Spatial Representation of Topological Concepts IN and ON:

A Comparative Study of English and Mandarin Chinese

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ABSTRACT

Spatial Representation of Topological Concepts IN and ON: A Comparative Study of English and Mandarin Chinese

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This dissertational research is a crosslinguistic study of the semantic and conceptual underpinnings of two topological spatial concepts of containment (expressed in English mainly by preposition *in*) and support (expressed in English mainly by preposition *on*) in English and Mandarin Chinese. It consists of three studies, each presented as a stand alone paper in a chapter by itself.

The first study experimentally examines the commonalities and variations between and within groups of English and Mandarin speakers in the categorization of a set of pictures into the containment and support relationship using terms. In addition to crosslinguistic similarities, systematic differences in the use of linguistic expressions by Mandarin and English speakers for these topological spatial relationships were found, as well as systematic individual differences within each language group. Together, these findings point to potential underlying differences in how speakers of English and Mandarin conceptualize these two topological spatial categories.

The second study examines the role of the first language (Mandarin) in the use of the spatial meaning of prepositions *in* and *on* by Mandarin speaking users of L2 English. It was found that the L2 users had difficulty using these two prepositions in an English appropriate way and the difficulty was largely attributed to the interference of L1 linguistic and

conceptual pattern. Furthermore, L2 proficiency, length of stay in L2 speaking country and

exposure to L2 were not related to the use of the two prepositions.

The third study is a descriptive study comparing the range of the semantic meanings

of English prepositions *in/on* and Mandarin postpositions *li/shang*. Important similarities

and differences in the linguistic encoding of containment and support between these two

languages were identified. These differences can be accounted for by both semantic and

conceptual factors. Most importantly, the study points out to the possibility of a continuum

of spatial conceptualization, on which the differences between languages are reflected by the

different places that they occupy on that continuum.

All together, the findings in the three studies have important implications for both the

research on semantics of spatial terms and on the conceptual structure of spatial

relationships.

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Contributions of Authors

This dissertation consists of a general introduction, three studies and a general conclusion. I wrote the general introduction and general discussion with feedback from my supervisors, Dr. Norman Segalowitz and Dr. Elizabeth Gatbonton, and my internal committee member Dr. Pavel Trofimovich. The contributions to the three studies are described below.

Study 1: Chapter 2

Zhang, Y., Segalowitz, N., & Gatbonton, E. (2011). Topological spatial representation across and within languages: IN and ON in Mandarin Chinese and English. *Mental Lexicon, 6*(3), 414-445.

I designed the experimental method based on the literature and I recruited and tested participants. The data were analyzed in collaboration with Dr. Norman Segalowitz. I wrote the manuscript with feedback and contributions from Dr. Norman Segalowitz and Dr. Elizabeth Gatbonton.

Study 2: Chapter 3

Zhang, Y., Gatbonton, E., & Segalowitz, N. (*in preparation*). First language conceptual interference in the second language: the impact of Mandarin L1 on the use of *in* and *on* in English L2. In preparation for submission to *Studies in Second Language Acquisition*.

I designed the experimental method and recruited and tested participants. The data was analyzed with feedback from Dr. Elizabeth Gatbonton and Dr. Norman Segalowitz. I wrote the manuscript with feedback and corrections from Dr. Elizabeth Gatbonton and Dr. Norman Segalowitz.

Study 3: Chapter 4

Zhang, Y. & Segalowitz, N. (in preparation). The comparison of uses of English prepositions *in/on* and Mandarin postpositions *li*（里）*/shang*（上）. In preparation for submission to *Linguistics.*

I conducted the descriptive study and wrote the manuscript with feedback and corrections from Dr. Norman Segalowitz.

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Chapter 1.

General Introduction

Space plays a fundamental role in human cognition. In our everyday life, we constantly need to locate and describe the location of ourselves or other objects in the physical world. The notion of space is so critical that it forms the basis for human conceptualization of many other domains, such as time (Levinson, 2003). Because of their common experience in the physical world and shared biological constraints, it is natural to assume that human beings' conceptual structure of space is universal and language independent, as indeed many researchers have claimed (Bierwisch, 1967, 1986; Clark, 1973; Jackendoff, 1983, 1990, 1996; Pinker, 1989). In this view, linguistic categories and structures are more or less straightforward mappings from a pre-existing conceptual space. However, there is more and more evidence arguing against the idea that there exists a strict prelinguistic set of spatial categories that are simply mapped directly onto language. Instead, the evidence indicates that language plays an important role in the conceptual structure of space. The data supporting this view comes mainly from three research areas: studies of the effect of language on non-linguistic task performance, studies of children`s acquisition of the first language (L1) spatial terms, and crosslinguistic studies of variation and similarity in the expression and categorization of spatial concepts across languages.

Some researchers claim that the effect of language on conceptualization may be so strong that the language we learn shapes the way we perceive the world and think about it. This is known as Sapir–Whorf hypothesis. Although this idea has fallen into

disfavour in past decades, in recent times this hypothesis has begun to attract researchers'

interest again. One of the most influential works on this topic in the field of spatial

language and cognition is Levinson's (2003) crosslinguistic study on frame of reference.

It was found that different languages favour different frames of reference (absolute,

intrinsic or relative). Through a set of carefully designed tasks, Levinson argued that

language is the driving factor that leads to the different cultural strategies with regard to

the choice of frame of reference. Furthermore, he and his colleagues reported that people

living in cultures relying on absolute frames of reference were better at finding directions

than people whose languages do not favour absolute frames of reference. These findings

were interpreted as support for the strong version of the Whorfian hypothesis (that

language shapes thought).

On the other hand, language may shape thought especially (and possibly only)

when we prepare to speak. This idea is known as thinking-for-speaking (Slobin, 1996;

2003) and is considered as the weaker version of the Whorfian hypothesis. Feist and

Gentner (2007) found evidence that supports this idea. In three continuous experimental

studies through a yes-no recognition task, the researchers tested participants' recognition

of pictures depicting ambiguous "in" or "on" spatial relationships. The researchers found

that spatial language influenced the encoding and memory of spatial relations.

Developmental research has also revealed evidence of the role of language in

forming conceptual structures. A series of well-known studies into children`s acquisition

of English and Korean showed that while infants do have prelinguistic conceptual

readiness for learning particular spatial categories, "language being learned is in some

sense teaching children how to conceptualize spatial relations" (Bowerman, 1996b;

Bowerman & Choi, 2001, 2003; Choi & Bowerman, 1991; Choi et al., 1999; McDonough, Choi and Mandler, 2003) (McDonough, Choi and Mandler, 2003, p.231). English and Korean differ in categorizing the following spatial relations. English makes a distinction between putting a located object into contact with the reference object (*e.g. put Lego on Lego stack*) and putting a located object into a type of container (e.g. *put cassette in case*), whereas Korean uses the verb *kkita* to indicate that both these two movements express a tight-fit relationship between these two objects and uses another verb *nehta* to express a loose-fit relationship (e.g. *put apple in bowl*), which is taken in English as an instance of putting a located object into container. It was found that 9-month-old infants are able to make distinctions between the types of relationships encoded in both English and Korean, however, by the age of 18 months children make only language-specific distinctions.

However, the role of prelinguistic spatial concepts cannot be ignored. Gentner and Bowerman (2009) found that despite the fact that children are very sensitive to the language specific semantic categories, not all ways of classifying a particular spatial category are equally easy for them. Compare English with Dutch. English uses the same word *on* to refer to the following three types of relations: support from below, support with attachment, and encirclement with contact. In contrast, Dutch uses three different words for these relations — *op, aan* and *om* respectively. Since the English pattern of partitioning these relationships is more common crosslinguistically, the authors hypothesized that this pattern is also cognitively more natural and hence easier for children to learn. Indeed, it was found that it took longer for Dutch-speaking children to learn the Dutch way of categorizing than English-speaking children.

The next set of investigations pointing to the important role of language in the spatial conceptualization comes from a series of crosslinguistic descriptive and empirical studies of meanings of spatial terms. Specifically, a considerable number of studies have looked at two basic topological relationships — containment (expressed in English mainly by preposition *in*) and support (expressed in English mainly by preposition *on*). The general finding is that the categorization of containment and support varies crosslinguistically.

For example, Cienki (1989) compared the English prepositions *in, on* and *at* and their Polish and Russian equivalents. He found that the uses of these spatial prepositions across the three languages do not fully overlap. For example, in English, the preposition *in* is used for the expression *a tent in a clearing*, whereas in Russian and Polish the equivalent words for *on* are used. He interpreted this difference as driven by different conventional conceptualizations of reference objects across languages. Cienki's analysis was based mainly on the comparison of translation equivalents and on the researcher's own linguistic intuitions about how to describe the same spatial scenes in other languages. Other researchers have used more controlled comparisons and have elicited the linguistic descriptions of certain spatial scenes from actual language users.

Bowerman and Pederson (1992) developed a tool called the Topological Relations Picture Series (TRPS). This tool makes possible a stricter crosslinguistic comparison of how spatial relationships are expressed. The TRPS consists of 71 pictures designed to encompass a wide range of scenes exemplifying possible containment and support relationships. This tool is being used by more and more researchers for studies of

semantic typology, i.e. to explore how linguistic representations expressed by real language users structure a given cognitive domain across languages.

In a study involving 38 languages, Bowerman and Pederson (1992) used the TRPS to investigate how speakers of different languages grouped particular scenes into subsets as evident by spatial terms they used to describe them. It was found that scenes typically covered in English by the prepositions *in* (e.g. *apple in bowl*) and *on* (e.g. *cup on table, picture on wall* and *ribbon on candle*) were grouped differently in the 38 languages being investigated. Sometimes they are covered by one spatial term as in Spanish, by more than two spatial terms as in Dutch, and by two spatial terms but with different patterns of grouping as in Berber.

Levinson and colleagues (Levinson, Meira, & The language and cognition group, 2003; Levinson & Wilkins, 2006) applied the TRPS tool to genetically diverse languages. They also found huge differences across the languages in how the pictures were grouped by the spatial terms applied to them. First, the languages differed in the grammatical forms that the concepts were encoded in. It was found that the languages do not just use adpositions (prepositions and postpositions), but also verbs, grammatical cases, spatial nominals, or adverbials to indicate spatial relationships. Second, diverse semantic varieties were also found. For example, in English the spatial concepts support with contact (e.g., *cup on table*) and the spatial relationship expressing higher than, no contact (e.g., *light over table*) are seen as two distinct concepts, whereas many languages (e.g., Japanese, Arrente) conflate these by using the same spatial term. Similarly, containment (e.g., *apple in bowl*) and the spatial relationship expressing lower in vertical position (e.g. *ball under chair*) were often expressed by the same term in Australian languages.

Furthermore, in English, preposition *on* is used to cover both the spatial situations involving the general feature of attachment (e.g. *bandage on leg*) and other types of support (e.g. *cup on table*). However, in other languages, the notion of attachment is often separated from the typical support by terms different from those used for scenes like *cup on table*.

Using the TRPS among other tools, Thiering compared (2007) Northern Athapaskan languages Dene Suline (Canada) with the indigenous language Upper Necaxa Totonac (Mexico), as well as with the three Indo-European languages-English, Norwegian and German. The main finding was that, unlike the Indo-European languages in which a single morpheme is able to express the spatial topological relations, in Dene and Totonac a single adposition does not give sufficient semantic information, and the encoding of topological space is distributed over a number of elements in the utterances. More importantly, the author further argued that the construction of topological spatial relations is not speaker-neutral and objective, but rather subjective, contextualized and perspectivized. For example, depending on a Dene-speaker's viewpoint, some scenes profile more than one reference object.

Brown (1994) employed another kind of elicitation tool in a study of Mayan Tzetal (Mexico) and found a radically different pattern for representing containment. In this language, there are no comparable morphemes to English *in*, instead, a large number of different forms are used for different types of containment, e.g. *man in house, apple in bowl, water in bottle, apple in a bucket of water,* etc.

While acknowledging the rich variations that exist across languages in the linguistic encoding of the spatial concepts of containment and support, researchers also found limits in the variation. For example, researchers (Bowerman & Pederson, 1992; Gentner & Bowerman, 2009) found that although languages make different choices about which scenes are similar enough to be put linguistically into the same containment and support categories as reflected by the spatial term used, these scenes can be arranged to form a similarity gradient, on which the particular scenes that are referred to by the same term are always adjacent. Feist (2000), in her crosslinguistic study employing the TRPS tool, obtained data that mostly respected this similarity gradient. Levinson and Wilkins (2006) reported another type of similarity gradient. According to them, all languages have answers to the "Where" question. The direct answers to the "Where" question is termed as "basic locative constructions (BLC)" by the authors. For example, "*The cup is on the table*" in English is a direct answer to the question "*Where is the cup*?" Whereas, "*There is a cup being put on the table*" is not. It was found that the possibility of responding to the "Where" question using BLC across languages varies depending on the nature of the relationship between the located object and the reference object. This results in a hierarchy of scenes according to the possibility that they will be encoded using BLC. For example, a scene on which the located object is impaled by the reference object is the least likely to be encoded by BLC, whereas a scene in which the located object is an inanimate, movable entity in contiguity with the reference object is most likely to be encoded by BLC.

Another important source of information that indirectly reveals crosslinguistic variations and similarities in linguistic and conceptual representations of containment and

support comes from linguistic and psycholinguistic studies of semantics of spatial terms, mostly prepositions, mainly in individual languages, but also crosslinguistically. For example, in attempting to categorize the meaning of the prepositions *in* and *on*, two factors have been found to be involved: geometry (Bennet, 1975; Cooper, 1968; Leech, 1969; Miller & Johnson-Laird, 1976) and function (Coventry, 1999; Coventry & Clibbens, 2004; Coventry & Garrod, 2004; Coventry & Prat-Sala, 2001; Vandeloise, 1991, 1994). (It should be noted that Feist (e.g. 2000, 2004, 2010) divided the factor of function into two separate factors: functional related knowledge of objects and qualitative physics. The latter one is also called functional control by researchers such as Coventry (e.g. Coventry, 1999; Coventry & Clibbens, 2004; Coventry & Garrod, 2004; Coventry & Prat-Sala, 2001). Functional control and object knowledge together are referred as extra-geometric factors by Coventry. In this dissertational research, both functional control and object knowledge are collapsed into the general term function.) Geometry is the most easily detected and is undoubtedly an important factor in defining the meaning of *in* and *on*. Leech (1969) gave the following definitions of *in* and *on:* X is *in* Y when X is enclosed or contained either in a 2-dimensional or 3-dimensional place Y; X is *on* Y when X is contiguous with the place of Y, where Y is conceived of either as 1-dimensional (a line) or 2-dimensional (a surface). This geometrical account can easily explain the meaning of *in* and *on* in examples like *apple in bowl* or *cup on table.* However, as Coventry and Garrod (2004) pointed out, this account alone fails to provide adequate explanations about why the following descriptions are also permissible: *flowers in vase, bulb in socket,* or *book on table* (when the book rests on the top of a pile of other books and is not in direct contact with the table). The critical role of functional control,

thus, has been addressed. In a study of French spatial terms *dans*, expressing containment and *sur* expressing support, Vandeloise (1991, 1994) argued that the force (function) that the reference object applies on the located object is more important in defining and explaining the use of these prepositions. For example, the fact that *in* is used in *bulb in socket* cannot be explained by a geometrical account because the bulb itself is not in the interior of the socket, whereas the use of *in* is justifiable by the fact that the socket exerts a controlling force on the bulb. Similarly, through a series of carefully designed experimental studies, Coventry and colleagues (Coventry, 1999; Coventry & Clibbens, 2004; Coventry & Garrod, 2004; Coventry & Prat-Sala, 2001) showed that extra-geometric factors, like the location control of the reference object on the located object is much more important than geometrical relations in the semantic description and mental representation of *in* and *on*. The other important element under the general factor of function is object related knowledge. For example, Feist and colleagues (e.g. Feist & Gentner, 1998) found that the naming of reference objects (e.g. plate, bowl and dish) had effects on the choices of *in* and *on*. People have been interested in extending the above findings based on individual languages to a crosslinguistic level. First, Vandeloise (2005) claimed that containment and support are primitive but complex concepts. They consist of a set of properties characterized by family resemblance (Rosch & Mervis, 1975). Languages differ in the number and the pattern of combination of these properties. Second, for the purpose of characterizing the semantic meanings of spatial terms across languages, Feist (2000, 2004, 2008, 2010) employed the TRPS tool and demonstrated that the semantics of spatial terms are built from a universal set of abstract attributes, including geometry, function and qualitative physics. These similarities coexist with

variations across languages. She claimed that the crosslinguistic difference could be explained by the relative importance of these attributes, although she did not test it with specific crosslinguistic examples. These studies examined what exactly constitutes spatial meaning and thus, provided a foundation for exploring the reason of crosslinguistic differences and similarities. These studies also provide insight into how the human mind organizes spatial relationships insofar as linguistically relevant attributes of spatial scenes may correspond to cognitively relevant attributes (Feist, 2000).

In general, although the role that language plays in spatial conceptualization is undeniable, the extent of the effect of the former on the latter is disputable. In order to further investigate into this issue, subtle crosslinguistic studies on the frequent and unique patterns in the linguistic categorization of space and the possible semantic and conceptual underpinnings responsible for these variations and universals are required. Such studies are able to provide sufficient data and a sound basis for any direct experimental testing of the relationship between language and cognition. This is the focus of this dissertation.

Although research has revealed a lot of interesting data on both similarities and differences across languages in the linguistic encoding of spatial concepts of containment and support, this area of research is still in its infancy (Levinson & Wilkins, 2006) and many questions remain to be answered, ranging from the theoretical to the methodological. In light of the research findings referred to above, this dissertation aims to explore the following three general questions through both empirical and descriptive research. First, why are there such differences in the linguistic expressions of containment and support across languages? Do these differences at the linguistic level reflect differences at the conceptual level? Second, is the widely used TRPS tool capable

of identifying possible differences and similarities across languages? Are there improvements that could be made to this methodology? Third, if a person's L1 and second language (L2) differ in the way they carve up the possible ways of expressing containment and support, what impact do such differences have for L2 acquisition?

The first research question is closely connected to the second one. As mentioned earlier, the TRPS tool provides a controlled basis for contrastive comparisons across languages. It can also reveal the possible semantic range of a particular spatial term and elicit semantic subtleties that often cannot be obtained from dictionaries or grammatical descriptions (Levinson et al., 2003). Furthermore, the strengths of the TRPS tool are responsible for it being used more and more by researchers in a variety of crosslinguistic and individual language studies. This provides a good basis for a standardized tool for eliciting scene descriptions from informants to be used for comparing results from different studies, just as in the case of the *Frog, where are you?* story (Mercer, 1969) being used in a large number of studies on how people describe motion.

However, as Levinson and Wilkins (2006) admitted, the TRPS cannot automatically reveal the semantic meaning of a particular term. Furthermore, it does not automatically tell us if the diverse categorizations revealed through the use of different terms in fact reflect different ways of conceptualizing spatial relationships per se. For example, English *within* is similar in meaning to *inside*, but the former sounds loftier in tone (Lindstromberg, 1997). The use of *within* for one picture and *inside* for another picture would likely be a difference in speech register or tone rather than conceptualization. In addition, the selection of pictures itself might restrict the full identification of the semantic meaning of a particular term. For example, Bowerman

(1996b) argued that Mandarin among other languages is indifferent to whether the located object is in contact with the reference object or not and uses the same term for situations that must be distinguished in English by *over/above* or *on*. However, as will be discussed later in this dissertation, the two specific pictures aimed at depicting the non-contact situation in the TRPS tool actually prevent revealing that Mandarin does make a distinction between non-contact and contact situations in many cases.

In general, further in-depth studies are needed to examine the semantic underpinnings of the spatial terms used for containment and support, in order to identify possible differences among languages in how the seemingly fundamental concepts of containment and support are represented, and most importantly, to explore the reasons for these differences. These issues are not easy to examine in studies that involve the simultaneous examination of a large number of languages, because in such studies there can be too many contrasts in the picture grouping patterns to consider. For this reason, the present study focuses on two languages only – English and Mandarin.

