed that the verb responses for the 5 relations by the Inference and Description groups were not significantly correlated with the responses in Choi and Bowerman's study. One possible explanation for this difference is that the participants in the current experiments are living in diverse linguistic and cultural communities in New York City and by being exposed to those environments, they may not be as representative of monolingual English speakers as one might find in more rural communities. Monolingual speakers in New York City may speak a dialect that is different from other English-speaking communities. Another possible explanation is that the experimenters' modeling may not have been exactly the same. Keeping in mind that there is likely to be some degree of variability among experimenters, the same spatial relations were tested using filmed demonstrations in a DVD to determine how much variability can be expected among participants (Experiment 3). The use of the DVD allows one to be absolutely certain that each participant is presented with each spatial relation modeled exactly the same way. The results showed no significant differences between the experiments that used the DVD stimuli and those that used real time modeling of the same relations demonstrated by the experimenter (see Chapters 7 and 9).

In sum, the results indicated that both partial modeling and complete modeling are reliable techniques for the elicited-production task. However, the pilot data with Japanese two-year-olds indicated that they had difficulty providing responses for the partially demonstrated actions. Since the main goal was to investigate the Japanese spatial language acquisition as well as to compare the Japanese spatial language to those of English and Korean, the present study chose to use the completed modeling (i.e., Description Groups) in the rest of the experiments.

Coding: prepositions/adverbs, verbs or both?

Experiment 2 tested Japanese speakers in order to compare the results with English speakers in Experiment 1. As found in comparisons between English and Korean by Choi and Bowerman, fewer spatial prepositions/adverbs were produced in English than spatial verbs in Japanese. This finding suggests that, like Korean, Japanese requires the speaker to precisely parse spatial categories that are not distinguished in English. Yet, when one examines the number of terms produced per relation tested, the number of variable responses between Japanese and English speakers did not differ; e.g., both described ring on pole with about the same number of descriptive terms. However, this difference could be due to factors other than spatial categorization abilities. After all, verbs contain dynamic information (e.g., manner and/or path of action) whereas prepositions/adverbs provide static information only. To make the two languages more semantically comparable to each other, the use of a different coding system for English, the verb-plus-preposition/adverb combination, was proposed in

Chapter 9. The English data (Experiment 1) were re-analyzed in various ways (i.e., responses consisting of verbs only, prepositions/adverbs only, and verbs-plus-prepositions/adverbs combinations) and were compared to the Japanese verbs. Coding both verbs and prepositions or adverbs may provide more path and manner information for English data, thus making the English data more semantically comparable to the Japanese and Korean data.

The results showed no significant differences in the actual number of spatial categories between English and Japanese. It should be noted that even though the goal was to allow a comparison that was more semantically equivalent by using the coding suggested, the various differences in the characteristics of languages (e.g., manner vs. path languages, different structures, grammars, pragmatics) still remain. Although there are similarities in the number of different spatial terms produced by the participants between the languages, numbers alone do not provide information as to how space is categorized in English and Japanese. The details that are attended to or ignored in the demonstrations of dynamic spatial relations are language-specific. Therefore, packaging of details such as fit, the orientation of a gesture in order to place one object in relation to another, and shape of objects themselves are parsed into speech categories that differ among languages. These are details generally ignored by most (but not all) in English.

Even though comparing prepositions/adverbs to verbs seems unsatisfactory, comparing verb-plus-preposition/adverb combinations to verbs alone has its own problems. One may claim that the two words in English (verb-plus-preposition/adverb combinations) are not comparable to one word in Japanese (verbs). As seen in the results, the comparison of the combinations of words in English to Japanese verbs found that the number of spatial terms produced per relation (e.g., the number of different ways ‘ring on pole’ was described) was larger in English than Japanese. This indicates that verb-plus-preposition/adverb combinations show more variable responses in English than Japanese. Another factor influencing these findings is that some of the single verbs or verb-plus-preposition/adverb combinations produced by the English speakers appeared to be synonyms. Does it make a difference to “place a ring on a pole” as compared to “put a ring on a pole”? In this example, ‘place’ and ‘put’ seem to describe the same action. Future research could address this issue in more detail. One could request participants to place a ring on a pole and also to put a ring on a pole. If the words are treated synonymously then the demonstrations should not differ. But if they do differ then this would indicate the type of activity used to complete the spatial relations differs which would not necessarily capture information about space per se but about the actions that are used to place one object in relation to another. The degree to which the action would also be parsed by a Japanese or Korean speaker would then be important to examine. Linguistically speaking, it could be that actions are more differentiated in English than Japanese but spatial relations are more differentiated in Japanese. Attention or inattention to these differences should reveal whether or not such differences are linked to perception.

Cross-linguistic comparisons of spatial categories: Korean vs. Japanese (two path languages)

The comparison of Korean and Japanese are important since both are path languages, and we do not know whether or not speakers of two Asian path languages describe the spatial relations in the same or a similar manner. Cross-linguistic comparisons revealed that responses made among the Japanese-speaking adults were more variable than those in Korean (e.g., more unique responses to ring-on-pole across all Japanese-speaking participants). However, the number of spatial categories parsed from all the relations tested is similar. This could be because both Korean and Japanese are path languages, and the verbs carry more information about path in motion events. However, only some semantically similar spatial categories were found between the languages. This finding indicates that there are small similarities in the meanings that are conveyed through words between Korean and Japanese.

In sum, the results indicated that spatial categories are complex for both path languages. The categories created based on more than one popular spatial term indicate that there are overlapping categories among the spatial relations. The comparisons of spatial categories between Korean and Japanese indicated that even though there are some overlaps in the categorizations of space by the two languages, there still remain differences in the way the speakers of Korean and Japanese categorize space. Future research should compare spatial categories of non-Asian path languages to those of Korean and Japanese to investigate whether more differences would appear among the path languages.

As previously mentioned, spatial relations can be described using various terms by the adult speakers of Korean or Japanese. When you look up the meaning of the terms in a dictionary, you can easily find more than one definition for one word. Furthermore, depending on the dictionary, the definitions of one word can be different from the others, which increases the variability in the definitions of one word. As seen in Appendix II, the definitions of Japanese spatial terms used for the present experiment showed highly variable meaning in the definitions of the terms.

Why is language complex and not clear-cut? We use language as a tool to communicate with others (Slobin, 1996a). In communication, when two people try to communicate with each other, both the speaker and listener need to understand the meaning of the words so that they can at least convey messages. For our convenience, we use a dictionary to understand the meaning of words for communication. A dictionary can be useful not only to find meanings of words but it also contains the translations of words from one language to another.

If a speaker of Japanese who does not know English tries to describe a motion event to an English speaker who does not speak Japanese, how can they communicate with each other? In this case, using English-Japanese and Japanese-English dictionaries can be a helpful tool for them to communicate with each other. When Japanese words are translated from Japanese to English, even though there might be three meanings for each of the 5 words, once they know what topic they are talking about, they are able to pick the appropriate meaning from the dictionary. Speakers often can make distinctions among the meanings in a dictionary when they use them in different contexts. For example, the speakers generally know which verbs can be used appropriately in a particular situation. It may be possible that the distinctions of words (which suggest that they may have the same meaning in the dictionary) are formed by applying either rules, prototypes, or exemplars of the relation based on the objects/situations. The translations of the verbs in a dictionary would not fully provide event information in a particular situation, so that spatial categories may not be indicated in a simple clear-cut manner. However, when the speakers make precise (narrow) distinctions among words depending on the situation (e.g., using size or shape of the objects, types of motion), spatial categories can be defined in a manner not captured by most dictionaries (Tzeltal is one example, P. Brown, 1999). Our perception and interpretation of space is likely to be coordinated with their spatial cognition and spatial language.

