### TABLE OF CONTENTS

**STRUCTURE**

1. **Introduction** ................................................................. 1

2. **What is Space?** ............................................................... 2

3. **How Children Learn To Talk About Space**
   3.1 Spatial Representations .................................................. 2
   3.2 The Acquisition of Spatial Language .................................. 3
   3.3 Spatial Systems in Child Language....................................... 4
   3.4 Children’s Communication about Spatial Relations.................. 5
   3.5 Biases in Young Children’s Communication........................ 6
   3.6 How Children Learn to Distinguish Between Left and Right........ 8

4. **Crosslinguistic Differences**
   4.1 Differences in Crosslinguistic Spatial Semantic Categorization........ 9
   4.2 Differences in Spatial Thinking at the Example of English and Tzeltal... 10

5. **Summary and Conclusion** .................................................. 11

**LITERATURE**..................................................................... 12
1. Introduction

Our understanding of the world is to a large part dependent on our spatial conception. Space therefore not only serves as an important foundation for our perception but it also determines how we classify events and objects in our environment. Research has proven that spatial conception is central to human thinking. (see Levinson, 1992) That is, it does play a key part in forming a foundation for later cognitive development. For this reason I will focus on the acquisition of the concept of space in this paper.

In this case, the term concept needs further explanation. Gelman (1996, p 117) says: “Concepts are fundamental to all of human experience”. When naming objects, for instance, we make use of concepts. Basically, concepts are mental representations that put experiences into order. They are “a set of properties that are associated with each other in memory and thus form a unit” (Gelman, 1996, p 118). Becoming more complex with the development of the child, a more abstract and logical structure develops.

In order to discuss the topic ‘the acquisition of the concept of space’, it will be necessary to provide some ideas about what space is, and especially how it is understood in linguistics. Further, I will focus on how spatial language is acquired; that is, I will regard representations about space in the mind and how they are influenced by the environment as well as the spatial systems that are prevailing in child language.

Though children cannot communicate about space when they are only a few months old, they already know a lot about space. They begin to characterize and develop concepts of space on the basis of their perception; that means, they start establishing a spatial network onto which early spatial words are mapped. In this paper, I will explain which kind of words these are.

3. How Children Learn To Talk About Space

3.1 Spatial Representations

Humans use geometric and nongeometric information to determine where they are. „The geometric system preserves information about sense relations, allowing children to differentiate between corners of the room which differ only with respect to the left/right relation of the short and long walls.” (Spelke & Tsivkin, 2001 in: Bowerman & Levinson, 2001, p 79) Nongeometric properties of the environment allow children „to confine their search for a displaced object to a container with appropriate coloring and...
patterning” (Spelke & Tsivkin, 2001 in: Bowerman & Levinson, 2001, p 79). Examples for nongeometric information are for instance: names of streets, numbers of buildings or landmarks (e.g. a particular shop).

This flexibility distinguishes humans from animals. Young children perceive both properties of the environment. Before they develop spatial language, children form representations\(^1\) of the geometry of the stable environmental layout, which is used for reorientation; as well as of the nongeometric properties of objects and surfaces in the layout, which is used for finding displaced or hidden objects.

Although both, geometric and nongeometric relations are represented prelinguistically, spatial language allows the child to represent the position of a hidden object in new ways. Over development the spatial concept enriches, depending on conjoining representations. (see Spelke and Tsivkin, 2001 in: Bowerman & Levinson, 2001)

### 3.2 The Acquisition of Spatial Language

Children know a lot about space before they begin to talk about it. They can already “distinguish between scenes and categorize them on the basis of spatial information such as left – right (Behl-Chadha & Eimas 1995) and above-below (Antell & Caron 1985; Quinn 1994)” (Bowerman & Choi, 2001 in: Bowerman & Levinson, 2001, p 478) within the first few days or months of life. At first words emerge for functional and topological notions of containment (e.g. in), contiguity and support (e.g. on) and occlusion (e.g. under), followed by words for notions of proximity (e.g. next to, beside, between) and eventually words for projective relationships (e.g. in front of, behind).