The reasons for focusing on these two particular languages are the following. First, the spatial concepts of containment and support in English are well studied and thus provide a strong basis for comparison with other languages. Second, there is very little empirical research published in English focusing on spatial language in Mandarin (Xu, 2008a, p. 1), perhaps because of the superficial correspondence between Mandarin and English in the way of expressing containment and support (as will be seen later in the dissertation). In addition, there is also lack of in-depth studies in Mandarin on this issue. In China, although both language teachers and linguists have noticed that the use of *in/on* in English and the corresponding words *li/shang in* Mandarin do not fully overlap (e.g.,

Tai, 1993), little research has explored in depth the reasons for these discrepancies. Among those that have done so, the studies have only attempted to provide a rough list of example differences (e.g., Guo, 2010; Yu & Ma, 2010), and none of them based on experimental investigation.

This dissertation consists of three studies, each presented as a standalone paper in a chapter by itself. The first study (published as Zhang, Segalowitz & Gatbonton, 2011) explored crosslinguistic variations and similarities in the representation of the topological concepts of containment and support in English and Mandarin Chinese, the possible cognitive underpinnings of these representations, as well as what may be responsible for variation between the two languages. For this purpose, a combination of empirical and descriptive techniques is used. The empirical technique employed a version of the TRPS, enhanced to capture the interesting patterns in the language of Mandarin-speakers not previously revealed through use of the TRPS. The descriptive aspect of the study examined closely group and individual differences among native speakers of English and Mandarin describing the same set of TRPS pictures.

The second study (Zhang, Gatbonton & Segalowitz, manuscript in preparation) was guided by the results of the first study that was done with native speakers and that used the enhanced TRPS tool. This second study examined the acquisition of spatial concepts of containment and support by Mandarin-speaking L2 learners of English. The difficulty that L2 users have acquiring L2 prepositions has long been acknowledged by language teachers and researchers (Khampang, 1974; Tyler & Evans, 2003). Prepositions seem to be "special" compared to words like concrete nouns. The former are considered more difficult to acquire accurately than the latter by L2 speakers (Slobin, 1996).

Furthermore, even if L2 speakers can process prepositions accurately, Taube-Schiff and Segalowitz (2005) found that they presented challenges to L2 speakers by costing greater attentional shift than the concrete nouns did. The second study in this dissertation aims to explore the cognitive factors that may cause the difficulty for L2 speakers to correctly acquire L1 prepositions. Specifically, this second study looks at whether L2 learners transfer their L1-specific conceptual patterns for handling spatial relations into their L2 speech for those spatial relationships that provide interesting crosslinguistic conceptual contrasts.

The third study (Zhang & Segalowitz, manuscript in preparation) is a descriptive study that further examined the similarities and differences between English and Mandarin in the linguistic expressions of topological concepts of containment and support with more linguistic examples that were not included in the previous two studies. In this study, the set of semantic and conceptual factors accounted for these similarities and differences were also addressed. In addition, it attempted to place the findings into a larger picture involving a number of other languages.

In general, the findings from the three studies in the dissertation taken together make up for the limitations of a single research method and will have important theoretical, empirical and methodological implications for the research on the topological spatial concepts of containment and support across languages, as well as for the bigger question behind – the relationship between spatial language and cognition.

Zhang, Y., Segalowitz, N., & Gatbonton, E. (2011). Topological spatial representation across and within languages: IN and ON in Mandarin Chinese and English. *Mental Lexicon, 6(3)*, 414-445.

Chapter 2.

Topological spatial representation across and within languages: IN and ON in Mandarin Chinese and English

2.1 Introduction

There has been a lot of interest in recent years in how different languages afford speakers the possibility of focusing attention on the spatial relationships between objects in their environment (see, for example, Ameka & Levinson, 2007; Bloom, Peterson, Nadel & Garrett, 1996; Levinson, 2003; Levinson & Wilkins, 2006). One reason for this interest is the following puzzle: the capacity to experience and think about space is universal yet cross-language comparisons reveal an unexpectedly large diversity in the way people speak about spatial relationships (Kleiner, 2004).

The wide crosslinguistic diversity can even be seen in the categorization of what would seem to be very basic topological relationships, including IN and ON (e.g. Bowerman, 1996a; Bowerman & Choi, 2001; Levinson, Meira & The language and cognition group, 2003; Levinson & Wilkins, 2006). (Note that in this paper, IN and ON in uppercase will refer to the concepts expressed primarily by the English prepositions *in*

and *on*, respectively: IN for the spatial concept of containment and ON for the spatial concept of support. These are the primary meanings of the English prepositions *in* and *on*, although clearly these prepositions also have other extended and metaphorical meanings.) That these are basic topological relationships can be seen in children who at very young ages show a great deal of knowledge of the concepts of containment and support (Clark, 1973; Hespos & Baillargeon, 2001; Needham & Baillargeon, 1993; Spelke, Breinlinger, Macomber, & Jacobson, 1992). In fact, it had been widely assumed that these two concepts are prelinguistic concepts that exist in the minds of speakers of the languages because of the shared biological constraints and life experience of human beings in a shared physical world (Levinson et al., 2003; Levinson & Wilkins, 2006). Within this view, these pre-existing concepts might be expected to be mapped onto words in a more or less simple and straightforward way. However, crosslinguistic comparisons of the linguistic representations of these concepts in a variety of languages are increasingly revealing a complex and diverse picture.

Cienki (1989), for example, compared the English prepositions *in*, *on* and *at* and their Polish and Russian equivalents. He found that the uses of these spatial prepositions across the three languages do not fully overlap. For example, in English, the preposition *in* is used for *a tent in a clearing*, whereas in Russian the equivalent word of *on* is used—*палатка на поляне* (*palatka* [tent] - *na* [preposition "on" taking the locative case] - *poljane* [clearing, field; locative form as indicated by the suffix "e"]), and in Polish—*namiot* [tent] - *na* [preposition "on" taking the locative] - *polanie* [clearing, field; locative form]. Cienki's analysis was based mainly on the comparison of translation equivalents and on the researcher's own linguistic intuitions about how to describe the same spatial

scenes in other languages. Other researchers have used more controlled comparisons and have elicited the linguistic descriptions of certain spatial scenes from actual language users. Their studies are reviewed below.

Until the early 1990s, most discussions about the way languages convey information about spatial relationships were descriptive, reflecting authors' intuitions. An important advance was made when Bowerman and Pederson (1992) developed a tool making possible more rigorous crosslinguistic comparisons of how spatial relationships are expressed. They employed a series of 71 pictures making up the Topological Relations Picture Series (TRPS). This series was designed to encompass a wide range of scenes exemplifying possible IN and ON relationships (the TRPS has been published in Levinson et al. 2003, and in Levinson & Wilkins, 2006, pp. 570-575). The pictures selected for the TRPS reflected the authors' intuitions about how best to depict the full range of such relationships. At this point, the only practical way to proceed, given the potentially infinite number of scenes that could be imagined, is to make informed guesses about what spatial relationship scenarios one should include in the series in order to capture all the possible relationships relevant to the languages targeted for study. Given a set of judiciously selected pictures one can empirically investigate what speakers of different languages actually say when describing the scenarios depicted. This provides an opportunity to reveal interesting differences in how various languages handle spatial relationships, based on what speakers actually say. At times, of course, it may prove necessary to expand the set of pictures used in the TRPS in order to capture distinctions researchers had not previously thought of. The present research does precisely this; it

builds on the TRPS approach by extending the pool of pictures to cover scenarios believed to be relevant to Mandarin Chinese but that were absent from the original set.

Bowerman and Pedersen (1992) used the TRPS to investigate how speakers of different languages labeled particular scenes and how the scenes were grouped together into subsets based on shared spatial terms in 38 different languages. They found that scenes typically covered in English by the prepositions *in* and *on* were grouped into different combinations by speakers of other languages in terms of the spatial terms they used. Figure 2-1 shows examples of the different ways five languages carved up six spatial scenes by the use of spatial terms. It can be seen that sometimes the same scenes are covered by one spatial term (as in Spanish), by more than two spatial terms (as in Dutch), by two spatial terms but with different patterns of grouping (as in Berber), by two spatial terms for the prototypical support and containment scenes, and by other terms for scenes in between (as in Japanese).

Figure 2-1. Crosslinguistic differences in categorizing the static topological relationships
(adapted from Bowerman & Choi, 2001, Figure 16.2).
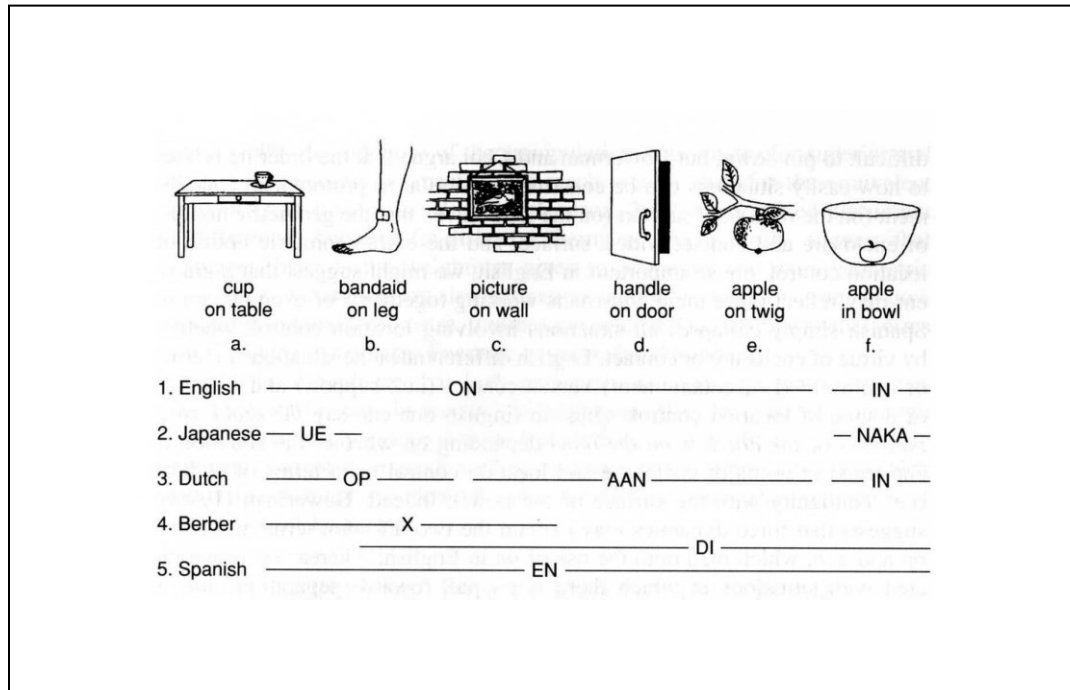
Levinson et al. (2003; Levinson & Williams, 2006) also employed the TRPS to investigate descriptions of topological spatial representation across genetically diverse languages. As Bowerman and Pederson (1992) did, they also found huge differences across languages in how the pictures were grouped by spatial terms, a result that ran counter to the idea that IN and ON are primitive holistic or fundamental concepts, and hence possibly universal. For example, in English, the spatial concepts ON (e.g., *apple on table*) and OVER (e.g., *light over table*) are seen as two distinct concepts, whereas many languages (e.g., Japanese; Arrente) conflate these by using the same spatial term. Similarly, IN (e.g. *apple in bowl*) and UNDER (e.g. *ball under chair*) tended to be conflated in Australian languages. Furthermore, the spatial scenes involving the general feature of attachment (e.g. *bandage on leg*, *clothes on clothes line*) are expressed in English by the preposition *on*, whereas they are described in many other languages by terms different from those used for scenes like *cup on table*. In addition, these concepts are encoded not just in adpositions (prepositions and postpositions), but also in verbs, by grammatical cases, spatial nominals, and adverbials.

As seen above, the TRPS tool provides a controlled basis for contrastive comparisons across languages. It can also elicit semantic subtleties that often cannot be obtained from dictionaries or grammatical descriptions (Levinson et al., 2003). The use of picture stimuli allows one to address a rich variety of linguistic treatments of the spatial relationships IN and ON to be revealed, offering a window into the cognitive underpinnings of these spatial representations. This was clear in the studies of Levinson et al. (2003), Levinson and Wilkins (2006) and Bowerman and Pederson (1992), where

the seemingly simple concepts IN and ON turned out to be far more complex than previously thought.

As Levinson and Wilkins (2006) recognized, and as alluded to earlier, this kind of extensional analysis of mapping words onto pictures does not necessarily reveal nuances of the various spatial terms found in different languages. For example, some of the differences that researchers have documented might be due to conceptual variations in how IN and ON are represented. On the other hand, the fact that different linguistic terms are used to describe two different pictures does not necessarily mean that the pictures are being conceptualized differently. The difference could be one of speech register or tone. For example, English *within* is similar in meaning to *inside*, but the former sounds loftier in tone (Lindstromberg, 1997); the difference between them may be more rhetorical than conceptual.

Even when studies revealed that underlying conceptual patterns might be responsible for differences in how the TRPS pictures were assigned to the IN and ON categories across languages, it can still be unclear whether the different assignments point to completely different concepts or just to differences in semantic range. For example, as mentioned previously, IN and UNDER are conflated in some languages but separate in others. The reason might be that IN and UNDER merge into a general concept composed of the idea of containment plus the idea of position below something. Alternatively, UNDER might also be understood as referring to a type of containment, similar to *bird in tree* where, for English speakers, the top part of the tree is treated as providing an imagined boundary enclosing (containing) the bird. Thus, in *ball under chair,* the space

between the four legs of the chair may also be perceived as creating a vague boundary confining where the ball could be located.

Further in-depth studies are needed to examine the semantic underpinnings of the spatial terms used for IN and ON, in order to identify possible differences among languages in how the seemingly fundamental concepts of containment and support are represented, and most importantly, to explore the reasons for these differences. These issues are not easy to examine in studies that involve the simultaneous examination of a large number of languages, because in such studies there can be too many contrasts in the picture grouping patterns to consider. For this reason, the present study focused on two languages only. The study explored crosslinguistic variation in the representation of the topological concepts of containment and support, and the possible cognitive underpinnings, in English and Mandarin Chinese.

These two languages are interesting to compare for several reasons. First, English has been well studied in terms of the spatial concepts IN and ON and thus provides a strong basis for comparison with other languages. Second, there is very little empirical research published in English focusing on spatial language in Mandarin (Xu, 2008a, p. 1), especially research that is based on elicited responses by native speakers. This may be due to the seemingly highly similar patterns between English and Mandarin in the way they express IN and ON. At first glance, Mandarin, like English, employs two widely used words to refer to the concept of containment and support. In addition, it seems that the carving up of spatial location scenarios into the two concept categories corresponds well across the two languages. For example, in Figure 2-1, the categorization pattern in Mandarin is exactly the same as in English. However, some studies of second language

learners of English (e.g., Larsen-Freeman, 2006) have descriptively referred to problems that Mandarin speakers have with the use of *in* and *at* in English. In China, although both language teachers and linguists have noticed that the use of *in/on* in English and the corresponding words *lǐ/shàng* in Chinese do not fully overlap in both literal and metaphorical meanings (e.g., Tai, 1993). Little research has explored in depth the reasons for these discrepancies. Among them, most studies have only attempted to provide a rough list of example differences (e.g., Guo, 2010; Yu & Ma, 2010; an exception is Wu & Wei, 2007, which will be discussed later in this paper) and none of them was based on an experimental study. The relatively few studies on this issue stand in particular contrast to the many studies focusing on the difference between English and Chinese in the metaphorical extensions of the spatial concepts UP/DOWN, which are more noticeable than the difference between the literal meanings of IN/ON.

A pilot study we conducted in preparation for the present one revealed that there might also be significant cross-linguistic differences in the expression of the two concepts IN and ON if one looked more deeply into the matter. With these considerations in mind, and in light of previous work on this topic, the present study examined the following questions:

1) Do Mandarin and English speakers' patterns of use of the canonical forms corresponding to IN and ON, when describing stimulus pictures, suggest that the pictures are associated with the same or with different categories with respect to containment (IN) and support (ON)?

2) If there are Mandarin/English cross-linguistic differences in patterns of use regarding the IN and ON categories, do these patterns suggest systematic

differences in the way the speakers may have conceptually represented the depictions of containment and support in the stimulus pictures?

3) Are there individual differences among speakers that suggest there exist *within*-language group differences in the conceptualization of containment and support?

The TRPS methodology was used to address these three questions. By means of this methodology, it was possible to elicit descriptions involving the spontaneous use of the canonical forms of IN and ON in an efficient way, thereby providing a controlled basis for comparing the range of spatial relationships (as represented by different pictures) covered by these terms in each language. For purposes of the present study, the following departures from the usual use of the TRPS were introduced. First, we identified from the elicitations all the adpositions that were used to express the spatial concepts of containment and support in English and Mandarin. Next, each adposition was classified as expressing either containment or support. Using a set of well-defined operational criteria (described below), it was then possible to determine whether each picture had been predominantly treated as exemplifying the IN or ON relationship in each language, or had failed to convincingly reflect one or the other relationship. As well, the TRPS stimulus set was expanded to include pictures of scenarios not previously part of the series. Finally, we used a large enough sample of participants to be able to apply statistical criteria for interpreting the results. Generally in TRPS research to date, informant samples have tended to be rather small. For example, Feist (2000; 2008) used from one to six participants for each language group and Levinson et al. (2003) used from one to ten informants for eight out of the nine languages they examined (and 26

informants for the ninth). It appears that scholars have tended to assume that small numbers of native speaking informants are sufficient for this type of study; for example, Levinson and Wilkins (2006) stated that "three or more consultants allow some qualitative and quantitative analysis of preferred solutions" (p. 9).

Before proceeding with the report of the present study it is necessary to first examine how English and Mandarin express the concepts of containment and support.

IN and ON in English.

In English, *containment* (IN) is often expressed by the preposition *in*, for example, *The apple is in the bowl* (Conventry & Garrod, 2004; Tyler & Evans, 2003; Vandeloise, 1994; Vandeloise, 2003). *Inside* and *within* are also used to express this spatial concept, often as emphatic forms of *in*. However, the meaning of *in* is broader than *inside* or *within* insofar as *in* covers a wider range of containment situations. *Support* (ON) is often expressed by the preposition *on*, for example, *The cup is on the table* (Conventry & Garrod, 2004; Tyler & Evans, 2003; Vandeloise, 2003).

IN and ON in Mandarin Chinese.

In Mandarin, containment (IN) is often expressed by the postposition 里*(lǐ)*[1], for example:

苹果	在	碗	里
píngguǒ	*zài*	*wǎn*	*li*

---

[1] The lexical category of locative particles such as *lǐ* and *shàng* is controversial. They are considered as postpositions (Ernst, 1988; Tai, 1973), parts of circumpositions (Liu, 2002) or nouns by most scholars. In this paper, they are being called postpositions. Moreover, in addition to the spatial meaning, *shàng* also has other non-spatial meanings. Even when *lǐ* and shàng are used for their spatial meaning, syntactically they can be used as adjectives, nouns or postpositions, depending on the word order. In the present paper, only the static topological spatial meanings which are expressed through the combination of noun+ *shàng /lǐ*, are discussed.

apple coverb *bowl* in

"*The apple is in the bowl*"

Note that 中 (*zhōng*), 内 (*nèi*) and 之中 (*zhīzhōng*) can also express this concept. They sound more formal and are interchangeable most of the time with 里 (*lǐ*) (Lü, 2007). Although there are still differences in kinds of lexical combinations they can enter into (cf. Xing, 1996), the concept expressed by 中 (*zhōng*), 内, (*nèi*) and 之中（*zhīzhōn*g) is still containment (Yang, 2008; Zeng, 2005). Support (ON) is often expressed by the postposition 上 (*shàng*), for example:

杯子　在　　　桌子　　　上　　.

bēizi　zài　　　zhuōzi　　shàng

cup　　　coverb　table　　on

"The *cup is on the table*"

For additional linguistic discussions on the historical origins of these terms in Mandarin and on comparisons across different Chinese dialects, see Chappell and Peyraube (2008) and Xu (2008b).

2.2 Method

2.2.1   Participants

Participants were 25 native English speakers living in Montreal, Canada, and 25 native Mandarin speakers living in Harbin, China. All speakers reported themselves to be monolingual or highly dominant in their first language, which means that although some of them knew a second language, they had limited knowledge of it. The age of the English speakers ranged from 19 to 38 years and the age of the Mandarin speakers ranged from 19 to 29 years. The English and Mandarin speakers were all university undergraduate or graduate students at the time of testing.