Developmental cross-linguistic comparison of spatial categories

An investigation of the developmental cross-linguistic comparisons of spatial terms in English, Korean, and Japanese compared the extensions of spatial terms of 2-year to almost 5-year olds to adult speakers. The results indicated that the more consistent responses were in the adults than the children within the languages. The study also found that the language-specific patterns of the spatial categories that were observed in between children and adults in English and Korean by Choi and Bowerman were also observed in Japanese. As expected, considerable agreement between the number of spatial categories produced by adults and those produced by children who speak the same language was found within each language. The adults produced more specific spatial categories than the children across all three languages whereas children are learning language and therefore they have limited vocabularies and made more errors.

The results indicated that the larger number of spatial categories that appeared in the data of Japanese adults than of the Korean adults was also found in the Japanese-learning children and Korean-learning children. Even though there are overlapping spatial categories in Korean and Japanese, they did not indicate the semantically same exact boundaries of spatial categorization.

As discussed earlier, for the speakers of path languages, they use verbs to describe motion events. Verbs used in both Korean and Japanese are specific to the narrower contexts. However, this could be a challenge for children. Even though Korean- and Japanese-learning children may have more opportunities to use spatial verbs, to be able to use a number of verbs appropriately in various contexts requires more consistent input and practice, therefore it may take a long time for children to fully reach the adults' level.

Acquisition of Japanese spatial language

The present study investigated the acquisition of Japanese spatial language in Japanese 2-to 5-year olds. The numbers of different spatial terms produced per relation by the younger and older groups of the Japanese children and adults were first compared to one another. The results showed that there are developmental changes between ages 2 and 5 years. The number of spatial terms produced per relation by both children's groups indicated that they produced a smaller number of spatial terms than the adults. In addition, it should be noted that there is a wider range in the number of responses provided by the younger children (age 2-3). Some young children used very expressive words, which are also seen in the adults' descriptions of the spatial relations. However, for some others in the younger group, they produced more consistent responses for the descriptions of the clothing items (e.g., put dress on, socks on, hat on), but their responses varied for the other items. One explanation of the difference may be due to how familiar children are with the functions of objects and actions. Children engage in various activities in their everyday lives. It is possible that familiarities of the activities may be the important key for the young children to describe the events. Another explanation is that the difference may be due to the children's language environments, such as talking with older siblings and/or a primary caregiver, who may have an impact on the language development. These results indicate that children around the age of 4 to 5 are still continuously acquiring spatial language.

The current study also closely examined the children's unique responses and discussed the various types of errors made by the children. The child unique responses were also compared between the younger age and older age groups of children and were analyzed by the error types. The results indicated that the number of different types of errors produced between the children in the younger group were larger than the older group. Whereas onomatopoeia was produced by both the younger and older groups, child-directed speech was only produced by the children in the younger groups. These results indicate that children are largely relying on the inputs from adults. Adults are more likely to use child-directed speech to younger than older children.

Besides the variability in the input of linguistic terms, there are other factors which influence a child's language development. As a child develops, there are changes in the size of vocabulary, cognitive abilities (memory, attention span, processing speed, perspective taking, inference), knowledge (e.g., purpose and function of objects), experiences (e.g., knowing which word to use in which context), and in the way one construes the world (contexts, situations, environments). Even though children might acquire language rapidly through the input of others in their everyday lives, in order for children to use the language correctly and efficiently, these factors influence how they use the language and how much children can express using language. As seen in the results, even children of ages of 4-to 5-years old are still acquiring language. It is still not clear at what age children can reach to the adults' level. The age can be extended to investigate the developmental trajectory of spatial language acquisition in future studies.

Variable responses and lexical choices in motion events

As seen in the results, the contexts of motion events impact the way we coordinate information with language. The variability in responses in English were compared among the categories support ('on'), containment ('in'), join ('together'), and close ('close') relations. The results showed the most variable responses were observed in the joining relations. The items such as closing relations or relations demonstrated with clothing items have more narrow contextual information of motions in space, and the contexts of events may structure and limit the way we coordinate the spatial information and language.

On the other hand, because of the figure-ground problems in the joining relations, these relations have wider degrees of freedom in the coordination of spatial information with language.

The variable responses in the joining relations may closely relate to the characteristics of objects (e.g., shape, size, orientation) and how the two sets of objects were moved for completing the joining actions. One type of joining relation is shown when two (sets) of objects move equal distances toward each other so that the path of the movement is symmetrical. For example, 'join legos together (2 legos attach to 2 legos)', both of the objects move horizontally towards each other until they become attached. The second type is that one set of objects moves towards a stationary object (e.g., 1 lego attaches onto a set of 3 legos). However, if these two sets of the legos are not moved in a symmetrical way (in other words, if one set of legos moved more than the other set), one may think that the set moving a longer distance is going 'onto' or 'into' the other set. Note that the asymmetry will be determined by the viewer, and is partially based on the shape of the objects and the direction of the motion (one side of legos has holes, and the other side has bumps).

The verbs produced for the joining relation widely vary. The popular verbs used to describe the joining relations were put, place, attach, join, stick, and connect, and these verbs were used either with prepositions/adverbs or by itself. These terms were used to describe all of the joining relations. One may think that some verbs may not be accurate to describe a particular joining relation. For example, the verb, 'stick' may not be a good fit for the relation, 'one pop beads go onto the other legos'. When you think of the use of the verb, 'to stick', you may think that there could be a sticky and gluey-like force that causes the two objects to become 'stuck' together. However, use of word and its meaning are sensitive to context. One can stick one lego onto another so that the two legos will be stuck together in the sense that it takes effort to separate them again. If stuck together through the use of glue then they are not as easily separable, if separable at all. As seen in the definitions of the verbs, attach, join, stick, and connect, all these verbs describe motions of objects in space which become one set of objects. Based on the definitions provided in a dictionary, we can create lexical boundaries for word meanings, however, as seen in the results of the current study, there were no clear or apparent lexical boundaries coordinating information of motion events in space with language.

McDonough et al. (2003) reported that distinctions highly salient in language aid adults' categorization abilities in terms of their initial construal of an event. The distinction between tight and loose is highly salient in Korean and even though this distinction can be made in English, it is likely that English speakers construed the tight- v. loose-fitting containment as simply perceptual variations of the same relation, containment. When spatial relations are salient and/or obligatory in communication, the responses among the participants will more likely agree and there will be a most popular or dominant response. The variable responses in the present experiments are probably due to the many factors, e.g., figure-ground problems, perspective taking, differences in lexical choices, or how much participants pay attention to the differences between the actions (e.g., tight vs. loose). As mentioned in the earlier chapter, the descriptions of the relation, 'putting a ring (small or big) on pole' would differ depending on how much a viewer pays attention and makes distinctions to the tight fit of the ring and pole. For the relation, the ring is put loosely on the pole, one can say 'kakeru' (hook, hang on) or 'ireru' (put in) and another might say 'hameru' (put in but also has a meaning of fit). The choices of the spatial terms would be based on what lexical decision individuals make in describing the relations. These factors play a role in contributing to the unclear boundaries of lexical spatial categories.