Assuming that early spatial words are mapped to preestablished spatial concepts, rapid generalization follows; that is, once children have heard the same preposition for several relationships between objects, they conclude that they can use it for all these kind of relationships. (see Bowerman & Choi, 2001 in: Bowerman & Levinson, 2001)

Many scientists therefore assume “that non-linguistic spatial development supports the acquisition of spatial language and provides many of the guidelines children follow in extending spatial morphemes to novel situations” (Bowerman & Choi, 2001 in: Bowerman & Levinson, 2001, p 479).

### 3.3 Spatial Systems in Child Language

Spatial systems in child language can either be **configurational**, that is they refer “to the location of […] objects relative to referent […] objects”\(^2\) (Weist, 2002, p 195) or **conventional**, namely that they refer “to the specification of […] directions and the measurement of […] distance”\(^3\) (Weist, 2002, p 195). With the age of 2 children begin to code contrasts in viewpoint aspects. Scientists differentiate in the spatial domain between the *theme*\(^4\), which is the to-be-located object and the *relatum*\(^5\), the reference location. According to Carroll and Becker (1997 in: Weist, 2002) the relationship between *theme* and *relatum* involves five concepts:

1. topological sub-spaces,
2. movement implicating a source or goal\(^6\),
3. coordinating axes,
4. spatial deixis\(^7\) and
5. distance.

Levinson argues that children code relations between a theme and a single relatum and that the frame of reference is relatum-centered; that is object-centered. (see Weist, 2002)

With spatial systems becoming more complex, the position of the deictic center changes, as well as the variety of co-ordinate axes\(^8\) and the extent of distance, which becomes more important. The spatial configurations that children use become more complex with the evolvement of their spatial systems. This means that they begin to be more precise in their description of a to-be-located-object and might use more than one reference object for their description. For instance, they would first say ‘the ball on the table’ and later add, after they have required more complex configurations, ‘the ball on

---

\(^1\) A representation is a mental idea of a content of an expression. (see Lexicon of Linguistics, 2004)

\(^2\) e.g.: across/along

\(^3\) e.g.: North/South

\(^4\) “The theme tends to be more movable, smaller, more salient, and geometrically simpler […]” (Talmy quoted in: Weist, 2002, p 196)

\(^5\) “[…] the relatum is […] more permanent, larger, more in the background, and geometrically more complex” (Talmy quoted in: Weist, 2002, p 195)

\(^6\) e.g.: into/out of

\(^7\) “[…] the phenomenon that elements in a language may have a reference which is dependent on the immediate context of their utterance” (Lexicon of Linguistics, 2004). This refers to spatial expressions like **here** and **there**.

\(^8\) That is, the vertical axis (up/down), which is acquired early; followed by the sagittal axis (front/back) and the lateral axis (left/right). (see Weist, 2002)
the table next to the chair.’ Linguistic research has shown that children acquire simple configurations\(^8\) before complex ones. Simple configurations would be the prepositions \textit{in/on or off/onto}, whereas more complex configurations would be \textit{between or across/along}. (see Weist, 2002)

Not very much is known about the manner conventional expressions are incorporated into the child’s spatial locative system, due to the fact that more research has been done on temporal locative systems. Conventional expressions are based on culture and are learned by children in “formal environments” (Weist, 2002, p 197), as e.g. minutes versus hours or inches versus yards. Other expressions such as \textit{left/right}, which are also regarded conventional, are learned by everyday experience. (see Weist, 2002)