2.2.2   Stimuli

The stimulus materials were 116 simple line drawing pictures, printed two to a page (top and bottom halves). Each picture was approximately 9 by 9 cm. Of the 116 pictures, 65 of the original 71 TRPS were adopted from Bowerman and Pederson (1992) (all except TRPS stimuli numbered 18, 20, 24, 33, 47, and 59 because pilot testing revealed them to be too ambiguous). An additional 64 pictures were developed by the authors to expand the possible range of the spatial relationships, creating new pictures numbered from 73 to 137 of which 13 proved to be ambiguous in a pilot study; the retained 51 pictures are shown in the Appendix 1.

Each picture depicted a topological spatial relationship between a located (target) object highlighted in yellow and with an arrow pointing to it, and a reference object. Together, the 116 pictures depicted relationships covering a range of situations that are usually described in English by the prepositions *against, in, near, on*, *over*, *under,* etc.

The names for the located and the reference objects were printed below each picture (e.g., cup/table) in the appropriate language for the Mandarin- and English-speaking participants respectively. The items depicted were all ordinary objects commonly found in both Mandarin- and English-speaking societies, thus it was not difficult to provide translation equivalents for the names in each language. The suitability of the names was further checked and confirmed by full agreement with three native speakers of each language.

2.2.3 Procedure

Participants were tested individually by the first author. Each participant was given a stack of pages containing the pictures and the following written instructions in the appropriate language: "In a moment, you will see a set of pictures. Please describe where the yellow object that the arrow is pointing to is located in relation to the other black-and-white part of the picture". Names of the objects are given below each picture. The name for the yellow object is also colored in yellow".

A short interview followed the completion of the task, during which participants were asked to explain their reasons for choosing the terms they indicated for certain pictures. To prevent systematic priming effects, the order of the pages in the stack was randomized differently for each participant within a language group (using the same 25 random orders in each language, but different orders for each participant within a language group). All responses were recorded. Participants were told that there were no

right or wrong answers and that the purpose of the study was to investigate how people naturally describe these pictures.

2.3 Analysis and Results

There were 5800 picture descriptions generated in total (25 speakers in each of 2 languages x 116 pictures). The data were analyzed in two phases. The first focused on similarities and differences by language group (Research Questions 1 and 2), and the second on individual differences within each language group (Research Question 3).

Similarities and differences by language group

Research Question 1:

We identified similarities and differences in how English and Mandarin speakers categorized the pictures through their usage of the canonical forms for IN and ON as follows. First, the adpositions used for each picture by each speaker were identified. It was found that a variety of adpositions were used for these 116 pictures. Second, these adpositions were then classified into three categories: (a) IN (containment); (b) ON (support); and (c) OTHER. The IN and ON category included the previously mentioned adpositions that express the concept of containment or support in English (IN: *in, inside, within*; ON: *on*) and Mandarin (IN: *lǐ, zhōng, nèi, zhīzhōng*; ON: *shàng*). The OTHER category included any other adpositions that do not belong to the IN and ON categories.

Finally, the total number and percentage of IN and ON responses to the 116 pictures were

calculated. The results are presented in Table 2-1.

Table 2-1. Total number and percentage of IN, ON and OTHER responses to the 116 pictures by the 25 respondents in each language group.

	Mandarin speakers	English speakers
IN*	860 (29.66%)	1285 (44.31%)
ON	1807 (62.23%)	1249 (43.07%)
OTHER**	233 (8.03%)	366 (12.62%)

* Includes English *in* (39.72%), *inside* (3.66%), *within* (0.93%) and Mandarin *lǐ* (19.14%), *zhōng* (9.79%), *nèi* (0.69%), and *zhīzhōng* (.03%).

** Neither IN nor ON

As Table 2-1 shows, the Mandarin speakers used more ON than IN, overall, compared to the English speakers, in a pattern suggesting that the concept of support was used more prevalently by Mandarin speakers than by English speakers for describing these particular pictures, whereas, for English speakers, neither concept was used more dominantly.

Further analyses were conducted to determine if the above result was due to some specific pictures being more strongly conceptualized in terms of support by Mandarin speakers than by English speakers, as opposed to just differential use of IN and ON adposition across all picture descriptions. For this, the total number of uses of IN, ON, and OTHER adpositions for each picture was counted for each language group. It was found that sometimes all or nearly all of the 25 speakers within a given group used the same term, and sometimes they were divided in how they described the picture. For this reason, a set of criteria was established to determine whether a given picture could be considered unambiguously IN-dominant or ON-dominant for a group of speakers in each language. Accordingly, a picture was operationally defined as IN or ON-dominant if:

(a) at least 90% of the participants from each language group used a term that was either a canonical form for IN or for ON to describe the picture;

(b) of those speakers using a canonical form, the number using the majority form for that picture, as a proportion of all speakers using either form, was statistically significantly (by the binomial test; $p < .05$).

These criteria are strict enough to ensure that pictures identified as either IN- or ON-dominant are unambiguously clearly so, without being so rigid as to exclude too many

picture descriptions from the study. In practice, these criteria ensured that, of the 25 participants in each language group describing a given picture, at least 22 (i.e. 90%) used a canonical form of IN or ON to describe it and the absolute difference between the number using the IN versus the ON form was at least 10 participants (e.g., an 18-7 split would establish dominance whereas a 17-8 split did not, by the binomial test of significance). Using the above criteria, it was possible to group the 116 pictures into three separate categories—"IN-dominant", "ON-dominant" or "OTHER", based on the responses from each language group. Pictures were assigned to the category OTHER when the difference between IN versus ON descriptor use was not statistically significant or when more than three people used a descriptor other than a canonical form for either IN or ON. The number of pictures in each category for each language group is shown in Table 2-2.

Table 2-2. Number and percentage of the 116 pictures falling into each of three categories for each language group.

	Mandarin speaking group	English speaking group
IN-Dominant	25 (21.55%)	44 (37.93%)
ON-Dominant	61 (52.59%)	39 (33.62%)
OTHER*	30 (25.86%)	33 (28.45%)

* Pictures not qualifying as either IN-dominant or ON-dominant according the

operationalized definitions used in the study.

In order to identify any similarities and differences between Mandarin and English in the categorization of pictures, the pictures were further categorized into the following four groups.

- An IN-IN group: congruent Mandarin IN, English IN—pictures that consistently qualified as "IN-dominant" for both Mandarin and English speakers;

- An ON-ON group: congruent Mandarin ON, English ON—pictures that consistently qualified as "ON-dominant" for both Mandarin and English speakers.

- An ON-IN group: non-congruent Mandarin ON, English IN—pictures that consistently qualified as "ON-dominant" for Mandarin and IN-dominant for English speakers.

- An IN-ON group: non-congruent Mandarin IN, English ON—pictures that consistently qualified as "IN-dominant" for Mandarin and ON-dominant for English speakers.

For the two non-congruent classes (ON-IN, IN-ON), the following additional criterion was used to ensure that the crosslinguistic contrast was unambiguous:

- The difference between the number of English and Mandarin speakers using the containment descriptor and the support descriptor had to be statistically significant (binomial test; $p < .05$).

In this manner, 71 out of 116 pictures were identified as falling clearly into one of the four possible categories described above, as follows: IN-IN, $n = 22$ pictures; ON-ON, $n = 35$; ON-IN, $n = 13$; IN-ON, $n = 1$. Figures 2-2, 2-3, 2-4 and 2-5 show the actual pictures for each group.

Figure 2-2: Twenty-two pictures that were consistently described as containment relationship in both English and Mandarin (the IN-IN picture group).
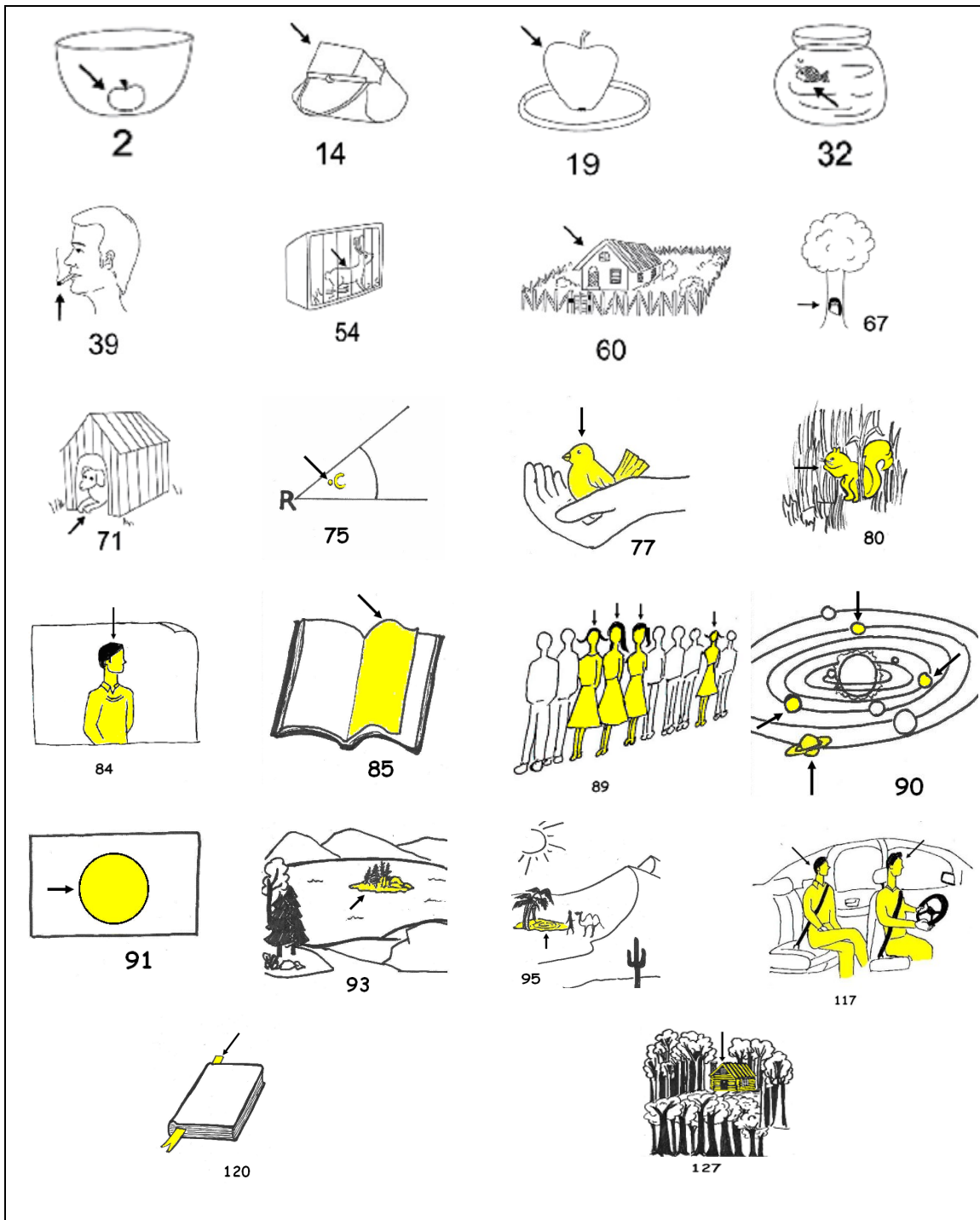
Note: Items numbered 71 or lower are from Bowerman and Pederson (1992) and those numbered 72 or higher were specifically created for this study.

Figure 2-3: Thirty-five pictures that were consistently described as support relationship in both English and Mandarin (the ON-ON picture group).
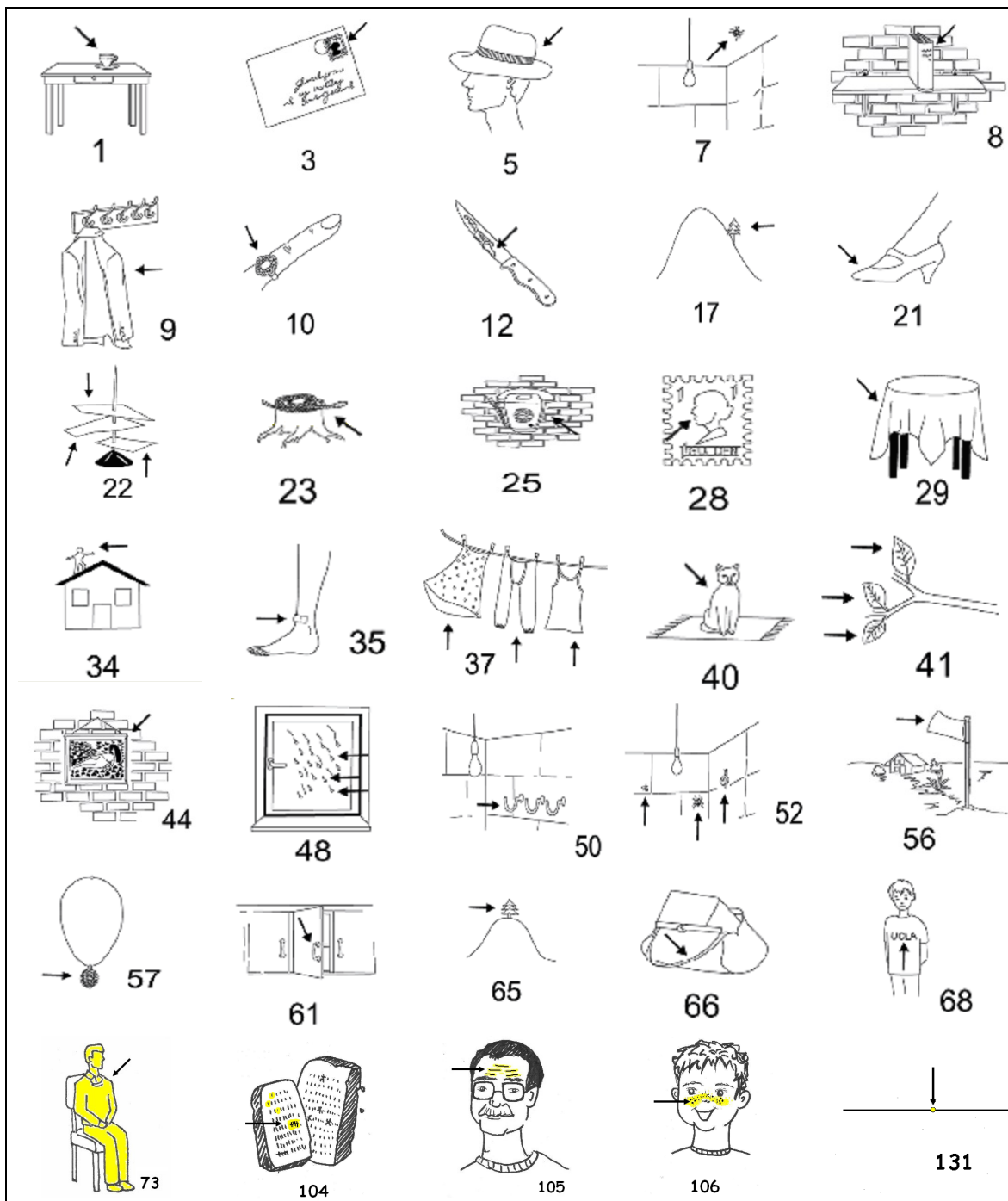
Note: Items numbered 71 or lower are from Bowerman and Pederson (1992) and those numbered 72 or higher were specifically created for this study.