The results of the present study also indicate that a very small number of the English speakers were able to describe the degree of the tight-fit for the relations. For Korean (see Bowerman, 1996a) and Japanese (Experiment 2), more participants lexicalized the degree of tight-fit than the English-speaking participants when the same relations were tested. But the responses by the Japanese speakers were not as consistent as the responses in Korean, and only some of the Japanese participants made clear distinctions of the degree of the tight-fit. Interestingly, when one language lexicalized the degree of tight-fit, the other of the two languages did not lexicalize tight-fit for some of the same relations. As mentioned above, the verbs such as attach, join, stick, and connect were popular spatial terms for the joining relations. For those joining relations, there also are popular terms for Korean, 'kkita'(fit, mesh) and 'pwuchita' (stick on, put together), and for Japanese, 'hameru' (fit, put) and 'kuttsukeru' (stick, put together). As seen in this example, the definition of terms in all three languages may have some similarities but they are not exactly the same. That is, ‘kkita’ does not directly translate to ‘hameru’ in all contexts and ‘pwuchita’ does not translate to ‘kuttsukeru’ in all contexts. This indicates that the semantic categorization between the languages are similar but differences remain.

What to focus on in motion events and what aspects of objects and/or motions to pay attention to may change from one viewer to the next. For example, for the item, ‘a person holding a toy boat and then the toy was moved into the bathtub’, one can describe this event as “the person put the boat into the bathtub” another may say “a boat is floating on the (imaginary) water”. Depending upon the viewer’s focus of the spatial event, it can be described based on the use of a combination of two objects, which is a boat should be in a bowl (a small object can be contained in the larger container) or a boat is floating (assuming that there is water in the container because of the functional information of a boat). Another spatial event, ‘a person holding a log and the log was put onto the toy train’, one may describe this event as “the person put the log in (into, inside) the back of the train”. Another may say, “the person placed the log on (onto) the train”. Both of the viewers saw that the log was moving toward the train and eventually placed it there, but the differences in choices of terms, ‘into’ or ‘onto’, are based on the viewers’ judgment depending on how the features such as shape, size, dimension or depth is perceived. As seen in these examples, the figure and ground objects often become ambiguous and can reverse roles for motion events.

The larger degrees of freedom in perceiving space in the joining relations increases the degrees of freedom in lexical choices. As previous research suggested, space is an analog format and language is a propositional format, however what is common between them is the flexible characteristic (Huttenlocher & Lui, 1979; McDonough et al. 2003).

Thought, culture, and language

As previously discussed, there are differences in the way we lexically categorize space. Once categorization of space is mapped in a propositional format of language, even though the semantic categorization of space may have some similarities between the languages, there still are remaining differences between the languages. How can we explain the differences? As mentioned before, the issue of how we make distinctions between the motion events in space may be dependant on how much we pay attention in differentiating an array. The results of the cross-linguistic comparisons (see Chapter 12) indicated that some of the participants across all three languages were able to make distinctions for the relations that are not lexically contrasted in their languages (e.g., tight and loose relation for English). At the same time, the results also revealed that many of the participants did not make those distinctions. For example, what are tight-fit and what are loose-fit object relations are, in most situations, perceptually obvious and, in other situations, a bit ambiguous.

As discussed earlier, we share the same biology and live in the same world. Because we are all humans who have the same kind of body structures and we experience the world through our sensory systems, our perceptions and thought should be experienced in similar ways even among people who speak different languages across cultures. Therefore, our experiences of reality should be quite similar regardless of which language we speak. Even young infants whose sensory systems are under development are still capable of experiencing the world through their sensory mechanisms before they acquire language. How the "Tower of Babel" came to be is a matter of theoretical debate. But on knowing that experiences in the physical, social and psychological world can be parsed in many different ways, there is no reason to assume that everyone has to make the same decisions as to how to go about the process of parsing, particularly when creating a language as an agreed upon tool for communication within a given community.

Whorf proposed that speaking is as habitual as is thought. What Whorf meant by 'habitual' is an automatic reaction that likely reflects to some extent conscious as well as unconscious processes (Lucy, 1992; Whorf, 1956). Whorf also proposed that the relation between language and thought is that "in main they have grown up together, constantly influencing each other" (Whorf, 1956, p.156), a position similar to the one proposed by Vygotsky (1934/1987, 1962) with the exception that Vygotsky considered conceptual knowledge to precede or separately coincide with linguistic knowledge in early infancy.

Sapir also discussed the relation between language and unconscious processes. He stated that language is free to construct knowledge/ideas but the process does not require or necessarily imply consciousness (Sapir, 1949), and in some (perhaps many) situations the particular way in which we use language is out of habit (Whorf, 1956). Even though there are differences in individuals' characteristics and perspectives, their behaviors become adapted to their living environments. This is because unique individuals must be accepted by their culture and society to survive, so that behaviors of individuals necessarily become intertwined with their cultural patterns unconsciously. Although we have conscious access to some of our behaviors, we do not have conscious access to all of our behavior. Sapir also stated that understanding cultures from an outside view is different from the view of insiders. The understanding of outsiders may not be the same or as deep as the insider's understanding. This is because outsiders' perspectives are based on their own culture and society, and what they believe as universal may not apply to other cultures (Sapir, 1949).

One might also argue that because preverbal infants can flexibly categorize relations that are not highlighted in the language of the culture they are being raised in (as found by McDonough et al., 2003) that this too constitutes evidence for linguistic influence. However, not only have preverbal infants not learned language, they also have not fully learned their cultures. Along with the research by Zheng and Goldin-Meadow (2002), these findings suggest that language might be more influential than culture, but neither can be completely unconfounded from the other. After all, language is a product of culture. The two develop and co-create together.

We use language for communication in everyday life, and talk about objects or events in the world experienced through our sensory mechanisms. The observers rely on their own cognitive understanding, therefore the views and interpretations are subjective so that perspectives between two people can be different from one another. For example, one might say, "there is a half moon tonight". This description is an interpretation of the observer's perception and at the same time is a somewhat metaphorical interpretation. The actual moon is not in half according to a scientific point of view. The changes of the shape become distorted by the observer's description, the perception of which is influenced by the way in which the scene is verbally described. Our reality is based on the mental representation of experienced perception through the sensory systems, embodied cognition, and our language, all of which could have discrepancies between the actual event and perceived event. Our understanding of science allows us to understand that the description of the moon is not literal but metaphorical (Lakoff, 1987).

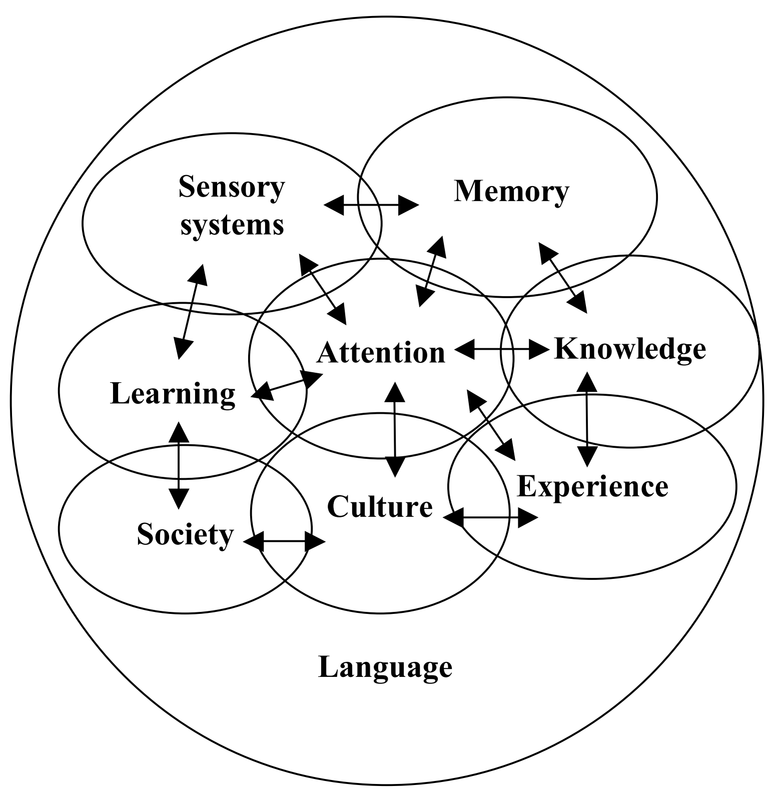
As with the color domain discussed earlier, space is perceived through our sensory systems, which is experienced in our language, culture, and environment. Some of our concepts of space are explicit, and some of our understanding is rooted in unconscious biases and habitual, automatic behaviors. Actual perceptions of space are experienced through our body structures that are fundamentally universal and preexist prior to learning language during infancy. The knowledge from embodiment provides meanings and potentially universal concepts whereas the acquisition of spatial terms, symbols, and input from everyday life provide children opportunities to match, differentiate, or realign meanings to the language they are learning.