3.4 Children’s Communication about Spatial Relations

Scientists assume that children move from describing one target object (e.g. a mouse) in relation to one single landmark (e.g.: in a bag), to describing one target object in relation to a series of nested landmarks (e.g.: a mouse in a bag on a table) and spatial regions, namely there is more than one landmark in a spatial region. Craton et al. (1990 in: Plumert, 1995) have found out in their studies that younger children, under the age of six, have difficulties with communicating about nested spatial relations. Linguists believe that young children do not take into consideration the needs of the listener; this is called difference rule in referential communication literature. In particular “preschoolers lack an understanding that a message should describe differences between a referent and the objects with which it might be confused” (Plumert et al., 1995). Additionally, linguists suppose that also the type of the spatial relation between the nested landmarks is of importance. It has been observed that younger children comprehend support relations (e.g. expressed with \textit{in/on}) before proximity relations (e.g. expressed with \textit{by/next to}). An example sentence that shows a support relation would be: ‘The ball is \textit{in} a bag.’ Whereas the sentence ‘The ball is \textit{in} a bag \textit{next to} the chair.’ expresses also a proximity relation. One reason why it is easier for children to understand a support relation prior to a proximity relation, scientists say, might be the fact that “support carries important functional meaning within the physical world”, i.e. if a plant is placed on a table and the table is removed, the plant will go with the table, namely it will drop since the table was its support. Linguists claim, even if English speaking children at the age of three are able to produce the spatial prepositions \textit{by and next to}, they might have problems using proximity relations identifying object locations without being ambiguous, especially when the target object and the landmark are not in contact with one another. This is due to the fact that children acquire terms such as \textit{in} and \textit{on} before the term \textit{next to}. In Clark’s experiments (1973, 1980), two year olds have clearly shown a preference “for placing objects on or in other objects even when instructed to place the object in front of or behind the other object” (Plumert et al., 1995, p 960). Another explanation for the fact that younger children might learn support relations more easily than proximity relations is according to scientists, that \textit{on} usually has an all-or-none meaning in nature; i.e. a person can be either \textit{on or off} a chair. In contrast to that, the term proximity, that is nearness in space, is rather continuous and relative, namely when “one object is considered to be near another object often depends on how close other neighboring landmarks are” (Plumert et al., 1995, p 961).

Plumert et al. observed that “references to secondary landmarks\(^10\) […] were dependent both on age and on the type of spatial relation […]” (Plumert et al., 1995, p 967). According to them, it is more likely that four year olds mention a secondary landmark than three year olds when describing a location of an object. Further they noticed that children “were more likely to mention the secondary landmark when it provided a horizontal surface of support for the primary landmark than when it was proximal to the primary landmark” (Plumert et al., 1995, p 967). They state that developmental differences in young children’s verbal fluency may account for this, as well as the supposition that “younger children may have difficulty using location as a means of identifying objects” (Plumert et al., 1995, p 967). A reason for the last mentioned aspect is that “younger children may find it easier to identify objects on the basis of properties intrinsic to the object\(^11\) […] than on the basis of relational properties such as location” (Plumert et al., 1995, p 967).

3.5 Biases in Young Children’s Communication

Experts say “[…] that the nature of the spatial relation exerts an important influence over the selection of spatial information in descriptions of locations” (Plumert & Hawkins, 2001, p 23). Research, which has been done on how children communicate

\(^8\) I.e., it refers to the arrangement of objects in space (see Weist, 2002)

\(^{10}\) In the sentence “The mouse is in a bag on a table.”, ‘on a table’ is a secondary landmark.
about location, has proven that children have a clear preference for support relations (i.e.: the bag on the chair) over proximity relations (i.e.: the bag next to the table). Therefore, functionality must play an important role in how young children communicate about location. Next to functionality, also containment (i.e.: the mouse in the bag), which is concerned with the features of containers (e.g. a box), is a factor for how objects move in the environment. Scientists assume that the “understanding of containment develops over the first two years of life” (Aguirre & Baillargeon, 1998; MacLean & Schuler, 1989 in: Plumert & Hawkins, 2001, p 23). Plumert and Hawkins (2001, p 27) observed that three and four year olds “find it easier to communicate about containment relations than about proximity relations.” They argue that this is not due to difficulties with mapping proximity terms onto the correct conceptual referents but rather that containment relations must be more salient to young children than proximity relations. Although the experiments showed that it depends on the difficulty of the task, whether three and four year olds prefer containment over proximity. When children were asked to describe the location of an object, they clearly preferred containment but once they had to follow directions of a person to locate a specific object, the difference between the choice of containment and proximity was not significant. Scientists rate the task describing directions more difficult than the task of following directions. This theory goes along with other language acquisition studies that discovered that “children can comprehend considerably more words than they can produce” (Benedict, 1979; Huttenlocher, 1974 in: Plumert&Hawkins, 2001, p 34). Plumert et al. suggest that the “preference for communicating information about containment or support over proximity does not disappear with development” (Plumert et al., 1996 in: Plumert&Hawkins, 2001, p 34), as adults in their experiments, who were free to choose which piece of spatial information to include in their descriptions, preferred using landmarks the target object was on instead of next to.