Figure 2-4: Thirteen pictures that were consistently described as support in Mandarin but as containment in English (the ON-IN picture group).
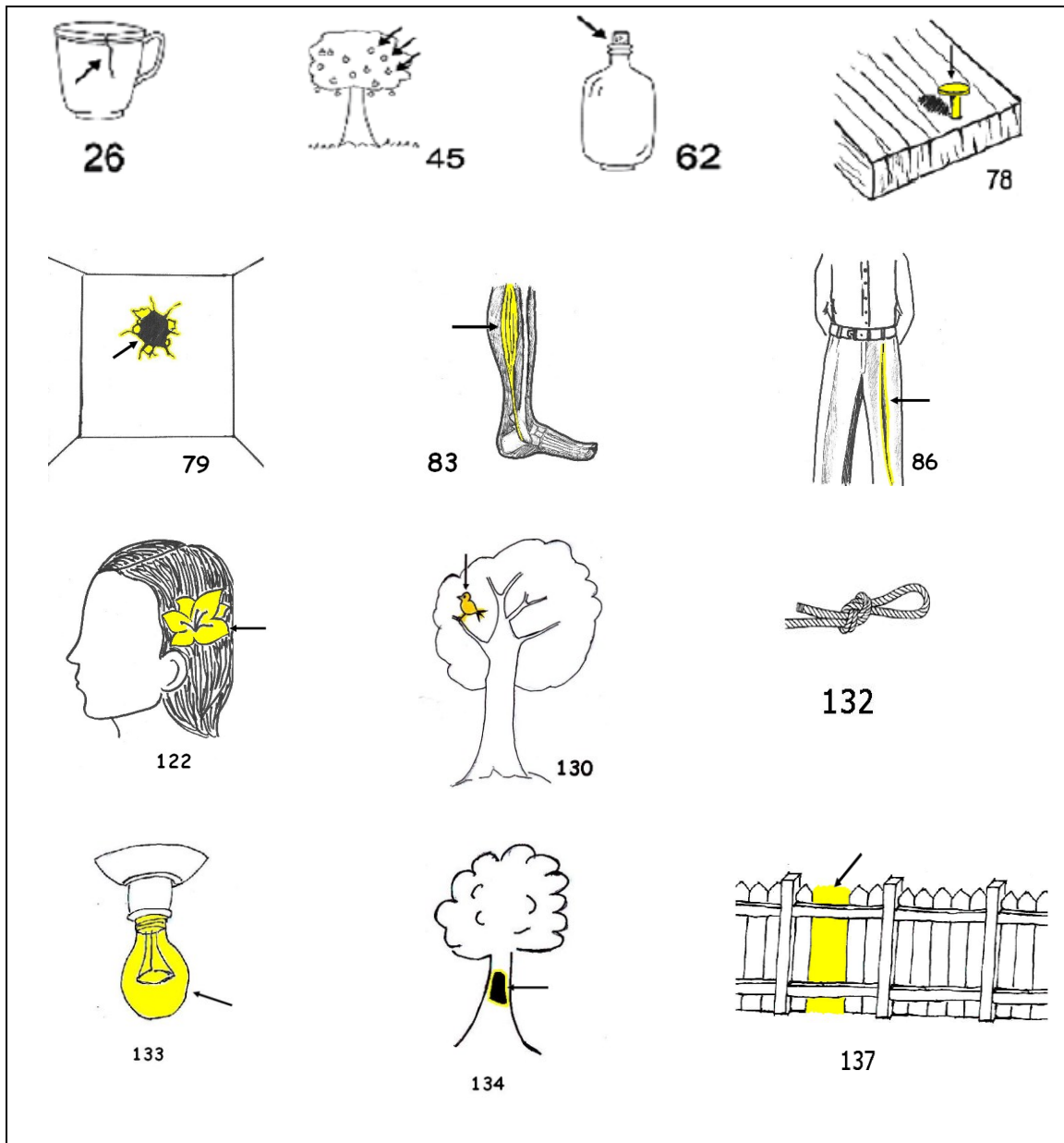
Figure 2-5: The one picture that was consistently described as containment in Mandarin but as support in English (the IN-ON picture group).
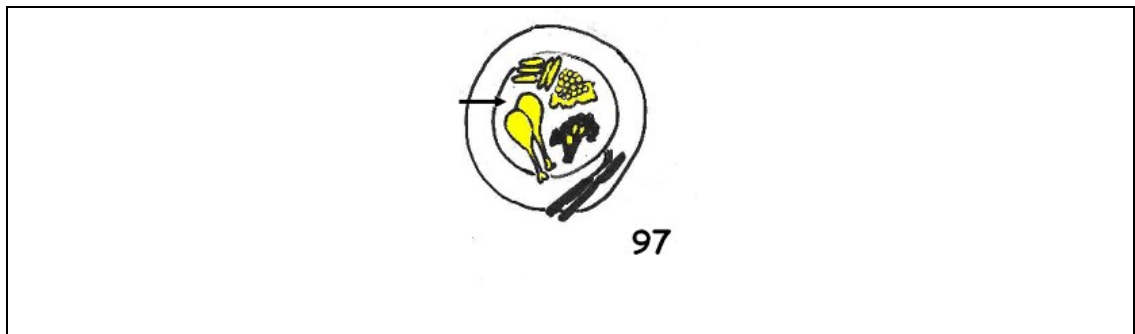
Note that the IN-ON category (Figure 2-5) had only one element in it. To confirm that in the other three categories the use of IN and ON descriptors followed truly distinctive patterns (an outcome not necessarily guaranteed by the application of the picture retention criteria described above), the numbers of speakers using IN and ON forms for each picture were submitted to a 2 x 2 x 3 item based analysis of variance (ANOVA) (i.e., with pictures as "subjects") with the within factors being language (Mandarin, English), descriptor (IN, ON), and the grouping factor being type (IN-IN, ON-ON and ON-IN), with n's of 24, 35, and 12 pictures for the three non-singular groups respectively. The important result was the significant three-way language by descriptor by type interaction ($F(2,68) = 219.75$, $MSE = 1916.905$, $p < .00001$, $\eta_p^2 = .866$; see Figures 2-6a and 2-6b).
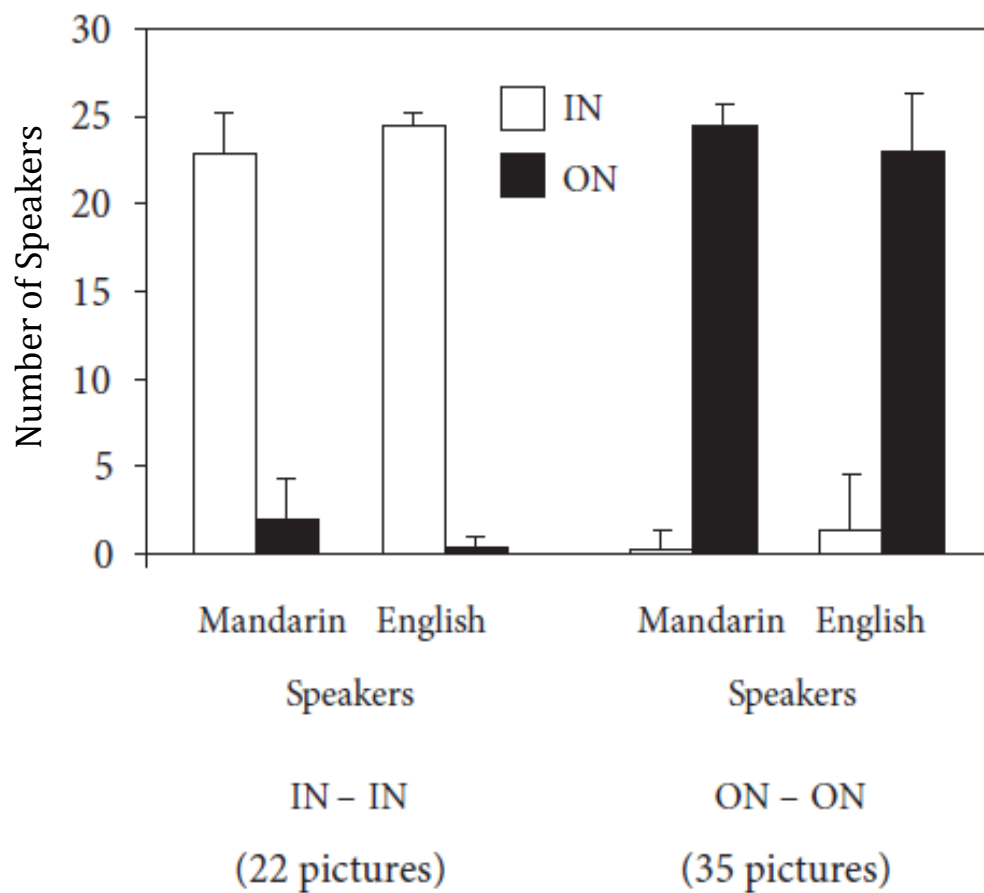
Figure 2-6 a: Number of speakers (and standard deviations) describing the congruent (IN-IN and ON-ON) pictures using canonical forms of IN versus ON in Mandarin and English.
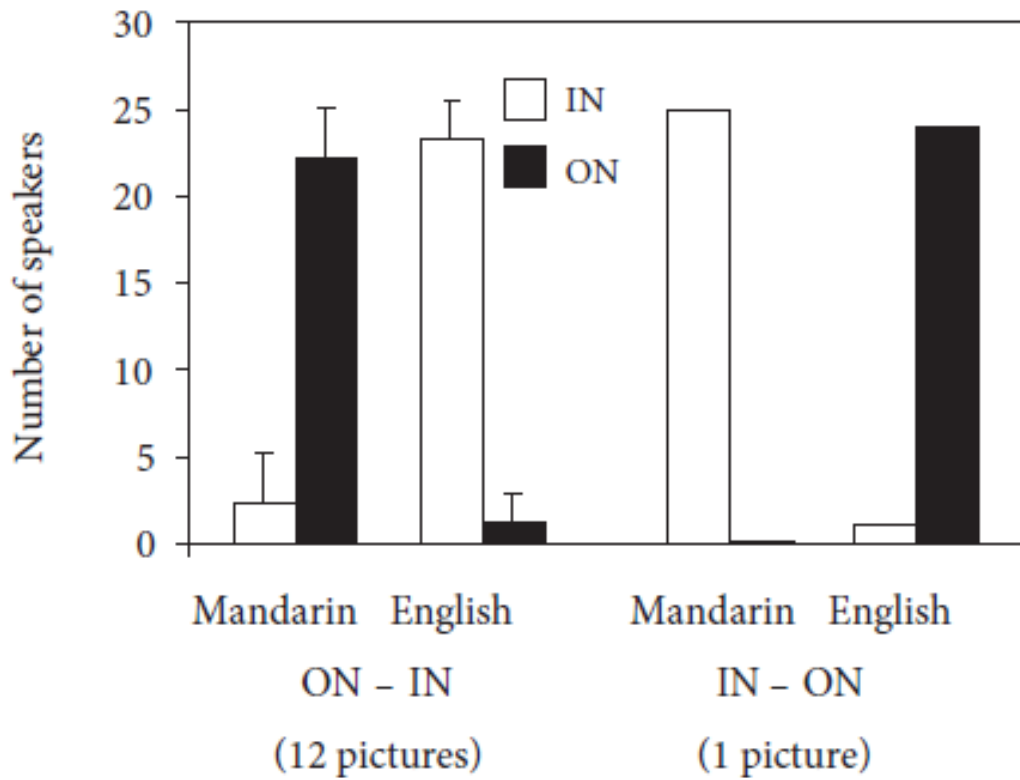
Note. There are no SDs for the IN-ON category because there was only 1 picture.

Figure 2-6 b: Number of speakers (and standard deviations) describing the non-congruent (ON-IN and IN-ON) pictures using canonical forms of IN versus ON in Mandarin and English.

Research question 2:

The next research question addressed whether there is some systematicity underlying the pattern of similarities and differences in the way Mandarin and English speakers used containment and support terms. To answer this question, a qualitative analysis was conducted to determine if the distribution of the pictures into each of the four categories (IN-IN, ON-ON, ON-IN, IN-ON) was consistent in some way, supporting the possibility that there might be some underlying conceptual explanation for the similarities and differences involved.

These qualitative analyses of the responses to the pictures were generally based on the principles and criteria identified by Herskovits (1986) regarding the semantics and pragmatics of locative expressions, including case studies of the prepositions *in* and *on*. She proposed that there is an ideal meaning for a given preposition. From this ideal meaning other use types of the preposition are derived using a set of principles involving convention-based shifting and pragmatic processes of tolerance. She provided a set of examples for each use type together with the defining principles and criteria. For example, the ideal meaning of *in* is "inclusion of a geometric construct in a one-, two-, or three-dimensional geometric construct" (Herskovits, 1986, p. 149). Then she derived eleven use types from this ideal meaning. One example is that the located object is located within the outline of the reference object, e.g., *bird in tree.* These principles were applied as follows to the present set of English and Mandarin data in an effort to discover cross-linguistic commonalities and differences.

IN-IN (Figure 2-2). Pictures in this group were consistently described in terms of the IN relationship by both English and Mandarin speakers. As can be seen from Figure 2-2, the pictures exhibited one of the following IN (containment) configurations:

- the located object was fully or partially contained by a 3-dimensional reference object with a clear interior (this situation included configurations that involve the prototypical containment meaning, i.e., the located object is more or less fully contained in a three-dimensional container), e.g., *rabbit in cage* and *box in bag*;

- the located object was located within the space defined by *the outline of a g*roup of objects, e.g., *squirrel in grass*;

- the located object was a member of the reference object, which consisted of a group of objects, e.g., *girls in line*;

- the located object was in an interior space defined by two planes at an angle, e.g., *bookmark in book*; or lastly,

- the located object was in a 2-dimensional *bounded area or geographical region,* e.g., *circle in rectangle* and *island in lake*.

ON-ON (Figure 2-3). Pictures in this group were consistently described as ON in both English and Mandarin. As can be seen from Figure 2-3, these spatial scenes also involve different situations. In most cases, the located object is supported by the reference object. The ways of supporting are diverse, as the following examples show:

- the located object rests on the surface of the reference object (this situation include configurations that are associated with prototypical support, i.e. the located object is supported by and resting on a horizontal upward facing surface of the reference object.), e.g. *cup and saucer on table*;

- the located object is adhered to the reference object, e.g., *stamp on envelop*; *fly on ceiling*;

- the located object is joined by devices to the reference object, e.g., *handle on door*;

- the located object encircles and is in contact with the reference object (Feist, 2000), e.g., *ring on finger*;

- the located object is impaled/spiked by the reference object (Feist, 2000), e.g., *paper on spike*.

In some cases, however, the located object can hardly be said to be supported by the reference object, but rather is part of the reference object, e.g. *freckles on face* and *strap on the bag*, or is attached to the reference object, e.g. *pendant on the necklace*. Nevertheless, a sense of support/contact (ON) was still present and thus both language groups used the ON adpositions to describe these pictures.

ON-IN (Figure 2-4). The pictures in this set are those that were described predominantly by ON in Mandarin but IN in English. As can be seen from Figure 2-4, these pictures exhibited features not possessed by the previously discussed two groups of pictures (Figure 2-2 and 2-3). The first is defined by Herskovits (1986) as "Gap/object 'embedded' in physical object" (p.150). According to this feature, the located object is included in part of the space that the reference object would have occupied if it had not been penetrated by the located object. (Interestingly, not all the examples of this type listed by Herskovits (1986) would be considered as support in Mandarin, further showing that the English preposition *in* does not apply identically to Mandarin.) Here the located objects are often what Levinson and Wilkins (2006) called "negative objects", like *hole*, *crack* or *gap*, for example *hole in wall*, *crack in cup*, *hole in tree*, *gap in fence*, but it can

also involve other objects, for example *nail in board*, *flower in hair*. In these scenes, the located object is geometrically partially included in or surrounded by the reference object. However, a second feature that stands out with these pictures is that the reference objects—the wall, board, tree trump, hair, fence, and the surface of the cup—can be considered as providing a supporting surface for the located object. The surface in English can be construed as a very thin lamina (Herskovits, 1986) which provides some inner space for the located object to be embedded in. In contrast, in Mandarin these spatial scenes were described using the support expression even though parts of the located objects were geometrically included and contained in the reference object. It seems that the embeddedness and inclusion aspects of the scenes did not elicit the containment conceptualization in the Mandarin speakers. In fact, the status of scenes involving located objects that are "damaged" or involve "negative space" is controversial across languages; Levinson and Wilkins (2006) have pointed out, for example, that such scenes tend not to be expressed from the spatial perspective in many languages. In Mandarin, such scenes can be described using spatial expressions, but exclusively as support (Zhang, Segalowitz & Gatbonton, in preparation).

Two other scenes where the located object is also partially included in the reference object were *cork in bottle* and *light bulb in socket*. For the latter, both the geometrical partial inclusion of the bulb in the socket and the functional position control of the socket on the light bulb can account for why this scene is treated as containment in English (Conventry & Garrod, 2004; Vandeloise 1994, 2003). Similar reasons apply to *cork in bottle*. In Mandarin, however, even though the position and movement of the socket and cork are fully controlled by the reference objects and the located objects are

partially included in the reference object, this scene was expressed using the canonical term for support. The reason might be that the inclusion segment was limited (e.g., only a small part of the light bulb is in the socket) whereas the salient part of the located object was clearly visible. The reference object's support role might have been perceptually highlighted, resulting in a support conceptualization.

There were also scenes in this ON-IN category in which the located object was the "accident/object part of physical or geometric object" (Herskovits, 1986, p.152). Here, the located object can be an actual physical part of the reference object (*muscle in leg*) or a geometric "accident" (*crease in pants*; *knot in rope*). The data suggest that for Mandarin speakers this situation does not elicit the concept of containment, unless the object is part of a group of objects, as in the example *girls in line* discussed earlier. Rather, it is the contact between the located object and the reference object that is highlighted for Mandarin speakers. For example, in the case of *muscle in leg*, from an anatomical perspective the muscle is contained within the leg; however, the apparent visibility of the muscle may have been salient for the Mandarin speakers.

The final pattern in this category involved the two spatial scenes *fruit in tree* and *bird in tree*, in which the located object was contained within the outline of another object. Here, the bird and fruit can be construed as being located within the volume bounded by the outline of the tree's branches. Earlier, we discussed a similar case concerning *squirrel in grass* and *house in woods*. The difference between these two pairs is that the reference object in *fruits in tree* and *bird in tree* is an individual object (tree) whereas grass is composed of many blades and woods is composed of many trees. In Mandarin, it would seem, a single tree is not normally construed as a container that can

hold birds and fruits within its outline; containment here would imply that the object was inside its trunk. Thus, instead of conceptualizing the salient relationship as one of containment, Mandarin speakers conceptualized it as the contact of the bird or fruits with the tree or part of the tree, for example, the branch.

IN-ON (Figure 2-5). Fourth, and finally, there was only one picture that was described using the term for containment in Mandarin but support in English—*food on plate*. Here, the food was surrounded and contained by the plate, but also supported by the plate.

Interestingly, the typical Chinese plate is usually not particularly flat, but has a concave bottom, more like a bowl. This example may simply reflect the difference in object knowledge (see later discussion) between the two languages —the assumption that the depicted plate was deep (bowl-like) by Mandarin speakers but flat by English speakers. More research on this category is needed.

In summary, these qualitative comparisons revealed that pictures in the ON-IN category (Mandarin ON-dominant, English IN-dominant) had some consistent features not present in the two congruent picture groups (IN-IN and ON-ON), and these features could account for the systematic differences in how English and Mandarin speakers used terms in their respective languages for the spatial concepts of containment and support. Configurations depicting a located object partially embedded in a two-dimensional surface, or as part of a single reference object, or located within the outline of a single object seemed to be consistently described in Mandarin by the ON term reflecting support but in English by the IN term reflecting containment. Also, located objects like

"hole", "gap" and "crack" were often described by terms associated with the concept of support in Mandarin but containment in English.

Individual differences within language groups

As mentioned earlier, it was possible to identify for each language group a set of representative IN (IN-dominant) and representative ON (ON-dominant) pictures. However, the speakers within each language group did not always provide a unanimous pattern of responses for every picture. Sometimes, a few individuals provided answers to particular pictures that were at variance with the dominant response for that speaker's language group (e.g., responding an IN word to pictures meeting the criteria for being classified as ON-dominant for that speaker group). It is especially worth noting how two individuals responded to certain pictures in the ON-IN subset (Figure 2-4), opening up the possibility that these individuals were conceptually representing the pictures to some extent in a way more similar to members of the other language group than to their own group.

For example, in the Mandarin group, informant MU described the following five scenes in terms of containment instead of support, contrary to what most of the other Mandarin speakers did, saying *light bulb in socket, gap in fence, nail in board, hole in tree* and *muscle in leg* instead of using Mandarin *shàng* to say *light bulb on socket, gap on fence, nail on board, hole on tree* and *muscle on leg*. Her description of these scenes in terms of containment relationship could even be said to sound somewhat non-native like in Mandarin. It was not clear why MU only showed departure from the majority pattern for these five pictures and not for the rest of pictures shown in Figure 2-4. In the short

interview following the picture description test, MU was asked about why she described the pictures as she did. She replied that the muscle is contained by the leg, the nail and socket are embedded in the reference object, and the hole penetrates into the tree trunk. For *gap in fence*, she could not give a clear reason. It seemed that the feature of geometric partial inclusion was one of the factors leading MU to choose the containment perspective.

In the English group, informant ET described the following four scenes in terms of support, saying *crack on cup*, *knot on rope*, *cork on bottle* and *nail on board* instead of using the dominant pattern for English speakers *crack in cup*, *knot in rope*, *cork in bottle* and *nail in board*. ET could not provide reasons for choosing to describe the scenes from a support perspective, saying simply that these scenes look like "on" to him.

These individual differences do not seem to be random errors. Instead, they seem to reflect the possibility that the individuals had adopted different concepts from the norm for their language group. This conclusion is consistent with the fact that the Mandarin speaker MU was able to justify most of her answers. As for the English speaker ET, although he could not explain his choices, it seemed unlikely that these choices were simply a result of carelessness or random error, given that his pattern actually conformed to the way Mandarin speakers typically described these pictures.

To determine statistically whether the choices made by speakers like MU and ET in the ON-IN group were indeed systematic and not idiosyncratic or random errors, the results were subjected to a binomial test as follows. Mandarin participant MU provided only one IN word response (*li*) to the 35 pictures that were ON-dominant for both

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Mandarin and English speakers. Given that both language groups treated these pictures as representing a support spatial relationship (ON), MU's single *lǐ* (IN) response can be interpreted as an idiosyncratic response, because in general neither speaker group tended to use IN words for these pictures. MU's rate of such idiosyncratic responses can thus be estimated to be 1/35 or .0286, given she made one such response on 35 trials with ON-dominant pictures. Thus, her idiosyncratic responses would appear to be a relatively rare event. In the case of the Mandarin ON-dominant / English IN-dominant picture set (ON-IN), however, MU deviated from the Mandarin group's response pattern five times in 13 trials by responding *lǐ* (IN). The statistical question, then, is whether 5/13 is significantly different from 1/35; if so, then we can reject the null hypothesis that MU's IN responses for the ON-IN pictures (ON-dominant for the Mandarin speakers) reflected only idiosyncratic responding. By the binomial test, this result was indeed statistically significant at $p < .00003$; 5/13 is statistically significantly greater than 1/35. A similar calculation was made for English speaking participant ET who responded 3/13 times with *on* for pictures that were IN-dominant for English speakers but only 1/22 times with *on* for the pictures that were IN-dominant for both language groups. In all, ten participants (including MU and ET) appeared to deviate in this manner from their own language group. Their responses are shown in Table 2-3. Together, these results show that it is possible to distinguish between cases where individuals depart from their own speaker group's pattern of responses in a systematic way from idiosyncratic cases where individuals depart in a non-systematic fashion.

Table 2-3: Data from participants whose response patterns deviated significantly from their home language group and that resembled those of the other language group, on trials involving pictures that were ON-dominant for Mandarin speakers and IN-dominant for English speakers, and using as baseline the response deviation patterns for pictures that were similarly ON-dominant and IN-dominant in both languages.

Participant	Language	(A) Deviation rate for ON-IN pictures	(B) Baseline deviation rate for ON-ON & IN-IN pictures	p *
MF	Mandarin	4/13 = .308	1/35 = .029	< .0001
MK	Mandarin	3/13 = .230	3/35 = .086	< .0205
MR	Mandarin	2/13 = .154	1/35 = .029	< .006
MS	Mandarin	2/13 = .154	0/35 → 1/35 = .029	< .006
MT	Mandarin	2/13 = .154	1/35 = .029	< .006
MU	Mandarin	5/13 = .385	1/35 = .029	< .0001
MV	Mandarin	2/13 = .154	0/35 → 1/35 = .029	< .006
MX	Mandarin	4/13 = .308	1/35 = .029	< .0001
EH	English	3/13 = .231	1/22 = .045	< .0022
ET	English	4/13 = .308	1/22 = .045	< .0002

* Binomial test, for the deviation rate (A) being significantly different from zero, given the baseline level (B). Where the baseline deviation was 0/35 or 0/22 (for ON- and IN-dominant pictures in both languages respectively) the binomial probability cannot be calculated and so the value of 1/35 or 1/22 was used instead. These numbers are conservative because the actual observed base rate was 0.00 in these cases.