According to Mandler (2004), meaning is constructed through our perceptual analysis, so that the meaning (the produce of the analysis) becomes accessible to thought. It is possible that spatial relations are conceptualized before language and the child needs to adjust existing categories to match the language being learned. Alternatively, the child may learn a few categories, such as containment and support and/or loose and tight fit, and on hearing different words used to describe these relations, seek out the meanings of those words by examining the context in which they are spoken. That is, the child may need to differentiate larger categories into smaller, more precise ones in order to communicate effectively in the language being learned. H. H. Clark (1973) and E. V. Clark (1973a, 1973b) reported that preverbal children can know and understand different spatial relations, so that they start to use prepositions in English to describe spatial relations by the age of two or two and half years old. They proposed that the meanings of words are learned in order to add more semantic features to define a word. Karmiloff-Smith (1986) suggested that making errors will aid children in learning certain conceptual structures. On observing that something was said erroneously (by failure to communicate a wish or desire) the child may then analyze the situation and the product of that analysis allows a new concept to be made explicit and gives a word that may have been previously used incorrectly in its appropriate meaning. Slobin (1971, 1996a) argued that the child must have an intention to express meanings and then begins to associate meanings with words. In his view, children can acquire a new concept by searching the meaning to encode the concept into the linguistic format. He also stated that children may acquire language by making mistakes.

Spatial thinking is a fundamental experience, which starts the moment a baby is born. Experiences of space are universal to all humans and animals.

However, as seen in recent research findings, space is described in various ways depending on the language we speak. Based on the previous research as well as the present findings, both the universal and embodiment view should take into account the discussion of spatial thought and language. When objects and motions in space are encoded and represented in our mind, various factors are involved in the processes (see Figure 13.01 below). When there is a difference in even one of the factors among individuals, this would influence how we categorize and talk about space.

Figure 13.01 Various factors involved when processing spatial information into the linguistic format.



Chapter 14

Limitations of the current study and suggested future research

There are some limitations in the present study. Some of the issues that need to be addressed in future research will be discussed here.

Throughout the experiments, the experimental sessions were not tape-recorded so reliability could not be measured. However, the responses recorded in the index cards were entered into the spread sheets and checked by two coders for the accuracy of data analyses. For the Japanese data, besides the experimenter who is a native Japanese speaker, an additional native Japanese speaker was also involved in the coding process. For the coding of the error response analyses, the first coder and the second coder agreed on the coding criteria. Future research should video-tape the experimental sessions so that gestures, particularly those used by children can also be coded with the verbal descriptions.

Experiment 1 was conducted to replicate Choi and Bowerman's findings with native English-speaking adults who were attending Brooklyn College in New York City. However, as mentioned before, there were more variable responses among the participants in the current study than the participants in Choi and Bowerman's study. One of the possible explanations to the variable responses was that the participants in the current study have been exposed to a multi-cultural and multi-linguistic environment in their every day lives. A language background questionnaire was used to filter the potential participants who are native speakers of English but speak other languages besides English or have opportunities to be exposed to other languages on a daily basis. Those who regularly spoke other languages were not included in the current study.

Language environment is an important factor in child language acquisition. Children living in New York City are also often exposed to more than one language in their every day lives (e.g., through the baby sitter/nanny, day care facility), therefore there was a difficulty of collecting purely monolingual children's data. Due to this reason, the English data reported by Choi and Bowerman were used for the developmental-cross-linguistic comparisons between Korean and Japanese (see Chapter 12). Therefore, the verb responses for 5 relations and prepositions/adverbs responses for 36 relations were compared to examine the developmental changes across the languages. As discussed earlier, prepositions/adverbs only provide static information of spatial relations and are not quite comparable to the verb responses provided by the speakers of Korean or Japanese.

Because the number of different spatial responses as well as the different error responses produced by the English and Korean speakers are not available in the data provided by Choi and Bowerman (Bowerman, 1996a), the present experiment was unable to conclude whether the variable responses (more than one popular responses) produced by the Japanese-learning two-year-olds and adults would also be observed in other languages. Monolingual English-speaking children from 2-to 5-years of age should be collected in future studies so that the data can be compared to those of English adults and Japanese-learning children. This would also allow us to compare the verb-plus-preposition/adverb combinations within a language and between Japanese and Korean. The types of errors English-speaking children make, for example, and how the acquisition of verbs in a manner language differs from a path languages is also of interest (see Choi, 1997). Ideally, the developmental changes observed among Japanese 2- to 5-year-old children should be compared to those of Korean as well as to other manner and path languages. This would reveal whether the acquisition of the Japanese language is a typical case for the path language or whether the same developmental changes can also be found in the acquisition of manner languages.

As suggested in Chapter 9, semantically comparable coding between languages is crucial in cross-linguistic studies. It is still not clear whether the manipulation included in the present experiments is the best alternative; certainly other ways of approaching this issue need further exploration. However, as seen in the findings in Chapter 12, motion categories are complex for both path languages. It is possible that when semantically comparable information were coded (e.g., verb-plus-preposition/adverb in English) for the descriptions of motion events, the categories could be as complex across the languages regardless of the manner or path languages.

The results of Experiment 3 used DVD stimuli and the data replicated the results of Experiment 1. The DVD can be now used reliably to test other languages in various geographical locations. However, as seen in the study by Li and Gleitman (2002), the testing environment can be the influential factor for the results of the experiments, and this needs to be controlled for during testing.

As suggested by McDonough et al. (2003), it is not known whether any nonlinguistic task is purely nonlinguistic (unless testing participants who do not comprehend language, such as young infants). Even though a given task may be nonlinguistic as seen in Levinson et al. (2002), there is a possibility of participants engaging in the linguistic strategies to solve the problem. Li and Gleitman (2002) also suggested that there are experimental environments that may have influenced the results by pointing out Levinson and his colleagues' study. One way to manage linguistic effects is to develop an effective masking technique (such as counting backwards by threes from 100) that can be used to keep the participant from using language to solve a particular nonverbal task. That is, guide linguistic processes in a direction incompatible with the task at hand.

As seen in the variable responses for the joining relations in the current experiment, it seems that the participants are sensitive to the characteristics of the objects and types of stimuli (e.g., shapes, sizes, and directions and distance of motions). When testing children, it is important to use objects with which they are familiar. At the same time, the details of objects as well as demonstrations of spatial relations such as distance and direction of motions, should be carefully examined in future research. This would help to minimize the variable responses due to issues such as figure-ground problems.

The results of testing 41 spatial relations indicated that some relations provided more consistent responses than others. At the same time, as seen in the results of the data by Choi and Bowerman (1996a), only 3 specific verbs were produced for 5 of the relations and the rest of the 38 relations provided prepositions/adverbs but no specific verbs were reported. Among the verb responses provided for the 5 relations, two relations created a single category. Based on these results, it is possible that the items tested are not representative for some of the spatial relations. A new selection of objects and actions should be explored in future studies.