Reasons for the assumption that young children prefer support and containment over proximity are that functional spatial relations are more salient to young children than non-functional spatial relations. Support as well as containment has important functional consequences for how objects interact with each other; that is when a ball (= object) is in a bag (= container), the ball moves when the bag is moved. Also, an object falls when the surface of support is removed. Instead, when two objects are next to each other, it does not have any consequence when one object is removed. This, Plumert and Hawkins (2001, p 34) argue “may […] explain why support and containment relations retain a relatively privileged status even after other spatial concepts have been mastered”; whereas proximity or nearness, lacks specificity in linguistic and conceptual representations. Therefore it only seems plausible that children have difficulties in describing proximity relations “because it is not clear how close two objects must be to be classified as near one another” (Plumert & Hawkins, 2001, p 35).

Children from a variety of cultures generally acquire spatial terms in the following order: in, on, under and then next to or by, as research by Dromi (1979) and Johnston & Slobin (1979) (in: Plumert & Hawkins, 2001) has shown. Clark even suggests that “very young children’s understanding of the meaning of spatial terms is biased more strongly toward containment than support relations” (quoted in: Plumert & Hawkins, 2001, p 35). He set up two rules for how children under the age of two respond to a given object and instruction for placing a toy in, on or under the object:

1. If the reference object is a container, put the toy inside of it.
2. If the reference object has a horizontal surface, put the toy on it.

Plumert and Hawkins propose that preferring containment over support does not vanish after children learn the meanings of containment and support terms. Further they assume that biases in “young children’s communication about location may be related to more general biases in how they remember location” (Plumert & Hawkins, 2001, p 36).

### 3.6 How Children Learn to Distinguish Between Left and Right

*Left and right* are the most common means for specifying direction and location. Young children who are able to distinguish their left and right sides often cannot identify the left and right sides of others. In fact, research suggests that children have difficulties using the terms ‘left’ and ‘right’ appropriately between the age of seven to eleven, as researchers suppose, due to the problem of distinguishing left/right differences. This phenomenon indicates that using left and right appropriately requires more than the understanding of the two terms but rather the understanding of a conceptual reference system. For example, a child may be able to distinguish whether his or her mother holds the bottle in the left or right hand but be unable to say which hand is right and which left. (see Roberts & Aman, 1993)
It is been said that young children learn left and right terms for parts of their bodies, that is the left and right distinction is acquired with the self as reference. Linguists have proven that children between six and eight years, who correctly distinguish left and right for others, perform an imagined rotation to align with an object or person before making left or right judgements, when the orientation of the triangle deviates from upright. Children, who have difficulties determining whether an object’s or person’s position is left or right, are said not to make use of the mental rotation strategy but rather stick with a stationary self-reference frame, just as very young children do. Adults, researchers found out, also utilize the mental rotation strategy but only when the to-described-object is located above an angle of 90° of the self’s left-right plane. The transition, from using mental rotation from all orientations to using them only when the to-be-described object is 90° out of phase with the self’s, shows how cognitive and spatial skills continue to develop to more efficiency with increasing age. (see Roberts & Aman, 1993)

4. Crosslinguistic Differences

4.1 Differences in Crosslinguistic Spatial Semantic Categorization

Languages vary considerably from one another in terms of how they describe the world. Differences reach from pronunciation and vocabulary to grammar. Sapir (1921) and Slobin (1996) for example, argue that “speakers of different languages have to attend to and encode strikingly different aspects of the world in order to use their language properly” (in Boroditsky, 2004, p 1). Benjamin Lee Whorf’s (Whorf, 1956 in: Boroditsky, 2004) idea that thought and action are entirely determined by language has long been neglected by many. Recent research has found new evidence that language has effects on people’s representations of space, time, substances, and objects. The meanings of spatial morphemes across languages are often similar, though their form may differ. Support (e.g. ‘on’) and containment (e.g. ‘in’) are cited two of the most fundamental and early-maturing spatial concepts, as I have already mentioned in several parts of this paper.