2.4 Discussion

This study set out to compare the linguistic realizations of the topological spatial concepts of containment (IN) and support (ON) between English and Mandarin. The aim was to identify differences, if any, in how speakers of these two languages use terms to express these concepts, which might initially seem to be fundamental concepts, and to explore the underpinnings of these differences. The main results were that there were both systematic similarities and differences between the way native speakers of Mandarin and English described stimulus pictures depicting a range of examples of containment and support. Most of the cases of cross-linguistic disagreement occurred with configurations described by Mandarin speakers as support and by English speakers as containment (the ON-IN picture set shown in Figure 2-4). Interestingly, the pictures in this set had particular features not present in the picture sets IN-IN and ON-ON where containment and support terms were used respectively congruently across the two languages, and these particular features appeared to play a role in how the speakers of these languages conceptualized the scenes as examples of containment or support. In addition, there were certain individual differences within language groups, in which some speakers, but not all, used terms for containment and support for certain pictures in the ON-IN set in ways that deviated statistically significantly from the dominant pattern of their respective language groups.

The findings support the arguments of Levinson and colleagues (Levinson et al., 2003; Levinson & Wilkins, 2006) against IN and ON being universal concepts in the sense that there is the same consistent one-to-one mapping of linguistic devices to the spatial relationships of containment and support. Instead, these concepts are

compositional and include notions like horizontal support, surface-surface contact, adhesion, etc. The compositionality of the concept of containment was also discussed by Vandeloise (1994, 2003, 2005), who argued that the concept of containment consists of a set of properties, including both geometrical and functional factors. Prototypical containment or support occurs when nearly all the properties are satisfied; extensions of the concept of containment or support occur when only a subset of the criteria is met. Crosslinguistic differences occur in these extended situations. For example, the comparison of Mandarin and English revealed convergence in the prototypical uses of containment and support (e.g. picture 54 in Figure 2-2 - *rabbit in cage* and picture 1 in Figure 2-3 - *cup and saucer on table*). On less prototypical cases there can be cross-linguistic agreement but there can be divergence as well (e.g., the pictures in Figure 2-4).

Naturally, the question arises about why English and Mandarin differ in the extended uses of the two concepts. Research on the semantics of spatial terms, like English *in* and *on*, suggest that a set of factors influence how speakers apply them, including geometric, functional, and object knowledge (Cienki, 1989; Coventry, 1999; Coventry & Garrod, 2004; Feist, 2000; Feist & Gentner, 2003; Herskovits, 1986; Vandeloise, 1994; 2003; 2005). These three factors will be considered in turn.

Geometry, without doubt, is an important factor distinguishing the use of English preposition *in* and *on*. *In* typically means that the located object is in the interior of the reference object, whereas *on* typically means that the located object is in contact with the reference object. This applies to Mandarin as well. However, geometry alone cannot explain all the uses of *in* and *on*. For instance, as Herskovits (1986) has pointed out, the topmost book of a stack of books can be said to be on the desk even though it is not

contiguous with the desk. Likewise, a piece of bread completely covered by an upside down bowl is described as *under the bowl* even though, from a geometric point of view it is entirely within the confines (i.e., *in*) of the bowl. According to Coventry and Garrod (2004), the degree of the *location control* that the reference object applies to the located object accounts for the suitability of *in* and *on* in the above two situations. For an x to be in or on y, y should be able to control the movement of x. In the book example, the topmost book is not in contact with the desk but the desk nevertheless has a strong control of its movement (e.g., if someone lifts the desk, the book would move along with it). Thus, *on* can be used. In the case of the bowl covering the bread example, while the bread is included in the bowl geometrically, the bowl has a very weak control of its movement (lifting the bowl would not displace the loaf of bread). Thus, *in* is not—or is much less—appropriate. Thus, in English, functional considerations appear to be very important.

The geometrical and functional factors also apply to the use of the two concepts in Mandarin. However, geometry factors would appear to be weighted more than function factors in Mandarin, at least for dealing with the stimuli presented here. For example, while the concept of *support* and *under* are appropriate for the *book/table* and *bread/bowl* examples respectively in Mandarin, for the latter, containment is also acceptable in Mandarin. Furthermore, as discussed above, the light bulb/socket scene in Figure 2-4 is often used (e.g., Vandeloise 1994, 2003) to show the importance of function control for the concept of containment. However, as this study revealed, this scene in Mandarin was described as support. The same thing is true for cork/bottle and flower/hair scenes in Figure 2-4. It would seem that in these cases the amount of physical inclusion or

penetration of one object into the other is sufficiently low that the scene did not compel expression as containment to Mandarin speakers. Nevertheless, when the degree of inclusion is strong, the conceptualization of containment is acceptable in Mandarin, even though the function of location control is weak. This explains why the bread/bowl example can be expressed as containment in Mandarin, but not in English.

The role of inclusion is evident in another example: *passengers in/on the bus*. As Herskovits (1986) suggests, in English, although passengers are included in the bus geometrically, the expression *passengers in the bus* is allowed only when the bus has lost its function of transportation, e.g., "Children are playing in an abandoned bus". In contrast, in Mandarin, it is perfectly acceptable to say "passengers in the bus" regardless of whether the bus is being viewed a form of transportation or not. In general, the respective importance of the geometrical and functional properties might be one of the reasons why there are certain variations between English and Mandarin in terms of the conceptualization of two concepts.

Object knowledge is another factor responsible for the difference between English and Mandarin in the conceptualization of containment and support. Languages may differ in the way that objects are conventionally conceptualized (Bowerman, 1996a). For example, Cienki (1989) argued that English, Russian and Polish have different criteria for determining if a two-dimensional reference object has an interior or not (e.g., clearing and desert), which explains why certain scenes are conceptualized differently across speakers of these three languages. A similar statement was made by Chinese scholars like Wu and Wei (2007). They claimed that when reference objects are two-dimensional "areas", such as mirror, world, desert, or village, these words can only be combined with

the preposition *in* in English, whereas in Mandarin it is "in the mirror/desert"[2], "in/on the village", and "on the world". These examples can be taken to show the difference between how English and Chinese speakers conventionally conceptualize these objects, although it is unclear in the statements by Wu and Wei what "area" really refers to, because the notion of area itself is language dependent. For example, why are both world and mirror considered as two-dimensional areas, when mirror has a clear visible boundary whereas world does not? It was found in the present study that the difference in object knowledge as reflected between English and Mandarin is not restricted to only two dimensional objects, but can also include other objects. For example, in Mandarin, "tree" is not usually conceptualized as a three-dimensional container, unless the focus is the trunk of the tree. "Plate" is conceptualized as a container just like a bowl in Mandarin, whereas in English it is conceptualized as a supporting surface. In addition, it seems that in Mandarin, objects like wall, fence, board, road, line (the geometrical line), as well as the outer surface of objects are usually conceptualized as providing a two-dimensional surface for supporting objects. In English, these objects can be seen as providing a very thin lamina in which the located objects can be embedded (e.g., a crack).

The findings in this study offer some potential insights into the interaction between the human conceptual system, language and the spatio-physical world. Tyler and Evans (2003) point out, for example, that the complex interaction between human conceptualization, language and the spatio-physical world is clearly reflected in the diverse use of spatial particles. In the present case, the use of *on* in *wrinkles on forehead* (picture 105 in Figure 2-3), for example, does not completely correspond to the

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[2]However, our data suggest that both "on/in the desert" are acceptable to Mandarin speaker.

prototypical meaning of ON. However, for English speakers this scene resembles the relationship of support and thus triggers English speakers to describe it using the preposition *on* (Herskovits, 1986). The same holds for Chinese speakers. Furthermore, this spatial sense of ON can be metaphorically extended to many non-spatial meanings, e.g., *a book on Africa*.

The complex nature of human conceptualization is also reflected by the fact that the same spatial scenes can be construed from different perspectives. For example, one can say both "*The boat is in/on the river*" in English, depending on speakers' perspectives and the context. This complexity of human conceptual system is even more evident in the crosslinguistic differences found in this study. The present study revealed how the spatial relationships of containment and support can be construed differently in different languages.

Similarly, just as there are variations across languages in spatial representation, there are also individual variations within a language group. This point is rarely mentioned in the literature. However, a more general point noted by Jarvis and Pavlenko (2008) is that conceptual representations of lexical, grammatical, and discursive structures are not necessarily identical within the same speech community. They are subject to individual variation. For example, ranking of the hierarchical structure of objects is influenced by the judges' experience and familiarity with the objects (Murphy, 2002). In the present study, despite the relatively stable nature of the spatial concepts in a given language, these concepts are nevertheless subject to individual differences. Presumably this is because language does not refer directly to the real world but to the speaker's construal of the relationships in the world—the reality that is interpreted and

shaped by the conceptual system. Under certain circumstances, one may choose to emphasize a different feature in the spatial configuration that is either unnoticed or not highlighted by the majority speakers from the same language group, but are more regularly well identified by speakers of another language group.

Finally, the results of this study have an important methodological implication. The study identified some systematic individual differences within a given language group. This finding underscores the fact that the number of participants for such studies employing picture stimuli is crucial. Studies with an N of 1 may produce misleading results. The existing literature tends to assume that the way spatial representation conveyed in a language is relatively fixed, and that all members of the language community use the language in exactly the same way. Contrary to this assumption, the present study revealed that there can be systematic cases where speakers diverge from the majority of the language group, even in speaking about something as seemingly straightforward as IN and ON spatial relationships.

In conclusion, this study revealed systematic similarities and differences in the linguistic expressions of the topological spatial relationship of containment and support between Mandarin and English speakers, as well as systematic individual differences within each language group. These findings suggest that there are underlying differences between English and Mandarin speakers in the conceptualization of these two spatial concepts, although clearly future research needs to investigate these potential differences using designs that target the relative role of functional versus spatial perceptual factors associated with how speakers view the relationships depicted in the TRSP stimuli and that explore the boundaries between categories for speakers of each language, perhaps

using techniques similar to those described in Coventry and Garrod (2004) and Garrod, Ferrier & Cambell (1999). The present research adds to the body of findings indicating that the once seemingly fundamental concepts of IN and ON are turning out not to be universal concepts. The crosslinguistic variations between language groups and within language group revealed in this study point to the complex nature of human spatial conceptual system and how it maps onto language.

Zhang, Y., Gatbonton, E., & Segalowitz, N. (in preparation). First language conceptual interference in the second language: the impact of Mandarin L1 on the use of *in* and *on* in English L2. In preparation for submission to *Studies in Second Language Acquisition*.

Chapter 3.

First language conceptual interference in the second language: The impact of Mandarin L1 on the use of *in* and *on* in English L2

3.1 Introduction

Every language has its own means for describing spatial relationships. Despite the fact that the ability to conceptualize spatial relationships might be universal, more and more research shows that there are wide crosslinguistic differences in the way languages allow people to express such relationships, even in the case of the two seemingly basic spatial concepts of containment (typically expressed in English by the preposition *in*) and support (typically expressed in English by the preposition *on*) (e.g., Bowerman, 1996a,b; Bowerman & Choi, 2001; Feist, 2000; Gentner & Bowerman, 2009; Levinson, Meira & The language and cognition group, 2003; Levinson & Wilkins, 2006). What effect these crosslinguistic differences have for second language (L2) learners is still an under-researched area. This paper sets out to explore, based on the example of Mandarin Chinese speaking learners of L2 English, if the discrepancy between first language (L1)

and L2 ways of categorizing containment and support create difficulties for L2 learners in using the English prepositions *in* and *on*. If so, could these differences be attributed to discrepancies in how these two spatial concepts are typically conceptualized by speakers of the L1.

Expressing containment and support: Crosslinguistic differences

One way to study how speakers of different languages express relationships of containment and support has been to ask informants to describe simple pictured scenes (e.g., a picture of a cup on a table, where the cup is referred to as the *located* object and the table as the *reference* object). Research has shown that different languages provide different choices about which scenes are similar enough to be described through the same spatial term, and be categorized together as examples of *containment* versus examples of *support* (e.g. Bowerman, 1996a, b; Bowerman & Choi, 2001; Feist, 2000; Gentner & Bowerman, 2009; Levinson, Meira, & The language and cognition group, 2003; Levinson & Wilkins, 2006; Zhang, Segalowitz & Gatbonton, 2011). For example, in English two prepositions can be used to cover the following three spatial scenes: (a) *apple in bowl*; (b) *cup on table*; and (c) *handle on door*. In contrast, these scenes can all be expressed by the same one term in Spanish, by three different terms in Dutch, and by two terms but with a different pattern of grouping in Berber (scenarios "a" and "c" by one term and "b" by another term; Bowerman and Pederson, 1992). This contrast raises a question regarding the nature of the different cuts between containment and support made by different languages. Several possible answers to this question have been presented in the literature.

First, the ways in which the objects are conceptualized have been found to be different among languages. Cienki (1989) found that the Polish and Russian languages have different criteria for determining if a two-dimensional reference object is normally conceptualized in terms of having an interior or not. For example, Russian and Polish may differ from English in the way they focus on the dimensions of *clearing*; in English the containment preposition *in* is used to express *a tent in a clearing*, whereas Russian and Polish use the equivalent words corresponding to English *on* to express support*, na* and *на* [na] in Polish and Russian respectively. However, Russian can still differ from Polish and correspond more closely to English in its conceptual focus for other situations. For instance, in both English and Russian, one says *in Siberia* (в Сибири [v Sibiri]), but in Polish *na* has to be used (na Syberii). Similarly, Zhang, et al. (2011) suggested that Mandarin and English speakers may differ in how they normally conceptualize what a plate is. In Mandarin, a plate is usually treated as a three-dimensional bowl-like container and the close translation equivalent of *in* is used to refer to the position of a located object (such as food) in relation to a plate, whereas in English, plate is treated more as a flat two-dimensional supporting surface and *on* is used instead.

Second, studies of the semantics of spatial terms have revealed some of the attributes of spatial scenes that people focus on when describing spatial locations. These attributes include geometric and functional aspects of the scene. A difference in the relative importance of one attribute over the other, e.g. greater importance attributed to geometry over function, has been hypothesized to underlie semantic differences between languages in the use of terms that express containment and support. Below we briefly review these attributes.

The importance of geometry in characterizing and differentiating the meaning of

in and *on* has been pointed out by many researchers (e.g., Bennett, 1975; Herskovits,

1986; Leech 1969; Miller & Johnson-Laird, 1976). The geometric inclusion of the

located object in the reference object is, without doubt, a critical factor to determine if the

located object is *in* the reference object. Similarly, the geometric contact between the

located object and the reference object is important for determining the *on* relationship.

However, geometry alone is not able to account for all instances of *in* and *on*; functional

control is another important determinant of the spatial relationship.

The importance of functional control of the located object by the reference object

for the comprehension and production of *in* and *on* has been acknowledged in the

literature (Conventry 1998; Feist, 2000; Feist & Gentner, 2003; Garrod, Ferrier &

Campbell, 1999; Richards, Coventry & Clibbens, 2004; Vandeloise, 1994). For example,

Coventry (1998) showed scenes featuring an apple located in various positions in a bowl,

where the bowl controls the movement of the apple to varying degrees in the sense that

moving the bowl carries the apple with it. He found that *in* was considered as the most

appropriate descriptor when the bowl has the strongest control over the apple (i.e. The

apple and the bowl move together at the same rate) compared to when the apple moved

independently in relation to the bowl.

Another important element in the use of *in* and *on* is what people know about the

objects involved in the spatial scenes. Such object related knowledge includes knowledge

about the normal uses of the objects and how the objects typically interact (Conventry,

Carmichael & Garrod, 1994; Coventry & Prat-Sala, 2001; Feist, 2000; Feist & Gentner,

1998, 2003). For example, Coventry and his colleagues (Coventry et al., 1994) found that

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in was judged to be more appropriate for expressing the spatial relationship in scenes depicting solid objects in a bowl rather than in a jug, because the typical function of the bowl is to hold solids, whereas, a jug is usually designed to hold liquids. These geometric and functional considerations have been shown to apply not just to English, but also to a wide range of languages; however it has been hypothesized that different languages might give different preferences for one type of attribute over another (Coventry & Garrod, 2004; Coventry & Guijarro-Fuentes, 2008; Coventry, Guijarro-Fuentes, & Valdés, 2011; Feist, 2000).

L2 learners and the use of English prepositions in and on

Researchers have reported that L2 learners have difficulty correctly using *in* and *on*, but that the exact causes of the difficulty are not completely clear. For example, Hartford (1987) tested the use of English prepositions by a group of learners of different proficiency and native language backgrounds (including Arabic, Spanish, Japanese, Bahasa Malay, and Chinese) through an error correction task. She found that all learners, including advanced learners, had less difficulty with the concrete and more prototypical meanings of prepositions (e.g., *The man is in the room*) than their less concrete uses (e.g., *He saw himself in the mirror*) and temporal uses (*on Friday*). She also found that the boundary between *in* and *on* was especially difficult for learners. For instance, while native English speakers preferred *in* for *He saw himself in the mirror*, half of the L2 learners from the most advanced group made wrong choices by choosing *on,* but not any other preposition. According to the author, the learners were misled by their normal experience with the objects, which allows one to consider a mirror as a surface (and

hence providing an appropriate context for using *on*). Such specific object knowledge might, however, differ between learners and native English speakers. It was unclear why normal experience and object knowledge that could be expected to affect all learners only resulted in some (and not all) of them choosing *on*. Did the learners' first language (L1) play any roles in this case? Because the author did not investigate how the learners expressed the spatial relationships of containment and support in their L1, it was not possible to address this issue directly.

The effect of L1 on the acquisition of the usage of English prepositions *in* and *on* has been documented by Mukattash (1984). The author tested the use of English prepositions by Arab learners of English through a fill in the blank test. Among other errors, many learners substituted *in* for *on*, for example, **Did you see the play in television last night?* The author interpreted this error as being induced by L1 interference because the Arabic preposition *fi,* which is the primary counterpart of *in*, covers all contexts that require the use of English *in*, *on* and *at*. The author claimed that as many as 76% of the overall number of errors was caused by L1 interference. Nevertheless, the exact nature of this L1 interference is unclear. We do not know, for example, if the learners chose *in* simply based on a direct word to word translation from L1 to L2 or if their use of *in* reflected their unique way of conceptualizing the relevant spatial relationships as containment. Conceptual factors behind the errors with prepositions *in* and *on* were also explored by Munnich and Landau (2010). In their study, they asked their learners to look at a set of pictures and do a fill in the blank test. The results showed that the border between *in* and *on* (but not between *on* and *under*) was problematic for Spanish and Korean speakers who started learning English late (between

8 and 13 years of age); these learners made errors no matter how long they had been exposed to the target language. On the one hand, both Korean and Spanish learners produced errors such as *owl on the tree* or *passengers on seats*. On the other hand, there were also errors specific to a particular group. For example, many Korean speakers wrongly produced the error *crack on pavement* while the Spanish speakers did not. The authors argued that the learners' problems with expressing spatial relationships in English might come from two possible sources: spatial regions of focus defined by prepositions and the representation of reference objects. Take *passengers in seats* for example. The reason why English speakers use *in* might be that the valid region of the seat is defined by the function of the seat, which is to contain (seated people), instead of by its geometry (surface to support a seated person). Perhaps learners have greater difficulty with the functional aspects of the prepositions compared to the geometric. In contrast, as can be seen in the example of *owl in tree*, there is a language-specific representation of the reference object—the tree—in English is as container. This language-specific way of focusing on the reference object might also be very problematic for late learners. The Munnich and Landau (2010) study seems to imply that the learners' errors with prepositions *in* and *on* were related to conceptual differences between L1 and L2 in the representation of containment and support. However, without an analysis of the learners' L1 performance, the authors were not able to discuss the possible L1 conceptual interference in detail.

Although the possible role of L1 conceptual interference in creating problems for distinguishing the usage of the static meaning of *in* and *on* is not clear, the effect of L1 in the usage and underlying issues of representations of a set of related meanings of *in, on*

and other prepositions has been documented. For example, among other findings, Jarvis and Odlin (2000) found that Finnish L2 learners of English overgeneralized English preposition *in* for internal source relation, such as *When they had escaped in the police car they sat under the tree*. This error was motivated by structural differences between Finnish and English. Finnish locative cases distinguish between goal, location, and source relations, whereas English prepositions conflate both internal location and internal goal (e.g. location prepositions *in, on* and *at* can also be used to express goal), therefore some Finnish learners of English may wrongly assume that *in* can be used to express all internal relations.