The results of the joining relations indicated that the verbs (e.g., attach, stick, connect, and join) were often used for describing the joining spatial relations. However, as seen in the dictionary, the definitions for those verbs are similar to one another. As discussed, space and language both have flexible characteristics. The boundaries of spatial categories for each of the terms should be tested using various objects and motions in future studies.

One of the child unique responses was onomatopoeia. This would be investigated with another child unique response, child-directed speech produced by children. It should be investigated whether the use of onomatopoeias or child-directed speech in parent/caregiver and child conversations aids in child language acquisition (Kempe & Brooks, 2001, 2005). As mentioned earlier, the Korean language has the same general terms that are produced in Japanese (e.g., 'suru' or 'yaru' meaning of 'to do something'). Using the general terms were the most frequent errors made by the younger groups of the Japanese children. It is assumed that since the young children's vocabularies are limited, that they were not able to specify the verbs that are appropriate for the actions in the contexts. There are two possible reasons: one is that young children simply did not know the appropriate words for the actions in the contexts, or that the children were not sure whether the words they knew could be used in the new contexts shown. It would be crucial to study those general terms used by the children to understand how space is understood and how they make lexical selections to express the spatial concepts.

There are various types of spatial events (e.g., loose vs. tight, in vs. on, stick, connect) in our everyday lives. What kind of spatial relations are easier for people to understand and can be expressed in more consistent ways, and what types of motions are seen and described in more various ways should also be investigated. The investigation of boundaries of spatial relations can be extended so that it will allow us to narrow down the factors that are largely influencing eliciting variable responses.

McDonough et al. (2003) used a preferential looking task to examine whether or not preverbal infants and adult speakers of English and Korean can notice the contrast relations (e.g., tight vs. loose in English). For English speakers, tight versus loose relations are not lexicalized in their language. They found that the English-speaking adults showed more difficulties in making the distinctions of tight versus loose relations, for example. Using the same stimuli tested in McDonough et al. (2003), a card-sorting task has been designed to test whether the speakers of language can successfully group the contrast relations in a problem-solving setting. This is currently under investigation along with Soonja Choi and Laraine McDonough.

In the present experiment, the participants were given enough time to respond to the dynamic spatial events shown. However, as with the issue of attention to differentiate the target relations (e.g., tight-fit) raised before, we still do not know whether we will clearly notice those target relations when the viewing time is limited. As mentioned earlier, McDonough et al. (2003) also conducted an oddity task which is the verbal task and tested whether the participants successfully choose one relation that was demonstrated with one set of objects (i.e., the ‘odd relation’) that differed from another relation that was demonstrated on three sets of objects. The participants were also asked to explain the reason why they made the choice they did. The results indicated that when the tight-containment and loose-support distinctions of the spatial relations were tested, 78 % of the English-speaking adults correctly selected the one which did not belong with the rest and all of them explained the distinctions correctly (containment versus support relation). However, the English speakers performed poorly when the relations tested were tight-containment vs. loose-containment (38%). Interestingly, for the Korean adults, 80% of them successfully made distinctions of the same contrast, tight-containment vs. loose-containment relations. The comparison of the results of the preferential looking and oddity tasks found that an influence of language consistently appeared in the way the speakers perceive and verbalize the space. But given that the preferential looking task was always administered prior to the oddity task, it is not clear when the relational differences were apparent to the participants. It is possible that the participants were not conscious of the differences until the oddity task was administered. To gain some insight as to how the scenes during the looking task were construed, the new experiment has been investigating using the same stimuli but now asking participants to describe aloud each scene.

The flexible characteristics found in both language and space are like puzzle pieces made of a soft and squishy material. The representation of space may be likened to finding the specific location where the puzzle pieces can fit. In searching for that particular place where the piece will fit, you try similar places to place the piece based on the puzzle piece's shape. If the shape of the puzzle piece can be a bit changeable, you can manage to fit the piece into that place.

We perceive spatial information and represent it so we can express it through language. As seen in joining terms such as connect, attach, stick, or join, some of the terms are interchangeable in some contexts, but are not interchangeable in other contexts. If those joining terms are thought of as the puzzle pieces discussed previously, their shapes may be similar but are not identical. Therefore, when mapping the concept/representation of space as puzzle pieces, the puzzle pieces need to find a place so that they can be expressed in the form of language. In this process, because of the flexibility of the puzzle pieces, which represent both spatial information and language, the flexibility of both language and space can help to coordinate one with the other.

Appendix I

Definitions of the popular verbs produced by the Korean speakers

(Bowerman, 1996a; Choi, 1997)

Korean verbs	Meanings of the verbs produced for the spatial relations tested
tatta	close
pwuchita	stick on, put together
kkita	tight-fit, mesh
tepta	cover
kelta	hook, hang
nehta	put loosely in or around
ssuta	put on head
sinta	put on feet
twuluta	put around, encircle, wear
talta	hang up, attach, wear, put on
mayta	tie
ipta	put clothing on trunk
nohta	put on horizontal surface

Appendix II

Definitions of the popular verbs produced by the Japanese speakers

(see also Merriam-Webster's Japanese-English Dictionary,1993)

Japanese verbs	Meanings of the verbs produced for the spatial relations tested
shimeru	close, shut, lock, cover
kuttsukeru	stick to, attach to
haru	put, stick to
ireru	put in (into), fill, insert, let in
kaburu	put on (headwear), be covered
haku	put on
kakeru	hang, place, put on, cover
kiru	put on, wear, have on
oku	put, keep, place
suru	do (something)
noseru	put on
nekaseru	put to bed, let sleep
tojiru	close, shut
tsukeru	attach, apply, fix, put on
hairu	enter, come in
shimau	put away, put back, store
tsunageru	tsunagu – tie, fasten, connect, join

Appendix II Continued.

tomeru	fasten
ukaberu	float
haritsukeru	see above, haru + tsukeru
hameru	put on (gloves, rings, etc), put in (into), fit, put
hamekomu	hameru + komeru (put into, include)
awaseru	put (join) together, add (up), fit, set
toosu	let pass, let in
oou	cover, veil
renketsu suru	connect, link, join
maku	wind, wrap
hikiyoseru	hiku – pull, draw + yoseru - bring (draw) up, put (push) aside
sashikomu	put in (into), insert, let in
kabuseru	cover, put on
shizumu	sink, go down

References

Aaronson, D., & Ferres, S. (1986). Sentence processing in Chinese-American bilinguals. *Journal of Memory and Language, 25*, 136-162.

Abramov, I. (1997). Physiological mechanisms of color vision. In C. L. Hardin & L. Maffi (Eds.), *Color categories in thought and language* (pp. 59-88). Cambridge, UK: Cambridge University Press.

Ammon, M. S., & Slobin, D. I. (1979). A cross-linguistic study of the processing of causative sentences. *Cognition, 7,* 3-17.

Au, T. K. (1983). Chinese and English counterfactuals: the Sapir-Whorf hypothesis revisited. *Cognition, 15,* 155-187.

Au, T. K. (1984). Counterfactuals: In reply to Alfred Bloom. *Cognition, 17,* 289-302.

Baillargeon, R. (1987). Young infants' reasoning about the physical and spatial properties of a hidden object. *Cognitive Development, 2,* 179-200.

Baillargeon, R. (1994). How do infants learn about the physical world? *Currnet directions in psychological science, 3,* 133-140.