Language specific conventions determine to a large extent what a language counts as support and what as containment. It is neither the structure of reality nor our perception of it that determines it. These conventions must be learned. (see Bowerman & Choi, 2001 in: Bowerman & Levinson, 2001) Differences in how language describes spatial relations have been noticed in English, Dutch, Finnish and other languages. English, for example, uses a containment/support distinction; that is it distinguishes between “putting things into containers (e.g. ‘the apple in the bowl’, ‘the letter in the envelope’) and ”putting things onto surfaces (e.g. ‘the apple on the table’, ‘the magnet on the refrigerator door’)” (Boroditsky, 2004, p 1); whereas Korean, for instance, differentiates between tight and loose fit or attachment. That means that “putting an apple in a bowl requires a different relational term (that is: nehta) than putting a letter in an envelope (that is: kita)” (Boroditsky, 2004, p 1), due to the fact that the first case is an example for loose containment and the second case an example of tight fit. Bowerman & Choi (2001) argue that from the children’s first productive uses of spatial words, they categorize spatial events language specifically. Though the spatial distinctions reinforced by a particular language are the ones that remain salient in one’s representation repertoire. (see Boroditsky, 2004) Language-specific learning begins with at least the second half of the second year of life, Bowerman & Choi (2001) say. Further they suppose that the sensitivity for language-specific spatial categories begins to develop in comprehension even before production begins. (see Bowerman & Choi, 2001 in: Bowerman & Levinson, 2001)

4.2 Differences in Spatial Thinking at the Example of English and Tzeltal

Levinson (1996 in: Boroditsky, 2004, p 2) suggests that there are also crosslinguistic differences in how languages describe spatial locations. The English language relies on relative spatial terms (i.e. left/right) to describe the relative location of objects, while the Mayan language Tzeltal for instance relies primarily on absolute reference; that is a system similar to the English North/South system, only that Tzeltal people refer to North as downhill and to South as uphill. This uphill/downhill system is called absolute because it represents the dominant way to describe spatial relations between objects in Tzeltal. (see Levinson, 1996 in: Boroditsky, 2004)
The research that has been done so far suggests that “reference frames and distinctions made available by one’s language may indeed impose important constraints on one’s spatial thinking” (Boroditsky, 2004, p 2).

5. Summary and Conclusion

The process of acquiring and appropriate usage of spatial language accompanies children from a few months old up to early adolescence. Even before children are able to verbally communicate about spatial relations between objects, they know a lot about it by forming mental spatial representations of the environment.

At first they acquire words for functional and topological notions of containment (e.g. in), contiguity and support (e.g. on), and occlusion (e.g. under), then words follow for notions of proximity (e.g. next to, beside, between) and eventually words for projective relationships (e.g. in front of, behind).

Over the course of development, the children’s spatial systems evolve and become more complex. With increasing age, they begin to be more precise in their descriptions of a to-be-located object; that is they take more into consideration the needs of the listener and refer to several reference objects, instead of only one, located with the to-be-located object. For instance, instead of saying ‘the shoe is on the pillow’, they later might add ‘the shoe is on the pillow on the chair’ and even later in development ‘the shoe is on the pillow on the chair next to the bed’. This also is dependent on the type of spatial relation given. Researchers suppose that children acquire simple configurations (e.g. in or on) previous to complex ones (e.g. between), that is they comprehend support relations (e.g. expressed with in/on) prior to proximity relations (e.g. expressed with by/next to).

Scientists assume that this is due to functionality reasons. A support relation between two objects obviously carries a more important functional meaning in the physical world than proximity. Except from functionality, containment (=support) also is an important factor in children’s communication. Children’s preference for communicating information about containment or support over proximity does not disappear with development; adults also like to rather rely on support relations over proximity relations when describing an object in a certain environment. Reasons for this can be that support as well as containment has important functional consequences for how objects interact with each other, whereas proximity lacks specificity in linguistic and conceptual representations.

Both, children and adults sometimes need help to orientate themselves. For distinguishing whether other people or objects are situated left or right from them, they make use of the mental rotation, though only at a certain angle. Children use it from all orientations, while adults only use it when the to-be-described object is 90° out of phase with the self’s. Again, this shows that cognitive and spatial skills become more efficient with increasing age.

Recent research has shown that language effects people’s representation of space, as well as others. It is claimed that once children productively use spatial terms, they categorize spatial events language specifically.

With this paper, my goal was to give a broad overview of the field of spatial acquisition. Since it is still a rather new field, a lot more research has to be done to provide distinguished theories that might prove the findings mentioned in this paper.
LITERATURE


< http://tristram.let.uu.nl/UiL-OTS/Lexicon/>


“Meaning Theories.” Lexicon of Linguistics. Utrecht University. 10 May 2004
< http://tristram.let.uu.nl/UiL-OTS/Lexicon/>