Ijaz (1986) found that both L1 semantic and conceptual patterns affected the representations of the English prepositions o*n, upon, onto, on top of, over and above* by Urdu and German L2 speakers of English. They reported two findings. First, they found that the meaning ascribed to these English words by L2 speakers was influenced by the counterpart lexical structures in L1. For example, when judging the meaning of the English word *on*, German speakers overemphasized the semantic dimensions of movement and verticality and underemphasized contact. This differential weighting of semantic dimensions corresponds to that of the translation equivalent in German, which is *auf. Auf* cannot express the non-vertical meaning. It ought to be expressed by another German word - *an*- which is the close translation equivalent of English *at*. This difference in the semantic dimension between L1 and L2 explains why German speakers wrongly used English *at* in sentences that involved a non-vertical meaning like *Dogs must be kept at a leash*. Second, L2 speakers had more difficulty with non-central meanings of the prepositions at issue (e.g., *Keys are hanging on the hooks*) than with more central

(prototypical) meanings of them (e.g., *There is a basket on the floor*). This was shown to be affected by the L1 (German) conceptual structure, because the classification of the central concepts of the semantic category was found to be similar across languages and non-central concepts, on the contrary, are language-specific. All these findings suggest that the use of prepositions by L2 speakers was strongly shaped by the L1 semantic and conceptual patterns.

Taken together, the existing research shows that there is wide crosslinguistic diversity in the way situations of containment and support are expressed and hence categorized according to the linguistic structures used for them. However, it is not completely clear what exact consequences such differences have for L2 speakers and how strong the consequences will be. The review of the related L2 studies points to the possibility that the semantic and conceptual patterns that characterize L1 use may strongly shape or even determine the use of *in* and *on* in the L2, thereby creating difficulties for L2 speakers. The present study explores this hypothesis. The present investigation looks at this issue in Mandarin speaking learners of English, and builds on an earlier crosslinguistic study regarding the use of terms for containment and support (English *in* and *on* and their Mandarin counterparts) conducted with native speakers of Mandarin and English (Zhang, et al., 2011).

Expressing containment and support in Mandarin and English.

Zhang, et al. (2011) found systematic differences in the use of linguistic expressions by Mandarin and English native speakers for the spatial relationships of containment and support, as well as systematic individual differences within each

language group. In that study, 25 English and 25 Chinese (Mandarin) monolingual native speakers described 116 simple pictures depicting a range of spatial relationships that are usually described in English by the prepositions *against*, *in*, *near*, *on*, *on top of*, *over* and *under*, with the primary research focus being on the uses of *in* and *on*. The 116 pictures set consisted of 65 pictures adopted from Bowerman and Pederson's (1992) topological relations picture series plus an additional 51 pictures developed by the authors to expand the possible range of the spatial relationships depicted. The findings revealed two congruent subsets of pictures that both groups of speakers reliably described in the same way. For one of the congruent subsets, the native Mandarin speakers used the canonically corresponding prepositions for *in* (mainly 里 [lǐ]) and the native English speakers used *in* to express containment (22 pictures; henceforth referred to as the IN-IN subset). For the other congruent subset, the native Mandarin speakers used the canonically corresponding prepositions for *on* (mainly 上 [shàng]) and the native English speakers used *on* (35 pictures; henceforth ON-ON), to express support. There was also a subset of pictures that the two groups treated differently. For this non-congruent subset, the native Mandarin speakers used the corresponding preposition for English *on* (上 [shàng]) whereas the native English speakers used *in* (13 pictures; henceforth ON-IN), suggesting that perhaps the two groups interpreted the spatial relationships depicted in the stimulus pictures in different ways. Finally, there was another non-congruent subset consisting of only one picture where Mandarin speakers used the corresponding preposition for *in whereas* English speakers used *on* (IN-ON).

In addition, Zhang et al. (2011) found that the speakers within each language group did not always provide a unanimous pattern of responses for every picture.

Sometimes, a few individuals provided descriptions for particular pictures that were at variance with the dominant response of that speaker's language group (e.g. responding with an IN word to pictures that met the criteria for being classified as ON-dominant for that speaker group). Statistically, these individual differences were shown to be systematic, and not random errors.

Taken together, the systematic differences found between native Mandarin and English speakers and within each language group in describing spatial scenes of containment and support point to potential underlying differences in how speakers of English and Mandarin conceptualize these two spatial categories. The present study investigates this issue with respect to native Mandarin speakers who are L2 learners of English to see if there is an L1 impact on the use of the prepositions *in* and *on*.

The present study

On the basis of the findings from Zhang et al. (2011), the present study investigated whether there are patterns of difficulty in the use of the prepositions *in* and *on* by Mandarin L2 speakers of English, and whether the difficulties are associated with differences in the way containment and support are realized in the learners' L1 (Mandarin) and L2 (English). Specifically, the following research questions were addressed:

RQ1: Will Mandarin speakers of L2 English have more difficulty using the appropriate prepositions *in* and *on* in English for the set of pictures that Zhang et al. (2011) found to be described differently by English and Mandarin monolingual speakers (the ON-IN subset) than for the ones that were described similarly (the IN-IN and ON-ON subsets)?

RQ2:   If the Mandarin speakers of L2 English do demonstrate such difficulties,
        are the response patterns attributable to interference from the L1
        (Mandarin)?

RQ3:   Are L2 proficiency, exposure and length of stay in the L2 speaking
        country directly associated with Mandarin speakers' accuracy in using the
        prepositions *in* and *on* in their L2 English?

3.2 Method

3.2.1 Participants

Two groups of participants were involved. The first group was 44 Mandarin L2 users of English living in Montreal or Ottawa, Canada at the time of testing. They were aged between 19 and 43 with a mean age of 28. Among them, 14 were males and 30 were females. English was their only second language. The second group was a control group consisting of 25 native English speakers living in Montreal or Ottawa, Canada and aged between 19 and 63 years with a mean age of 23. Among them, 10 were males and 15 were females. All members of the control group self-reported a very low level of L2 proficiency (in any language, including French which is spoken widely in Montreal) and reported using English exclusively in their daily lives. Both groups either held or were pursuing university undergraduate or graduate degrees at the time of testing at English language universities.

3.2.2 Stimuli

The primary set of testing stimuli materials was a booklet consisting of 42 pictures selected from the Zhang et al. (2011) study. Specifically, three subsets of

pictures were used: 14 congruent IN-IN pictures from the IN-IN subset; 14 congruent

ON-ON pictures from the ON-ON subset; and 14 non-congruent pictures, 13 from the

ON-IN subset (described by Mandarin monolingual speakers using the canonical form for

on and by English speakers using *in*, and the one IN-ON subset picture. In addition, 7

filler pictures depicting other types of relationships such as *under, near* and *above* were

included in the test booklet. The actual pictures are shown in Appendix 2-1. Under each

picture, a sentence in English was provided to describe the picture. In this sentence, the

spatial location preposition was omitted and five options were provided (*in, on, under*,

above and *near*). The sequencing of the picture-sentence pairs was randomized (same

orders for both groups and for all the participants). Written instructions in the

participant's native language were attached to each booklet. A sample of the (English)

questionnaire is shown in Appendix 2-2.

In order to investigate the possible relationship between Mandarin speaking

participants' language proficiency and preposition use, the Michigan English language

proficiency test was used. In addition, a language background questionnaire written in the

participants' native language was used with both English and Mandarin participants. The

questionnaire included sections eliciting the following information: self-evaluated

language proficiency (listening, speaking, reading and writing skills), amount of exposure

to all languages known, and length of stay in Canada or other English speaking countries

(for Mandarin speakers only).

3.2.3   Procedure

The participants were tested individually. Both groups were first given the

language background questionnaire, followed by the picture description task. After this,

the Michigan English language proficiency test was presented to the Mandarin speakers. In addition, short interviews were conducted at the end of study to obtain introspections on responses from the Mandarin speakers. Testing took approximately 95 minutes for Mandarin speakers and 20 minutes for native English speakers.

3.3 Analysis and Results

First, to obtain a basis of comparison, the native English speakers' choices of prepositions for each picture were calculated. As in Zhang et al. (2011), not all 25 speakers used the same term for the same picture. For this reason, in order to determine if a given picture could be considered unambiguously IN-dominant or ON-dominant for the English control group, the criteria used in Zhang et al. were applied to the responses produced by the English speakers. These criteria are strict enough to ensure that pictures fell clearly into either the IN- or ON-dominant categories, yet are not so rigid as to exclude too many picture descriptions from the study. Specifically, a picture was considered IN- or ON-dominant for the English speakers if:

- at least 90% of the participants selected a term that was either a canonical form for IN (i.e., *in*) or for ON (*on*) to describe the picture;
- of those speakers using a canonical form, the number using the majority form for that picture, as a proportion of all speakers using either form, was statistically significantly (by the binomial test; $p < .05$).

In practical terms, at least 22 (i.e., about 90%) of the English speakers had to have selected either *in* or *on* to complete the sentence description of a given picture and the absolute difference between the number selecting *in* versus *on* had to have been at least

10 participants (e.g., an 18–7 split would establish dominance whereas a 17–8 split would not, by the binomial test of significance). In using this procedure, several pictures failed to meet the dominance criteria and so were eliminated: #86 (*crease/pants*), #122 (flower/hair), and #45 (*fruit/tree*) from the non-congruent ON-IN group, and #60 (*house/fence*) from the congruent IN-IN group. We also eliminated picture #97 (food/plate), the only item that was in the non-congruent IN-ON subset from Zhang et al. (2011) and picture #22 (paper/stick) because many English and Chinese participants appeared confused about which element was the located and which was the reference object. All together, 36 pictures were left for the analysis: 13 as *on* pictures from the original congruent ON-ON group in Zhang et al. (2011), another 10 as *in* pictures from the original non-congruent ON-IN group, and 13 as *in* pictures from the original congruent IN-IN group. All these pictures were classified by the English speakers as ON- or IN-dominant in the same way by English speakers from the Zhang et al. (2011) study and the present study, despite the differences in procedure (free oral description versus prompted sentence completion, respectively).

Second, the Mandarin speakers' preposition-selection target accuracy scores for each picture were identified. Target accuracy was defined in terms of whether the Mandarin speakers selected the appropriate preposition, *in* or *on*, depending on picture's dominance category as determined by the English speakers' responses. These target accuracy scores were submitted to a one-way between groups ANOVA item analysis, with the between groups factor being picture category (3 groups: congruent IN-IN, congruent ON-ON, or non-congruent ON-IN) picture, where picture category was based on how the picture had been classified in Zhang et al.). Results showed that the scores

differed significantly across the three categories, $F(2, 33) = 32.16$, $p < .001$. Post hoc tests further revealed that non-congruent pictures received significantly lower English-appropriate scores from Mandarin speakers compared to the congruent IN-IN and congruent ON-ON pictures, with no significant difference between the congruent IN-IN and congruent ON-ON pictures (see Figure 3-1).

Figure 3-1: Mean target-accuracy scores (with standard error bars) for pictures based on Mandarin speakers' use of the English dominant preposition.
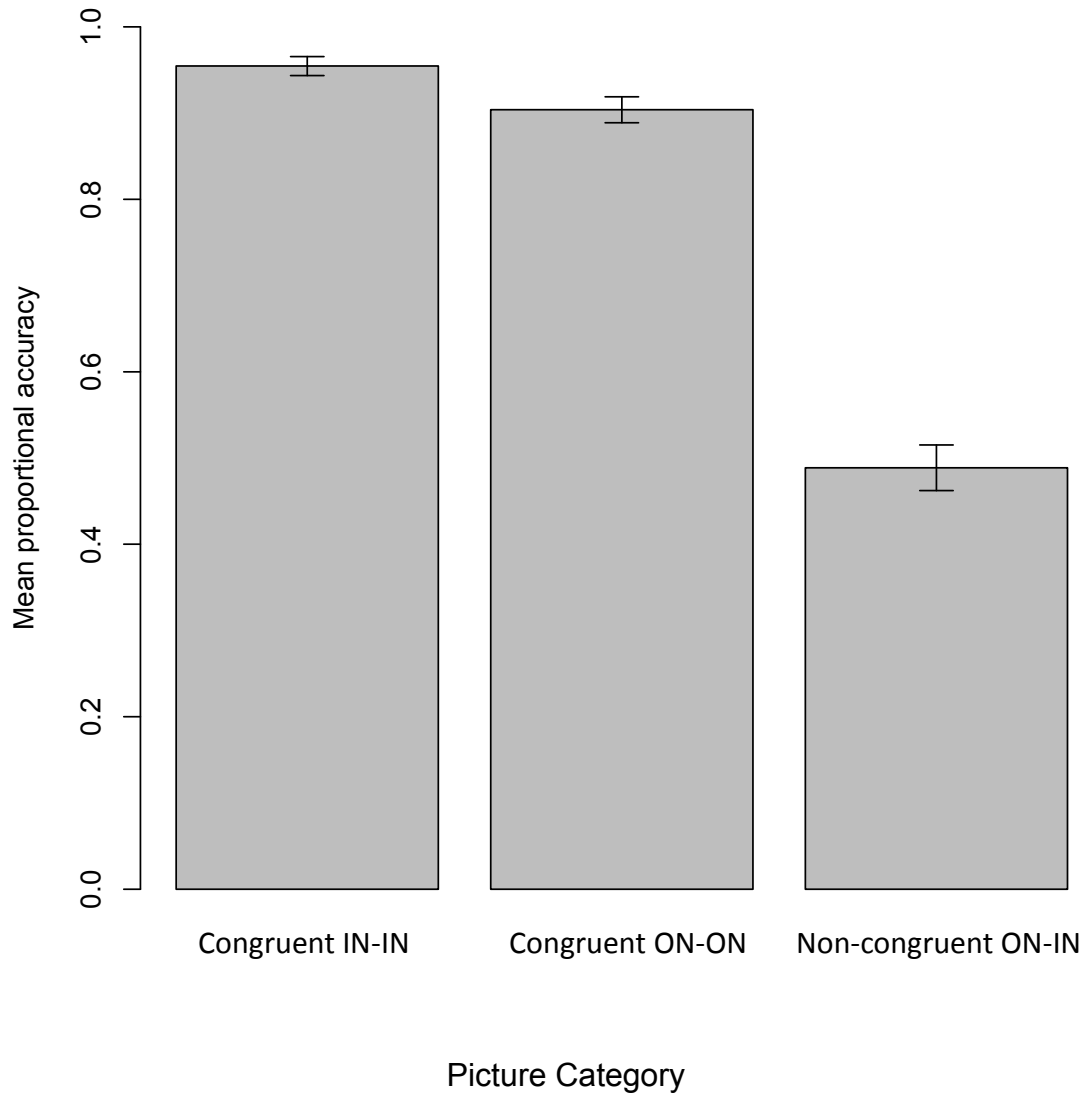
These results indicated that Mandarin speakers of English made significantly more errors (less English native-like preposition selections) in choosing a preposition to describe the pictures in the non-congruent ON-IN category compared to the other two categories.

A closer look at the actual errors made in the three categories revealed the following patterns. In the congruent ON-ON category, where in Zhang et al. (2011) both monolingual English and Mandarin speakers described these pictures as example of support by using the preposition *on* or *shàng* (上) respectively, it was found that most Mandarin L2-English speakers also used the English preposition *on* for these pictures. The one exception is for picture #28 (figure/stamp), for which more than half of the speakers (26 speakers) chose *in*[3]. A very large proportion (21 out of 22 non-target responses, representing just over 2% of all 968 responses by the 44 participants to these 22 pictures) of the remaining non-target word selections by the Mandarin speakers was for the word *above* (instead of *on*). For example, the following three pictures induced the most frequent use of *above*: #23 (*rope/tree stump*), #29 (*tablecloth/table*), #35 (*bandage/ankle*). For the congruent IN-IN category, where both monolingual English and Mandarin speakers in Zhang et al. (2011) had described these pictures in terms of containment by using *in* or *lǐ* (里) respectively, in the present study out of the total 26 choices that were not for *in*, 17 instances involved the selection of *on*, five of *under*, three of *near* and one of *above*. In the non-congruent ON-IN category, where monolingual Mandarin speakers had used *shàng* (上) whereas monolingual English speakers had used *in* in Zhang et al., in the present study a large proportion of the Mandarin speakers' 256

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[3] This pattern is different from what was found in Zhang et al. (2011). In that study, most monolingual Mandarin speakers identified this picture as reflecting the ON (*shàng* -上) relationship. It is unclear why many of the Mandarin L2 speakers of English in this study departed from both English and Mandarin speakers by choosing *in*.

non-target responses (58% of the total responses produced in the non-congruent ON-IN category) involved selecting *on* (221 responses); other substitutions included *under* (24), *above* (8), and *near* (3).

Another way to examine the responses to the pictures is to plot each picture's location in a space defined by the proportion of responses to that picture that involved selection of the word *in* (x-axis) and the word *on* (y-axis). Figure 3-2 shows this for both the Mandarin and English speakers, for the congruent IN-IN pictures, Figure 3-3 for the congruent ON-ON pictures, and Figure 3-4 for the non-congruent-ON-IN pictures. Visual inspection of Figures 3-2 and 3-3 reveal clearly that English speakers almost unanimously selected *in* and *on*, for the congruent IN-IN and congruent ON-ON pictures respectively, and that the Mandarin speakers did so in the vast majority. The most interesting case is what happened with the non-congruent ON-IN pictures, where Mandarin and English speakers using their native languages would describe the pictures differently, as revealed in Zhang et al. (2011).

Figure 3-2. Plot of the proportion of responses reflecting selection of *in* versus selection of *on* by Mandarin and English speakers for each of the13 pictures originating from the congruent IN-IN category in Zhang et al. (2011).
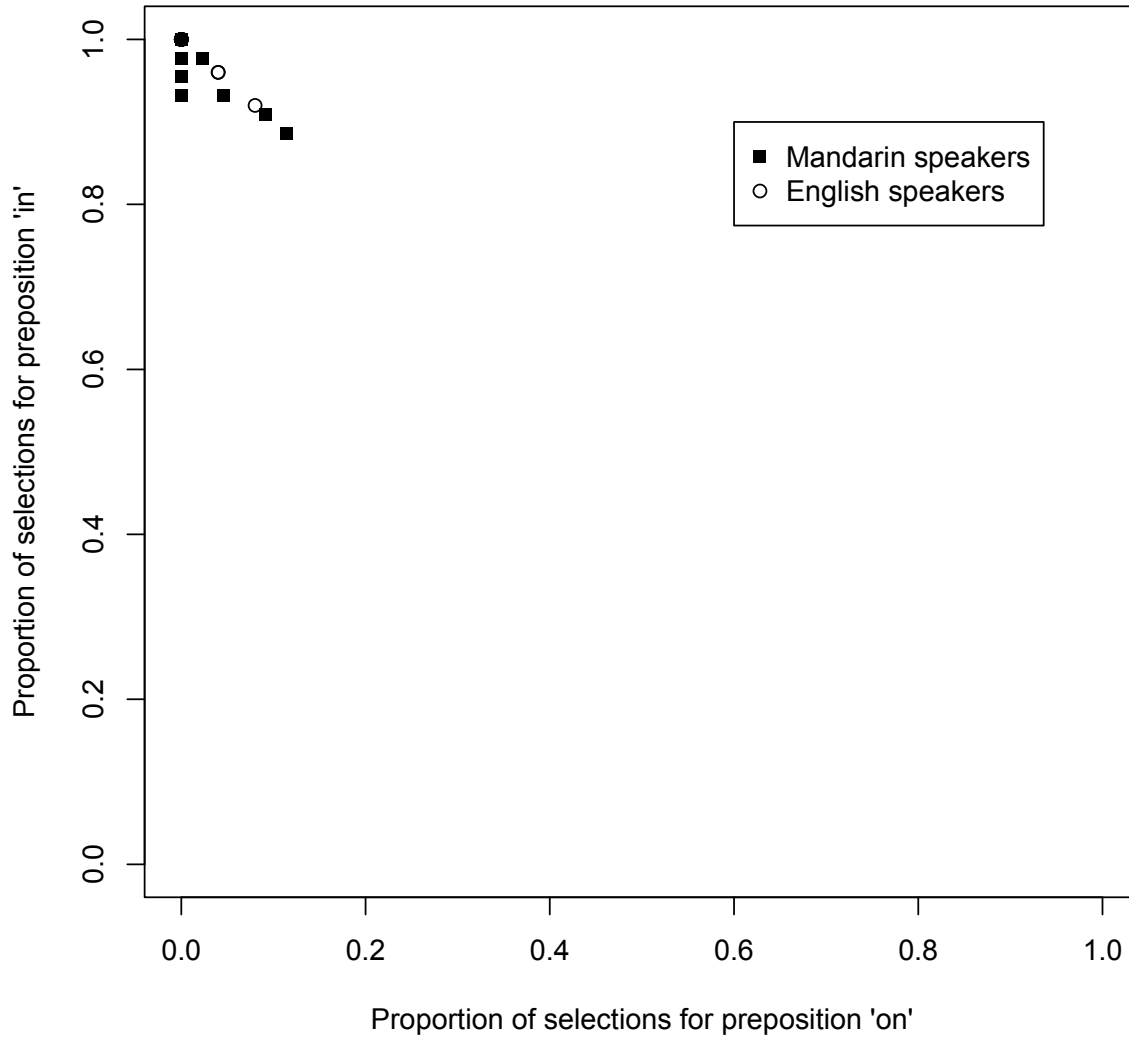
Note: Although each picture should be represented by two data points, one for each language group, the data points for many of the pictures may occupy the same spot on the graph.