Baillargeon, R. (1995). A model of physical reasoning in infancy. In C. Rovee-Collier & L. P. Lipsitt (Eds.), *Advances in infancy research, Vol. 9.* (pp. 305-371). Norwood, NJ: Ablex.

Baillargeon, R., Needham, A., & De Vos, J. (1992). The development of young infants' intuitions about support. *Early Development & Parenting, 1*, 69-78.

Berlin, B., & Kay, P. (1969). *Basic color terms: Their universality and evolution.*

Barkeley and Los Angeles: University of California Press.

Biederman, I. (1987). Recognition-by-components: A theory of human image understanding. *Psychological Review, 94*, 115-145.

Bloom, A. H. (1981). *The linguistic shaping on thought: A study in the impact of language on thinking in China and the West.* Hillsdale, NJ: Erlbaum.

Boas, F. (1938a). *General anthropology.* D. C. Heath and Company.

Boas, F. (1938b). *Mind of primitive man.* The Macmillan Company.

Boroditsky, L. (2000). Metaphoric structuring: understanding time through spatial metaphors. *Cognition, 75,* 1-28.

Boroditsky, L. (2001). Does language shape thought?: Mandarin and English speakers' conceptions of time. *Cognitive Psychology, 43,* 1-22.

Boroditsky, L.., & Ramscar, M. (2002). The role of body and mind in abstract thought. *Psychological Science, 13,* 185-189.

Bowerman, M. (1996a). Learning how to structure space for language: A crosslinguistic perspective. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp. 385-436). Cambridge, MA: MIT Press.

Bowerman, M. (1996b). The origins of children's spatial semantic categories: Cognitive versus linguistic determinants. In J. J. Gumperz & S. C. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 145-176). Cambridge, UK: Cambridge University Press.

Bowerman, M., & Choi, S. (1994). *Linguistic and nonlinguistic determinants of* *spatial semantic development: A crosslinguistic study of English, Korean, and Dutch.* Paper presented at Boston University Conference on Language Development, Boston, MA.

Bowerman, M., & Choi, S. (2001). Shaping meaning for language: Universal and language-specific in the acquisition of spatial semantic categories. In M. Bowerman & S. C. Levinson (Eds.), *Language Acquisition and Conceptual Development* (pp.475-511). Cambridge, U. K.: Cambridge University Press.

Bowerman M., de Leon L., & Choi, S. (1995). Verbs, particles, and spatial semantics: Learning to talk about spatial actions in typologically different languages. In E. V. Clark (Ed.), *Proceeding of the Twenty-seventh Annual Child Language Research Forum* (pp.101-110). Stanford, CA: Center for the Study of Language and Information.

Brown, P. (1998). Children's first verbs in Tzeltal: Evidence for an early verb category. *Linguistics, 36,* 713-753.

Brown, P., & Levinson, S. C. (1993). 'Uphill' and 'downhill' in Tzeltal. *Journal of Linguistic Anthropology*, 3, 46-74.

Brown, R. W., & Lenneberg, E. H. (1954). A study in language and cognition. *Journal of Abnormal & Social Psychology, 49,* 454-462.

Bryant, D. J., Tversky, B., & Franklin, N. (1992). Internal and external spatial frameworks for representing described scenes. *Journal of Memory and Language, 31*, 74-98

Carmichael, L., Hogan, H. P., & Walter, A. A. (1932). An experimental study of the effects of language on the reproduction of visually perceived form. *Journal of Experimental Psychology, 15,* 73-86.

Choi, S. (1997). Language-specific input and early semantic development: Evidence from children learning Korean. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition, Vol. 5: Expanding the contexts* (pp. 41-133). Mahwah, NJ: Lawrence Erlbaum.

Choi, S. (2003) Personal communication. April, Tampa, FL.

Choi, S. (2003) Personal communication. November.

Choi, S. (2006). Influence of language-specific input on spatial cognition: Categories of containment. *First Language, 26*, 207-232.

Choi, S., & Bowerman, M. (1991). Learning to express motion events in English and Korean: The influence of language-specific lexicalization patterns. *Cognition, 4,* 83-121.

Choi, S., & McDonough, L (in press). Adapting spatial concepts for different languages: An exploration of containment and support relations in English and Korean. Chapter for '*Emerging landscapes of mind: Mapping the nature of change in spatial cognitive development.'*

Choi, S., McDonough, L., Bowerman, M., & Mandler, J. M. (1999). Early sensitivity to language-specific spatial categories in English and Korean. *Child Development, 14,* 241-268.

Chomsky, N. (1965). *Aspects of the theory of syntax*. Oxford, UK: MIT Press.

Chomsky, N. (1968). Language and the mind. *Psychology Today,1*, 48-68.

Clancy, P. M. (1985). The acquisition of Japanese. In D. I. Slobin (Ed.), *The cross* *linguistic study of language acquisition, Vol.1: The data* (pp. 373-524). Hillsdale, NJ: Erlbaum.

Clark, E. V. (1973a). Non-linguistic strategies and the acquisition of word meanings. *Cognition, 2,* 161-182.

Clark, E. V. (1973b). What's in a word? On the child's acquisition of semantics in his first language. In T. E. Moore (Ed.), *Cognitive development and acquisition of language* (pp. 65-110). New York: Academic Press.

Clark, H. H. (1973). Space, time, semantics, and the child. In T. E. Moore (Ed.), *Cognitive development and acquisition of language* (pp. 65-110). New York: Academic Press.

Clark, H. H. (1996). Communities, commonalities, and communication. In J. J. Gumperz & S. C. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 324-355). Cambridge, UK: Cambridge University Press.

Cole, M., & Cole, S. (2001). *The development of children* (4th ed.). New York: Freeman and Company.

Damasio, A. (2000). *The Feeling of What Happens: Body and Emotion in the Making of Consciousness.* London, UK: William Heinemann.

Davidoff, J., Davies, I., & Roberson, D. (1999). Colour categories in a Stone-age tribe. *Nature, 398,* 203-204.

Davies, I. R. L., Sowden, P. T., Jerrett, D. T., Jerrett, T., & Corbett, G. G. (1998). A cross-cultural study of English and Setswana speakers on a colour triads task: A test of the Sapir-Whorf hypothesis. *British Journal of Psychology, 89,* 1-15.

Fishman, J. A. (1960). A systematization of the Whorfian hypotheses. *Behavioral Science, 5,* 323-339.

Franklin, N., & Tversky, B. (1990). Searching imagined environments. *Journal of Experimental Psychology: General, 119*, 63-76.

Gardner, H. (1985). *The mind's new science.* New York: Basic Books, Inc.

Gentner, D., Imai, M., & Boroditsky, L. (2002). As time goes by: Evidence for two systems in processing space → time metaphors. *Language and Cognitive Processes, 17,* 537-565.

Gibson, E. (1967). *Principles of perceptual learning and development.* New York: Appleton-Century-Crofts.

Glenberg, A. M. (1997). What memory is for. *Behavioral and Brain Sciences, 20*, 1-56

Gordon, J., Abramov, I., & Chan, H. (1994). Describing color appearance: Hue and saturation scaling. *Perception and Psychophysics, 56*, 27-41.

Greenberg, J. H. (1954). Concerning inferences from linguistic to nonlinguistic data. In H. Hoijer (Ed.), *Language in culture; conference on the interrelations of language and other aspects of culture* (pp. 3-19). Chicago: University of Chicago Press.

Hardin, C., & Banaji, M. R. (1993). The influence of language on thought. *Social Cognition, 11,* 277-308.

Heider, E. R. (1972). Universals in color naming and memory. *Journal of Experimental Psychology, 93,* 10-20.

Heider, E. R., & Olivier, D. (1972). The structure of the color space in naming and memory for two languages. *Cognitive Psychology, 3,* 337-354.