Figure 3-3. Plot of the proportion of responses reflecting selection of *in* versus selection of *on* by Mandarin and English speakers for each of the 14 pictures originating from the congruent ON-ON category in Zhang et al. (2011).
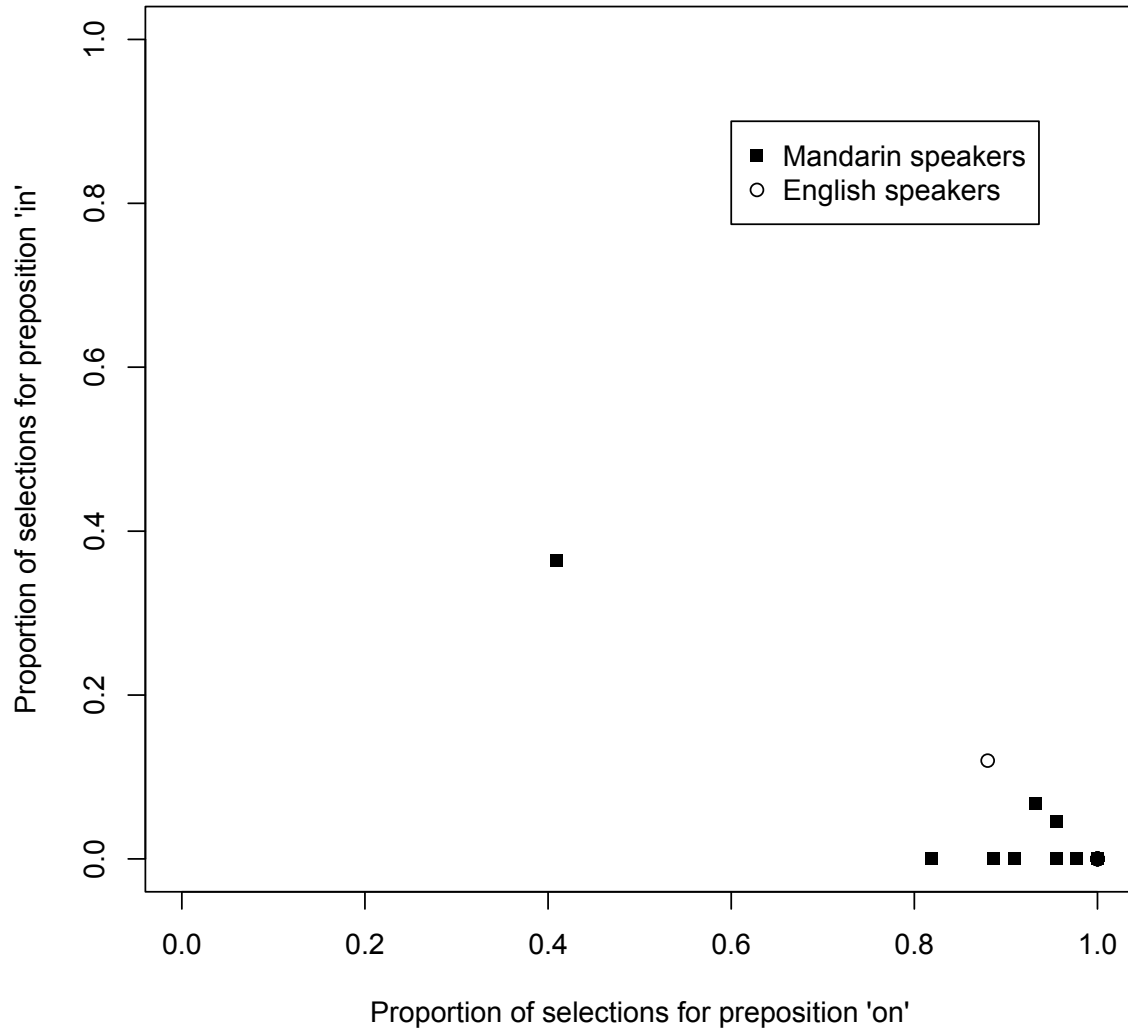
Note: Although each picture should be represented by two data points, one for each language group, the data points for many of the pictures may occupy the same spot on the graph.

Figure 3-4. Plot of the proportion of responses reflecting selection of *in* versus selection of *on* by Mandarin and English speakers for each of the 13 pictures originating from the non-congruent ON-IN category in Zhang et al. (2011).

Note: Although each picture should be represented by two data points, one for each language group, the data points for many of the pictures may occupy the same spot on the graph. An additional data point from Mandarin speakers for picture [#122], shown in brackets as part of Set A, did not make the strict eligibility criteria for inclusion, but it is discussed below in the text and so is also shown here.
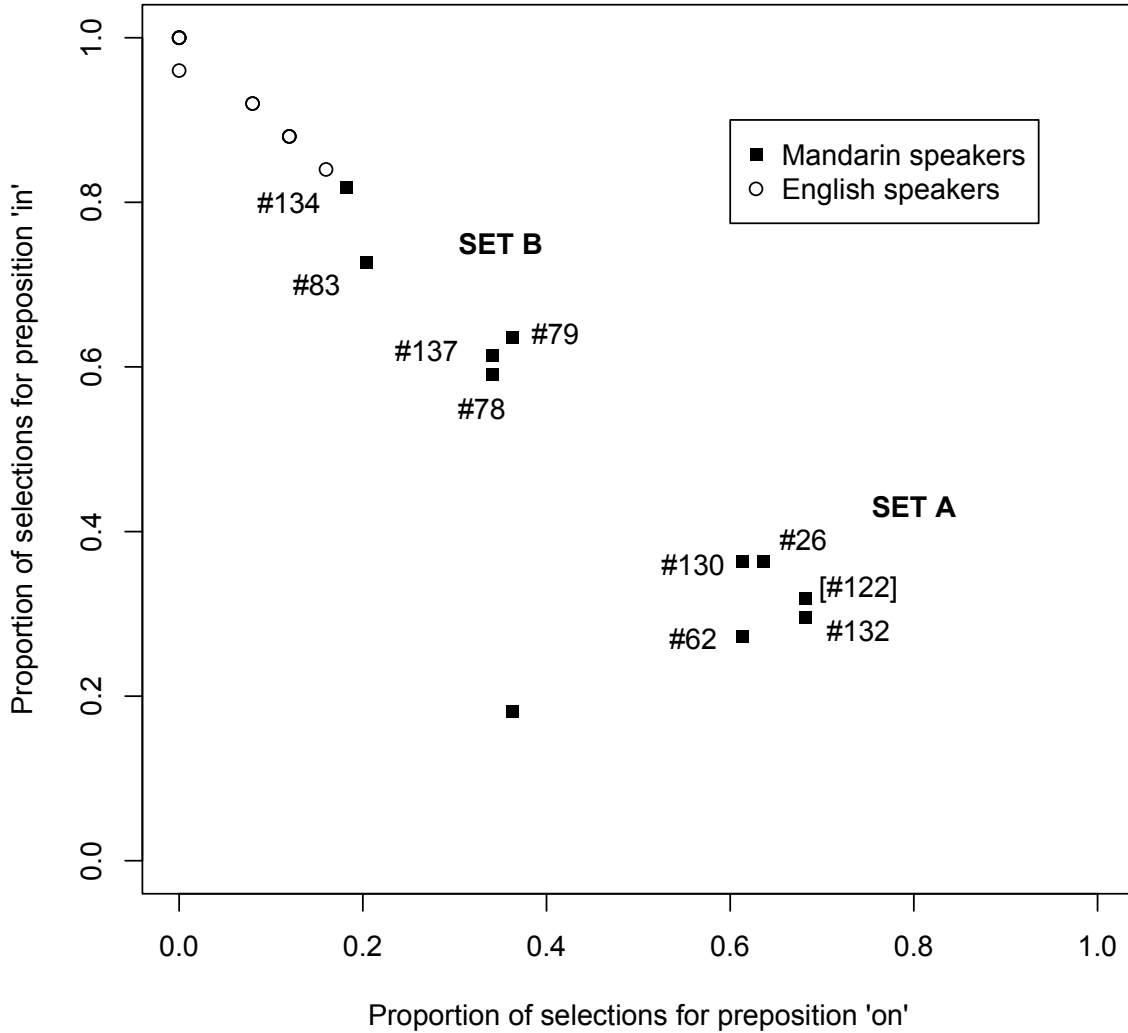
Finally, self-reported English exposure, length of stay in Canada (including other English speaking countries) and scores of the Michigan English language proficiency test were submitted to correlation analyses with performance on each picture category. Significant correlations were found between self-reported L2 exposure and proportion of English-appropriate preposition use for pictures from the congruent ON-ON category (r = .30, N=44, p < .05), but not with the pictures from the other two categories. Also, there was a significant correlation between the measure of self-reported L2 exposure to English and the Michigan proficiency scores (r = .36, N = 44, p < .05) providing confidence in the L2-exposure measure. No significant correlation was found between any other two factors.

3.4 Discussion

Research Question 1

The first research question concerned whether Mandarin L2 speakers of English have more difficulty selecting the English prepositions *in* and *on* appropriately for pictures that Zhang et al. (2011) previously found to be described differently by English and Mandarin native speakers (the non-congruent ON-IN subset) compared to pictures that are similarly described by native speakers. The findings revealed that Mandarin L2 speakers of English did indeed have more difficulty with the non-congruent ON-IN category.

Research Question 2

The second research question concerned whether, given the above results, the Mandarin speakers' English-inappropriate response patterns are attributable to

interference from the L1 (Mandarin)? Two pieces of evidence seem to answer this question in the affirmative.

First, analysis of the actual errors made in the non-congruent category revealed that the general error pattern was that speakers wrongly used the preposition *on* for *in,* usage that corresponds to the way these pictures were linguistically described by monolingual Mandarin speakers identified in Zhang et al. (2011).

Second, an analysis and comparison of the appropriate and alternative preposition choices made by both English and Mandarin L2 speakers of English shed light on this issue.

Certain sets of pictures seemed to be somewhat more readily given a focus from an alternative perspective (i.e., support versus containment or vice versa) for both English and Mandarin speakers, compared to other pictures that tended to be treated more or less in only one way. As seen in Figure 3-4, some items tended to cluster together and the pattern was similar for both groups. Specifically, two clusters or sets of items can be identified in the Mandarin speakers' data: Set A — #26, # 62, #122, #130, #132, in the lower right quadrant of the figure; and Set B — #78, #79, #83, #134, #137, closer to the top-left quadrant in the mid region of the figure. It shows that although overall Mandarin speakers of L2 English produced significantly more English-inappropriate responses in the non-congruent category, they had less trouble with items in Set B than with the ones in Set A. Furthermore, it is worth noting that English speakers produced a similar pattern to that of the Mandarin speakers. Although generally most English speakers used *in* for the items in Set A, these items also tended to be associated with slightly less use of *in* compared to items in Set B. In addition, the non-*in* choices made by English speakers in

Set A were exclusively *on*, and by the Mandarin speakers they were also mostly *on* (for #130 only one choice was for *under* and 27 were for *on*; for #122, one *under* versus 30 *on*, for #62, 5 *above* versus 27 *on*; for #26, 28 *on* vs. 0 choices for other prepositions; and for #132, 30 *on* vs. 0 choices for other prepositions). The number of alternative choices made by English speakers in the congruent IN-IN (Figure 3-2) (1%) and congruent ON-ON (Figure 3-3) category (1%) were much fewer than in the non-congruent category (10%).

The evidence discussed above seems to point to the possibility that the English-inappropriate *on* responses from the Mandarin L2 learners in the non-congruent category were not simply a case of transfer of the L1 form to the L2 form, but may be deeply rooted in differences between the two languages in how they focus on spatial relationships. Put another way, the languages may differ in the types of construals made about the reference object as affording support versus containment. The spatial relationships depicted in the Set A items might possess certain inherent attributes that lend the pictures fit a possibility to be construed from a support perspective, hence favoring use of the preposition *on*, whereas, the spatial relationships depicted in Set B items might lend the pictures the possibility of being construed from a containment perspective, hence favoring the use of the preposition *in*. If one's L1 (in this case Mandarin) happens to emphasize one or the other construals, then this might affect how the learner expresses the relationship in the L2 (in this case English). The differences between the items in Set A and Set B might provide some clues to this possibility because while monolingual Mandarin speakers treated all the items from the perspective of support in Zhang et al. (2011), the Mandarin speaking L2-English users in the present study had a slightly greater tendency to use the English-appropriate containment

preposition *in* for Set B items than for Set A items. Examining the differences between the items in these two sets might reveal something about the conceptual bases for the Mandarin speaking participants L2-English choices.

Sets A and Set B may differ in the nature of the valid region where the reference object interacts with the located object. In Set B, most of the reference objects are normally considered as surfaces, e.g. wall, board, the surface of the trunk of the tree and fence. Therefore, the possible interaction region that the reference object may provide is less controversial compared to the ones in Set A. For the items in Set A, #26—crack/cup, #62—cork/bottle, and #130—bird/tree, the relevant region of the reference object that may offer interaction with the located object is controversial. For the first two items, the prototypical function of a cup and a bottle is as containers, for which the whole interior enclosed by the inner surface of the cup and bottle is relevant and this function is closely associated with the use of *in*. Therefore, this firm knowledge of the function of these objects makes speakers more or less reluctant from accepting the idea that when the located object is not something that is associated to the containing function of the reference objects and their respective relevant region also could be ***in*** the container. As for item #130—bird/tree, the possible interior that a tree can provide can be the outlined interior formed by the branches and leaves, or the interior enclosed by the trunk of the tree. In other words, the bird can be either among the branches and leaves or inside the trunk of the tree. The presence of the clear and full enclosure in the latter case may make the speaker reluctant from using *in* for the former case when the interior is not as clear and non-controversial as in the former case. The presence of the other valid region of the reference object might make the Mandarin speaking L2-English users harder shift to the

English appropriate construal and some English speakers easier to shift to the alternative construal. As for item #83—muscle/leg in Set B, the reference object "leg" can offer two valid regions to interact with a certain located object. Physically, the muscle is in fact embedded inside the leg. It seems easier for Mandarin speaking L2-English users to accept this physical reality and thus shift to the English appropriate way of expressing this spatial situation. However, it is worth noting that unlike other items in set B for which English speakers reached the full agreement, some English speakers also used the Mandarin appropriate *on* for this item. Again, the two possible regions of the leg may account for this use. Whereas, for the item #132—knot/rope in Set A, the reference object – rope is usually approximated as a one-dimensional object. As Herskovits (1986) acknowledged, the conceptualization of inclusion in a one-dimensional object is not widely used. The rareness and perhaps more difficult way of construing this situation may serve as a clue to explain why Mandarin speaking L2-English users were hard to shift to this English appropriate construal, but stick to the other Mandarin appropriate and more appealing construal of the rope which is support (or attachment) that trigger the use of *on*. Similarly, the same reason enables some English speakers to see the other possible construal. These are, of course, *post hoc* speculations and would require further investigation. However, these speculations have strong plausibility and suggest that the pattern of use of English-appropriate prepositions by L2 users might not simply be random. Instead, they may be conceptually driven by the way the L1 focuses attention on the properties of the located and reference objects as a function of the construals they convey.

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Of course, the difference that we found between these two sets of pictures might not be conceptual at all, but rather caused by a difference in the frequency of occurrence of *in* or *on* in similar word combinations describing similar spatial relationships. For example, in general English may provide more linguistic instances of "bird in the tree" (including owls, sparrows, robins and etc.) than "on the tree". Unfortunately, considering the vast variability of possible realizations of this usage in different syntactic structures, it is not possible to systematically search this type of frequency in a corpus.

Figure 3-5. The continuum of similarity gradient (adapted from Bowerman & Choi, 2001, Figure 16.2).
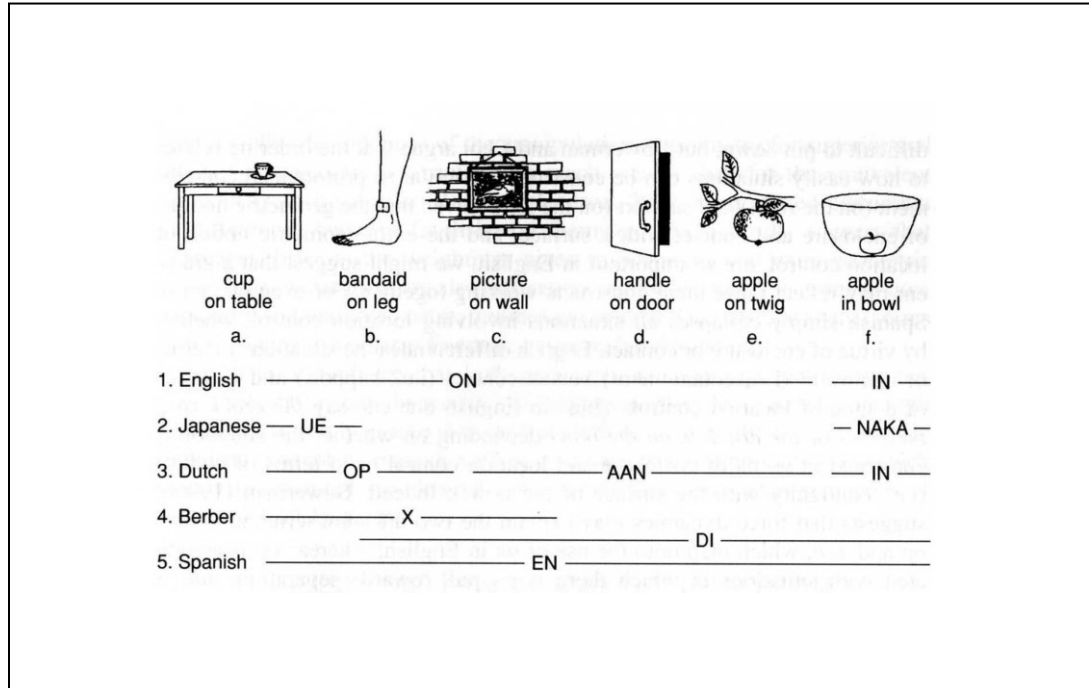
Regardless of whether there is a frequency of occurrence aspect contributing to the results, the present research seems to suggest a possibility that certain spatial relationships are inherently more in-like or on-like. Bowerman and colleagues (Bowerman & Pederson, 1992; Gentner & Bowerman, 2009) found that although languages make different choices about which scenes are similar enough to be put in the same IN or ON category as reflected by requiring the use of the same spatial term, these scenes can be arranged to form a similarity gradient (see Figure 3-5). At one end of the gradient may lie configurations on which the located object is supported by the reference object from below, and at the other configurations on which the located object is completely included in the reference object. It was found that if one term is used for two or more than two scenes, these scenes are always adjacent. For example, in Spanish, because *en* can be used to refer to both scenes (*a)* and (*f)* in Figure 3-5, which lie at the two very ends of the continuum, then all the scenes between (*a)* and (*f)*, (i.e. (*b), (c), (d)* and *(e)*) can also be referred to by *en. (e)* (2000) found in her study that her crosslinguistic data largely respected this similarity of gradient. The existence of this similarity of gradient implies that spatial scenes contain certain features that make them conceptualized as either more similar or dissimilar from each other across languages. Similarly, the pictures in Set A also possess certain features that make them more ON-like than those in Set B. Similarly, Bowerman (1996b) in a study of children's spatial language development suggested the possibility that "within a given domain, some principles of classifications may be inherently easier by saying that "principles that are used frequently in languages of the world may be cognitively more "natural", hence easier for children to identify, than those that are used infrequently" (pp. 161). This claim

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seems also to imply that some ways of conceptualizing a particular spatial scene are more natural than others. It is worth noting that not all errors made by Mandarin L2 speakers of English were related to the difference in the conceptualization between L1 and L2. As was discussed above, a large proportion of the non-target selections (21 out of 22, but as noted earlier, still only about 2% of all responses for these particular stimulus pictures) by Mandarin speakers in the congruent ON-ON category, was the use of the word *above* (instead of *on*). However, no English speakers used *above*. In Mandarin, *above* is usually translated as *shàngfāng* (上方), but in some cases (in certain lexical combinations) can also be translated as *shàng* (上) or *shàngmiàn* (上面), which corresponds to the translation of *on*. However, this does not necessarily mean that Mandarin speakers conceptually categorize the *above* relationship as being in the same category as the *on* relationship. We can suggest this on the basis of the fact that Mandarin speakers of L2 English used *above* appropriately for filler pictures *cloud above the hill* and *lamp above the table* and used no instance of *on* for these two filler pictures. Therefore, the English-inappropriate use of *above* was likely due to a simple L1 transfer, but not conceptual transfer. Another possible reason for the English-inappropriate use of *above* may be that speakers confused the preposition *above* with *over*, which can be used in some of instances, e.g. tablecloth over the table. The notion of *over* is expressed in Mandarin by the same word *shàngfāng* (上方) (or *shàng* (上) as discussed previously) which is used to express *above*. In other words, both *over* and *above* are expressed by the same word in Mandarin. The difficulty of differentiating *over* from *above* experienced by Mandarin speaking L2 learners of English has been acknowledged in the literature (e.g. Li, 2007; Wang, 2011). Taken together, the identified English-inappropriate use of *above* is likely caused by mixed

factors of transfer of the L1 form to the L2 and incomplete mastery of the target L2 construction. Future research is needed to explore this question.