Henle, P. (1958). Language, thought, and culture. In P. Henle (Ed.), *Language, thought, and culture* (pp. 1-24). Ann Arbor: University of Michigan Press.

Hermer-Vazquez, L., Moffet, A., & Munkholm, P. (2001). Language, space, and the development of cognitive flexibility in humans: the case of two spatial memory tasks. *Cognition, 79*, 263-99.

Hermer-Vasquez, L., Spelke, E.S., & Katsnelson, A. S. (1999). Sources of flexibility in human cognition: Dual-task studies of space and language. *Cognitive Psychology, 39*, 3-36.

Hill, J. H., & Mannheim, B. (1992). Language and world view. *Annual Review of Anthropology, 21,* 381-406.

Hoffman, D.D., & Richards, W. A. (1984). Parts of recognition. *Cognition, 18*, 65-96.

Humboldt, W. von (1988). *On Language: The diversity of human language-structure and its influence on the mental development of mankind* (P. Health, Trans.). Cambridge, MA: Cambridge University Press (Original work published 1836).

Hunt, E., & Agnoli, F. (1991). The Whorfian hypothesis: A cognitive psychology perspective. *Psychological Review, 98,* 377-389.

Huttenlocher, J., & Lui, F. (1979). The semantic organization of some simple nouns and verbs. *Journal of Verbal Learning and Verbal Behavior, 18,* 141-162.

Imai, M., & Gentner, D. (1997). A crosslingusitic study of early word meaning:

Universal ontology and linguistic influence. *Cognition,62,*169-200.

Imai, M., & Mazuka, R. (2003). Reevaluating linguistic relativity: Language-specific categories and the role of universal ontological knowledge in the construal of individuation. In D. Gentner & S. Goldin-Meadow (Eds.), *Language in mind: advances in the study of language and thought* (pp. 429-464). Cambridge, MA: The MIT Press.

Jackendoff, R. (1994). *Pattern in the Mind.* New York, NY: Basic Books

Jackendoff, R. (1996). The architecture of the linguistic-spatial interface. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp.1-30). Cambridge: MIT Press.

Jia, G. (2003). The acquisition of the English plural morpheme by native Mandarin Chinese-speaking children. *Journal of Speech, Language, and Hearing Research, 46*, 1297-1311.

Johansson, G. (1973). Visual perception of biological motion and a model for its analysis. *Perception and Psychophysics, 14,* 201-211.

Johansson, G., von Hofsten, C., & Jansson, G. (1980). Event perception. *Annual Review of Psychology, 31,* 27-63.

Johnson, M. (1987). *The body in the mind: The bodily basis of meaning, imagination, and reason.* Chicago: University Chicago Press.

Johnson-Laird, P. N. (1996). Space to think. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp. 437-462). Cambridge: MIT Press.

Johnston, J. R., & Sloin, D. I. (1979). The development of locative expressions in

English, Italian, Serbo-Croatian and Turkish. *Journal of Child Language, 6,* 529-545.

Kameyama, M. (1987). *Computing Japanese discourse: Grammatical disambiguation with centering constraints.* Paper presented at the workshop on Computing Japanese at the University of Manchester Institute of Science and Technology, Manchester, England.

Kant, I. (1965). On the priori nature of space. In J. Watson (Trans.). *The philosophy of Kant as contained in extracts of his own writings* (pp.132-135). Cambridge, MA: Harvard University Press (Original work published 1781).

Karmiloff-Smith, A. (1986). From meta-processes to conscious access: Evidence from children's metalinguistic and repair data. *Cognition, 23*, 95-147.

Kay, P., & Kempton, W. (1984). What is the Sapir-Whorf hypothesis? *American Anthropologist, 86,* 65-79.

Kay, P., & McDaniel, C. K. (1978). The linguistic significance of the meanings of basic color terms. *Language, 54,* 610-646.

Kempe V. & Brooks, P. J. (2001). The role of diminutives in Russian gender learning: Can child-directed speech facilitate the acquisition of inflectional morphology? *Language Learning. 51,* 221-256.

Kempe, V. & Brooks, P. J. (2005). The role of diminutives in the acquisition of Russian gender: Can elements of child-directed speech aid in learning morphology? *Language Learning, 55, Supplement 1*, 139-176.

Kimball, M. M., & Dale, P. S. (1972). The relationship between color naming and color recognition abilities of preschoolers. *Child Development, 43,* 972-980.

Kohlberg, L., Yaeger, J., & Hjerthorm, E. (1968). Private speech: Four studies and a review of theories. *Child Development, 39,* 691-736.

Lakoff, G. (1987). *Women ,fire, and dangerous things: What categories reveal about the mind.* Chicago: University of Chicago Press.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by.* Chicago: University of Chicago Press.

Lee, P. (1997). Language in thinking and learning: Pedagogy and the new Whorfian framework. *Harvard Educational Review, 67,* 430-471.

Lenneberg, E. H. (1953). Cognition in ethnolinguistics. *Language, 29,* 463-471.

Levelt, W. J. M. (1996). Perspective-taking and ellipsis in spatial descriptions. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp.77-107). Cambridge, MA: MIT Press.

Levelt, W. J. M. (1999). Producing spoken language: a blueprint of the speaker. In C. M. Brown & P. Hagoort (Eds.), *The neurocognition of language* (pp. 83-122). New York: Oxford University Press.

Levinson, S. C. (1994). Vision, shape, and linguistic description: Tzeltal body-part terminology and object description. *Linguistics, 32,* 791-855.

Levinson, S. C. (1996a). Frames of reference and Molyneux's question: Crosslinguistic evidence. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp.109-169). Cambridge, MA: MIT Press.

Levinson, S. C. (1996b). Relativity in spatial conception and description. In J. J. Gumperz & S. C. Levinson (Eds.), *Rethinking linguistic relativity* (pp.177-202). Cambridge, UK: Cambridge University Press.

Levinson, S. C. (2003). *Space in Language and Cognition.* Cambridge, UK: Cambridge University Press.

Levinson, S. C., Kita, S., Haun, D. B. M., & Rasch, B. H. (2002). Returning the tables: language affects spatial reasoning. *Cognition, 84,* 155-188.

Li, P., & Gleitman, L. (2002). Turning the tables: language and spatial reasoning. *Cognition, 83,* 265-294.

Lucy, J. A. (1992). *Language Diversity and Thought: A Reformation of the Linguistic Reality Hypothesis.* Cambridge: Cambridge University Press.

Malt, B. C., Sloman, S. A., & Gennari, S. P. (2001). Universality and language specificity in object naming. *Journal of Memory and Language, 49*, 20-42.

Malt, B. C., Sloman, S. A., & Gennari, S. P. (2003). Speaking versus thinking about objects and actions. In D. Gentner & S. Goldin-Meadow (Eds.), *Language in mind: advances in the study of language and thought* (pp. 81-111). Cambridge, MA: The MIT Press.

Malt, B. C., Sloman, S. A., & Gennari, S. P., Shi, M., & Wang, Y. (1999). Knowing versus naming: Similarity and the linguistic categorization of artifacts. *Journal of Memory and Language, 40,* 230-262.

Mandler, J. M. (1996). Preverbal representation and language. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp. 365-384). Cambridge: MIT Press.

Mandler, J. M. (2004). *The foundations of mind.* NY: Oxford University Press.

Marr, D. (1982). *Vision*. San Francisco, CA: Freeman.

McDonough, L., Choi, S., & Mandler, J. M. (2003). Understanding Spatial relations: Flexible infants, lexical adults. *Cognitive Psychology, 46,* 229-259.

Merriam-Webster, Kenkyusha Ltd. Staff (1993). *Merriam-Webster's Japanese-English dictionary.* Springsfield, MA: Merriam-Webster, Inc.

Munnich, E., Landau, B., & Dosher, B. A. (2001). Spatial language and spatial representation: A cross-linguistic comparison. *Cognition, 81*, 171-207.

Naigles, L. R. Eisenberg, A. R., Kako, E. T., Highter, M., & McGraw, N. (1998). Speaking of motion: Verb use in English and Spanish. *Language and Cognitive Processes, 13,* 521-549.

Naigles, L. R., & Terrazas, P. (1998) Motion-verb generalizations in English and Spanish: Influence of language and syntax. *Psychological Science, 9*, 363-369.

Nelson, K. (1985). *Making sense: The acquisition of shared meaning.* San Diego, CA: Academic Press.

Nisbett, R. E. (2003). *The geography of thought: how Asians and Westerners think differently… and why.* New York, NY: The Free Press.

Paivio, A. U. (1971). *Imagery and verbal processes*. Hillsdale, NJ: Erlbaum.

Papafragou, A., Massey, C., & Gleitman, L. (2002). Shake, rattle, 'n' roll: the representation of motion in language and cognition. *Cognition, 84,* 189-219.

Papafragou, A., Massey, C., & Gleitman, L. (2006). When English proposes what Greek presupposes: The cross-linguistic encoding of motion events. *Cognition, 98*, B75-87.

Pederson, E., Danziger, E., Wilkins, D., Levinson, S., Kita, S., & Senft, G. (1998). Semantic typology and spatial conceptualization. *Language, 74,* 557-588.

Piaget, J. (1953). *The origin of intelligence in the child.* London, UK: Routledge and Kegan Paul.

Piaget, J. (1962). *Play, dreams and imitation in childhood* (C. Gattegno & F. M. Hodgson, Trans.). New York: Norton.

Piaget, J. (1967). *Six psychological studies.* New York: Random House.

Quinn, P. C. (1994a). Development of recognition and categorization of objects and their spatial relations in young infants. In L. Balter & C. S. Tamis-LeMonde (Eds.). *Child Psychology: A handbook of contemporary issues* (pp. 85-115). Philadelphia, PA: Psychology Press/Taylor and Francis.

Quinn, P. C. (1994b). The categorization of above and below spatial relations by young infants. *Child Development, 65,* 58-69.

Quinn, P. C. (2003). Personal communication. April, Tampa, FL.

Roberson, D., Davies, I., & Davidoff, J. (2000). Colour categories are not universal: Replication and new evidence from a Stone-Age culture. *Journal of Experimental Psychology: General, 129,* 369-398.

Sapir, E. (1921). *Language: An introduction to the study of speech.* New York:

Harcourt Brace and Company.

Sapir, E. (1949). The unconscious patterning of behavior in society. In D. G. Mandelbaum (Ed.), *Selected writing of Edward Sapir in language, culture, and personality* (pp.544-559). Bakeley, CA: University of California Press.

Sinha, C., & de López, K. J. (2000). Language, culture, and the embodiment of spatial cognition. *Cognitive Linguistics, 11*, 17-41.

Sinha, C., Thorseng, L. A., Hayashi, M., & Plunkett, K. (1994). Comparative spatial semantics and language acquisition: Evidence from Danish, English, and Japanese. *Journal of Semantics, 11,* 253-287.

Slobin, D. I. (1971). *Psycholinguistics.* Glenview, Ill: Scott, Foresman.

Slobin, D. I. (1996a). From "thought and language" to " thinking for speaking." In J. J. Gumperz & S. C. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 70-96). Cambridge, UK: Cambridge University Press.

Slobin, D. I. (1996b). Two ways to travel: Verbs of motion in English and Spanish. In M. Shibatani & S. Thompson (Eds.), *Grammatical constructions: Their form and meaning* (pp. 195-219). Oxford: Oxford University Press.

Slobin, D. I. (1997). *The crosslinguistic study of language acquisition, Vol. 5: Expanding the contexts.* Hillsdale, NJ: Erlbaum Associates.

Spelke, E. S. (1990). Principles of object perception. *Cognitive Science, 14*, 29-56.

Spelke, E. S. (2000). Core knowledge. *American Psychologist, 55,* 1233-1243.

Spelke, E. S., Breinlinger, K., Macomber, J., & Jacobson, K. (1992). Origins of knowledge. *Psychological Review, 99,* 605-632.

Spelke, E. S., Katz, G., Purcell, S. E., Ehrlich, S. M., & Breinlinger, K. (1994). Early knowledge of object motion: Continuity and inertia. *Cognition, 51,* 107-130.

Spelke, E. S., & Tsivkin, S. (2001). Language and number: A bilingual training study. *Cognition, 78,* 45-88.

Talmy, L. (1985). Lexicalization patterms: Semantic structure in lexical forms. In T. Shopen (Ed.), *Language typology and syntactic description: Vol. 3. Grammatical categories and the lexicon* (pp. 57-149). Cambridge, UK: Cambridge University Press.

Talmy, L. (1988). Force dynamics in language and cognition. *Cognitive Science, 12,* 49-100.

Tomasello, M. (2003). The key is social cognition. In D. Gentner & S. Goldin-Meadow (Eds.), *Language in mind: advances in the study of language and thought* (pp. 47-58). Cambridge, MA: The MIT Press.

Tversky, B. (1996). Spatial perspective in descriptions. In P. Bloom, M. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp. 463-491). Cambridge: MIT Press.

Tversky, B. (2003). Structures of mental spaces: How people think about space. *Environment and Behavior, 35*, 66-80.

Tversky, B.. & Hemenway, K. (1984). Objects, parts, and categories. *Journal of Experimental Psychology: General, 113*, 169-193.

Varela, F. J., Thompson, E., & Rosch, E. (1991). *The Embodied mind: Cognitive science and human experience.* MA: MIT Press.

Vygotsky, L. S. (1962). *Thought and language.* Cambridge, MA: MIT Press.

Vygotsky, L. S. (1987). Thinking and speech (N. Minnick, Trans.). In R. W. Rieber & A. S. Carton (Eds.), *The collected works of L. S. Vygotsky, Vol. 1: Problem of general psychology* (pp. 37-285). New York: Plenum Press (Original work published 1934).

Werker, J., Gilbert, H., Humphrey, K., & Tees, R. (1981). Developmental aspects of cross-language speech perception. *Child Development, 52*, 349-353.

Werker, J., & Lalonde, C. (1988). Cross-linguistic speech perception: Initial capabilities and developmental change. *Developmental Psychology, 24*, 672-683.

Werker, J., & Tees., R. (1984). Cross-language speech perception: Evidence for perceptual reorganization during the first year of life. *Infant behavior and Development, 7,* 49-63.

Whorf, B.L. (1956). *Language, thought, and reality: selected writings.* Edited by J. B. Carroll. Cambridge, MA: MI T Press.

Wierzbicka, A. (1985). The double life of a bilingual. In R. Sussex & J. Zubrzycki (Eds.), *Polish people and culture in Australia* (pp. 187-223). Canberra, Australia: Australian National University.

Yamada, S. (1990). Kinougo no imi no hikaku. In T. Kunihiro (Ed.), *Nichieigo Hikaku Kouza, vol. 3,* Taishuukan-shoten.

Yoshida, H., & Smith, L. (2001). Early noun lexicons in English and Japanese. *Cognition, 82,* B63-B-74.

Zheng, M., & Goldin-Meadow, S. (2002). Thought before language: How deaf and hearing children express motion events across cultures. *Cognition, 85,* 145-175.