Taken together, the findings discussed above support the case for saying that the difficulties Mandarin speakers of L2 English have in using English-appropriate prepositions *in* and *on* is (at least in part) driven conceptually and is not just a simple lexical transfer of the L1 form to L2.

Research Question 3

The third research question concerned whether L2 proficiency, exposure and length of stay in the L2 speaking country were directly associated with the Mandarin speakers' English-appropriate use of the prepositions *in* and *on* in their L2 English. The findings revealed that the more proficient L2 speakers of English did not use the prepositions in more English-appropriate manner, as people might have expected. Furthermore, length of stay in English speaking countries did not lead to more appropriate use of *in* and *on*. Similarly, amount of L2 exposure was only related to the correct use of *on* to describe pictures from the congruent ON-ON category, but not in the other two categories. In other words, more exposure to L2 did not necessarily lead to general overcoming of L1 interference by Mandarin speakers of L2 English. The finding that exposure to L2 was correlated with performance in the congruent ON-ON category seems reasonable given that most of the inappropriate uses of *on* with this category of stimuli involved the substitution of *above* for *on*. This was discussed earlier as reflecting incomplete mastery of the target language items.

3.5 General Discussion

In sum, the present results provided answers to the three research questions. Mandarin-speaking users of L2 English revealed difficulties in using the spatial prepositions *in* and *on* in an English-appropriate way. Moreover, their patterns of usage were not random but were concentrated on spatial relationships that normally are handled differently by speakers of English and Mandarin. Furthermore, of the stimulus items that proved to be problematic for the Mandarin speakers to describe in an English-appropriate way, one cluster of stimulus items appeared to be relatively more resistant to appropriate use of *in* whereas another cluster appeared to be relatively less resistant, although the appropriate use of *in* did not yet match that of native English speakers. These results suggest that there are L1 influences on L2 performance and that this is driven, in part at least, by conceptual considerations and not just by mechanical transfer of L1 constructions to the L2. These results have interesting implications for understanding how languages can differ in the way they make it possible to describe spatial relations and for understanding how L2 learners can be influenced by their L1 experiences.

Consider first the differences between Mandarin and English for describing the spatial relationships of containment (IN) and support (ON). As discussed previously, research on the semantics of the prepositions *in* and *on* revealed a set of geometrical, functional and qualitative attributes that contribute to the comprehension and production of *in* and *on*, and these attributes were shown to apply not just to English, but to a wide range of languages (Feist 2000, 2008). The difference in the weightings given to these attributes by different languages was hypothesized to cause the semantic difference in the spatial concepts of containment and support (Coventry & Garrod, 2004; Coventry,

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Guijarro-Fuentes & Valdés, 2011; Feist 2000, 2008). Are the differences discussed above between English and Mandarin speakers actually the consequences of difference in semantics?

Zhang et al. (2011) reported evidence that pointed to the possibility that compared to English *in,* the attribute of geometry weighted more than function for Mandarin *lǐ* (里). For example, the reason why the light bulb is *in* the socket in English may be because the socket controls the movement of the bulb, and the attribute of functional control is proved to be crucial for the use of in, when full geometrical inclusion is absent (Conventry & Garrod, 2004; Vandeloise 1994, 2003). However, in Mandarin one says the light bulb is *on* the socket. Similarly, cork is *on* the bottle, flower is *on* the hair, nail is *on* the board in Mandarin. The possible reason for this may be that the geometrical inclusion of the located object in the reference object is very limited (e.g., only a small part of the light bulb is in the socket, whereas the salient part of the located object was clearly visible), thus it is not able to trigger the concept of containment, although the reference object can fully control the movement of the located object. On the other hand, *lǐ* can be used in Mandarin, as long as there is full inclusion, for example, when someone is inside the bus, no matter the bus still acts as a means of transportation or not, or when a ball is located under a bowl which is put upside down on a table. The Mandarin L2 speakers of English might have transferred the L1 weightings to L2, i.e. inclusion is weighted more than functional control when judging if *in* can be used for a particular spatial scene. This wrong assumption might have led to the wrong decision that *in* is not appropriate for scenes such as *light bulb/socket* or *cork/bottle*.

The hypothesis that Mandarin L2 speakers of English might have transferred the L1 weightings to L2 can be tested employing the methodology designed by the above discussed study conducted by Coventry (1998), i.e. by comparing the use of terms by monolingual English and Mandarin speakers, as well as Mandarin L2 speakers of English for scenes showing that the located object is in various geometrical positions in relation to the reference object where the latter controls the movement of the former to various degrees.

However, the different weighting of geometry and function is not able to explain all the differences found in this study. For example, in the attempt to identify attributes that contribute to the semantics of the concept of *in* and *on* across languages, Feist (2000) coded if a set of elements, such as "inclusion", are present for the pictures examined in her study. According to her analysis, "inclusion" is present for the configuration of *bird in tree*. However, it might not be that straightforward to judge if inclusion is involved in this scene, instead, it can depend on how the speaker construes it. In fact, as Munnich and Landau (2010) argued, conceptualizing the tree as an abstract container was found to be odd for many speakers of different language background, including native speakers of Mandarin (Landau & Papafragou, in preparation, cited in Munnich and Landau, 2010) They further pinpointed that in order to represent the outline of the tree as a container, one needs to possess a "geometric imagination" that may be shaped early in life. This might explain why proficiency or exposure does not lead to better use of preposition *in*. Similarly, Hottenroth (1993) showed that in order to represent the tree as a container, certain general cognitive principles and systematic mental manipulations of object knowledge, such as the mental completion of the material boundary was involved. This

finding shows that the difference in construal, but not just in semantics of containment between L1 and L2 accounts for the difference in the use of English preposition *in*, and thus lead to the wrong use of English *in* by Mandarin L2 speakers of English.

The instance of *bird in tree* can also be explained by the statement made in the literature that how language conventionally conceptualizes an object (often reference object) leads to variations in the spatial representation across languages (e.g. Cienki, 1989). However, the notion of language specific object knowledge alone is not able to explain the choice of one preposition over the other. For example, this study revealed that more than half of the English speakers used *on* for *fruit on tree*, which is in contrast to *bird in tree* produced by the same group of speakers. While the use of *in* can be attributed to the language specific conceptualization of tree as a container, as mentioned above. Nevertheless, in the similar scene of *fruit on tree*, tree is no longer conceptualized as container. Furthermore, the same spatial scene or spatial object can be conceptualized differently in the same language. For example, both *in the field and on the field* are correct in English (Taylor, 1988). These evidence indicate that other than the language specific representation of the reference object, the construal of the whole scene is also important for choosing between *in* and *on*.

The possible role of language in forming particular construals can be explored through non-linguistic tasks, such as memory tests. Feist and Gentner (2007), in three continuous experimental studies using a yes-no recognition task tested English speakers' recognition of pictures depicting ambiguous *in* or *on* relationships. It was found that spatial language influenced the encoding and memory of spatial relations. In our case, it would be interesting to see if the different focus between English and Mandarin on scenes

such as bird/tree, cork/bottle and etc. influences the memory of these scenes by both native and L2 speakers. However, the techniques for such memory tests need to be carefully designed in order to capture any possible differences. Assuming that the use of *in* and *on* in English constrains how spatial relations are conceptualized, Coventry, Guijarro-Fuentes, and Valdés (2011) addressed this question. However, they were unsuccessful in their attempt to explore whether Spanish speakers acquiring English as L2 show patterns closer to their L1 or L2 through a memory test. As the authors stated, the technique was not subtle enough to reveal the possible differences.

The role of construals in the encoding of spatial relationships can also be explored through the study of children's language development. Bowerman and colleagues (Bowerman, 1996a, b; Bowerman & Choi, 2001, 2003; Choi & Bowerman, 1991; Choi, McDonough, Bowerman & Mandler, 1999) in a series of well-known work report evidence for the impact of language-specific properties on English and Korean speaking children's construction of spatial relations, like tight containment (e.g. put cassette in case), loose containment (e.g. put apple in bowl) and loose support (e.g. put cup on table). It was found that 9-month-old infants are able to make distinctions of the types of relationships encoded in both English and Korean, however, by the age of 18 months children make only language-specific distinctions. Furthermore, English-speaking adults were not sensitive to categorizations that were not focused by their native language. In contrast, Korean-speaking adults were able to distinguish this contrast that was encoded in their native language, but not the contrast in English. The findings suggest that "some spatial relations that are salient during the preverbal stage become less salient if language does not systematically encode them" (McDonough, Choi and Mandler, 2003, pp. 229).

In light of the findings in this paper, it would be interesting to compare how children from the Mandarin and English backgrounds at different ages develop in the categorization of spatial relationships that are being focused differently in their respective native languages.

At last, considering the fact that language proficiency, length of stay and exposure to L2 did not lead to better accuracy in the use of *in* and *on*, future research should look into the role of age of immersion in the accuracy of use of in and on by L2 learners. As Munnich and Landau (2010) pointed out, the difficulty with the border between *in* and *on* experienced by L2 learners is possibly due to the developmental decline. As the authors pointed out there might be a possible sensitive period for learning spatial terms, just as learning phonology or morphosyntax.

3.6 Conclusions

The findings in this study point to the importance of language in forming particular construals regarding the containment and support relationships by both native speaking English and Mandarin speakers, as well as Mandarin speaking users of L2 English. This study provides the potential for experimentally studying a difficult and long-time controversial topic – the relationship between language and the conceptual representation of spatial relationships. In addition, the findings also have implications for language pedagogy.

Zhang, Y., & Segalowitz, N. (in preparation). The comparison of uses of English prepositions *in/on* and Mandarin postpositions *li*（里）*/shang*（上）. In preparation for submission to *Linguistics*.

Chapter 4.

The comparison of uses of English prepositions *in/on* and Mandarin postpositions *li*（里）*/shang*（上）

4.1 Introduction

Human beings have the ability to locate objects and describe verbally the spatial relations between objects. Language does not simply define the spatial relationship that exists objectively in reality. It also reflects how people interact with and conceptualize the world. Because of human beings' shared neurophysiological constraints and similar interactions with the world, there are a set of common patterns in the conceptualisation and linguistic encoding of space. For example, all human beings locate entities with respect to other objects, therefore at least two objects must be segregated (Svorou, 1994): the located object (LO) and the reference object (RO)[4]. The criteria for determining the LO and the RO also seem to be similar crosslinguistically: the LO usually presents a list of various characteristics such as being smaller, moveable, and more dependent, whereas, the RO is usually larger, more permanently located and more independent, (Talmy, 1983).

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[4] The RO and the LO can also be termed as figure/ground (Talmy, 1983) and trajector/landmark (Langacker, 1987) respectively.

Research on the semantics of terms describing spatial relationships between entities, such as adpositions, also revealed that one and the same term can often be used to describe a variety of spatial situations. This principle seems to apply to most languages, if not all. For example, the English preposition *in* can be used to refer to situations such as:

(a) *The milk in the glass*.

(b) *The dried flowers in the book.*

(c) *The man in the crowd*.

(d) *The sugar in the coffee.*

(e) *The oasis in the desert*.

Similarly, although the above spatial situations are different from each other in terms of the specific type of spatial relationship involved, they all can also be expressed by one word in French (*dans*), Mandarin (*li*) and Russian (*v*). This means that speakers in all the four languages conceptualize these five spatial scenes as similar enough to be expressed by one and the same spatial term.

Despite the many similarities across languages in the conceptualization and encoding of spatial relationships, research has revealed that there is also wide diversity in how languages categorize spatial relationships by they way they assign terms to express these relationships (e.g., Bowerman, 1996a; Bowerman & Choi, 2001; Feist, 2000; Gentner & Bowerman, 2009; Levinson, Meira & The language and cognition group, c2003; Levinson & Wilkins, 2006; Zhang, Segalowitz & Gatbonton, 2011). The most documented findings on this issue are with two seemingly basic spatial relationships:

containment (expressed in English by preposition *in*) and support (expressed in English by preposition *on*). For example, the following spatial scenes are grouped differently across languages (Bowerman, 1996a):

(a) *cup on table*

(b) *handle on door*

(c) *apple in bow*l

In Spanish, one word *en* can cover all the scenes. In Finnish (b) and (c) are grouped together by the same suffix –ssa, whereas, in Dutch (a), (b) and (c) are expressed by three separate terms *op*, *aan*, and *in* respectively.

Why do languages differ in the categorization of spatial scenes? What and how much do these differences reveal about the differences in semantics and the underlying spatial conceptualization between languages? The answers to these questions are far from clear and are the focus of this paper. Specifically, this paper aims, first of all, to identify the similarities and differences in the linguistic encoding of containment and support between English and Mandarin, where containment is expressed in English mainly by the preposition *in*, and in Mandarin mainly by the postposition *li*, and support is expressed in English mainly by preposition *on* and in Mandarin mainly by postposition *shang*. Second, it aims to explore the possible cognitive and semantic factors that underlie the similarities and differences between the two languages. Lastly, it aims to locate the two languages within a framework that others have proposed based on comparisons across other languages. Note that there is a fundamental debate about the relationship between the semantic structure and the conceptual structure. One approach argues that the semantic

structure is a subset of the conceptual structure (Jackendoff, 1983), whereas the other one claims that the two are different in nature (Bierwisch & Lang, 1989; Lang, 1989). Although a distinction is made between conceptual and semantic factors in this paper, no particular position on the debate about the relationship between the two is adopted. The factors that are included here in the semantic category are those that have been termed as "semantic" in the literature. For example, geometry and function are assumed to be important components affecting the semantics of the prepositions *in* and *on* in English by a number of researchers (e.g., Coventry & Garrod, 2004; Feist, 2000; Miller & Johnson-Laird, 1976; Vandeloise, 1991). In contrast, the factors that are included here in the conceptual category are specific construals of objects or spatial scenes that are dependent on language or context. For example, a culture specific conceptualization of objects is considered as a conceptual difference among languages by Cienki (1989). Within a language, the phenomenon that different terms may be used for the same spatial scene certainly reflects the conceptual role of construal. In addition, Bowerman (1996a) pointed out that while elements such as "support" or "inclusion" seem to constitute the semantic meaning of English preposition *on* or *in* and a number of equivalent terms in other languages, what counts as "support" or "inclusion" may be different across languages. In this paper, elements like "support" and "inclusion" are considered to be semantic factors whereas the cognitive principles that determine their qualification are considered as conceptual factors.

Topological relationships refer to the static spatial coincidence of the LO and the RO and do not involve the frame of reference (Levinson & Wilkins, 2006). For example, the spatial relationships that are covered by the English prepositions *in, at* and *on* are

considered to be topological. Topological relationships have been chosen as the focus for this paper for several reasons. First, these concepts do not require a frame of reference, that would complicate comparison across languages (Feist, 2000). Second, topological relationships are acquired early by children and are therefore presumed to be prelinguistic elements mapped onto linguistic forms (Clark, 1973). Third, containment and support have been extensively studied in the literature and so there are useful reference points in which to anchor the discussion. The reason for comparing English and Mandarin is that, whereas the two spatial relationships containment and support have already been widely studied in English, relatively much less has been done in Mandarin and in particular there are very few works comparing the two languages. This gap in the research might be due to the superficial semantic consistency between these two languages (Zhang et al., 2011), leading people to think there was nothing interesting to discover, as will be discussed later.

In this paper we compare the possible ranges of meaning that *in/on* and *li/shang* can take in English and Mandarin respectively. The approach taken to compare the two languages is mainly based on the use types of English prepositions *in/on* that were identified by Herskovits (1986). For the purposes of this paper, some changes have been made in the titles of the use types. Furthermore, some use types were collapsed into one, and still others were divided into two. In addition, a few use types that involve more or less metaphorical uses were deleted. In a book length study of the meaning of *in/on* among other prepositions, Herskovits defined the meaning of *in/on* as consisting of the ideal meaning and use types derived from the ideal meaning. The ideal meaning refers to the use of these two prepositions for the most prototypical situations, for example, the use

of *on* for situations where LO is in contact with and supported by a horizontal surface, e.g., *cup on table*. The different use types refer to the extensions of the ideal meaning. These extensions result from different conventions and pragmatic processes of allowance or tolerance. In the analysis provided below, examples are listed under each of the use types Herskovits proposed. The English examples are followed by the equivalent Mandarin expressions. The English examples (phrases and sentences) without citations come from Herskovits's study, and a few more examples came from Cienki's (1989) study that compared English prepositions *in, on,* and *at* with their translation equivalents in Russian and Polish. The Mandarin translations of these English examples were created by the first author (YZ) who is a native Mandarin speaker and they were verified by three more native Mandarin speakers. There are also examples shown from the perspective of Mandarin, i.e., Mandarin examples followed by the equivalent English expressions. In this case, the uncited Mandarin examples come from the Corpus of Chinese Language (CCL). The frequency counts come from an experimental study, parts of the results of which were published in Zhang et al., (2011). The analysis was restricted to the literal topological meanings of the two prepositions *li*/*in* and *shang*/*on*.

Before we present the analysis, it will be useful to describe the grammatical structures used in English and Mandarin to express containment and support.

4.2 The grammatical structure of expressing containment and support:

English:

Containment is expressed in English mainly by the preposition *in. Inside* and *within* can also express containment. On one hand, *in* has meanings that *inside* and *within* do not have. On the other hand, *inside* is the emphatic alternative to *in*, whereas, *within* is loftier in tone (Lindstromberg, 1997). The focus of the paper is on *in*. However, when need comes, *inside* and *within* are also discussed. Support is expressed mainly by preposition *on*.

Typically, a preposition is combined with two nouns or noun-phrases to form the simplest static locative expression that indicates the location of the LO with respect to RO. Syntactically, the LO typically precedes the preposition and the RO typically follows the preposition. For examples, *the cup on the table* or *the apple in the bowl*.

A locative expression can be structured around a copulative verb or an existential quantifier to form a sentence, e.g., *The cup is on the table* or *There is a cup on the table*. In both syntactic structures, the LO precedes the RO.

Mandarin:

Containment in Mandarin is mainly expressed by *li* (里)[5] including *lǐmian, lǐbian,*

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[5] The postposition *li* individually is pronounced in the third tone and marked as *lǐ*. However, it is pronounced in the neutral tone in combination with nouns and marked as *li* (Wu & Wei, 2007). In this paper, it is marked as *li* henceforth.

lǐtou that are completely interchangeable with *li*, the only difference is that *lǐban* and *lǐtou* sounds less formal than *li*. Note that *nèi, zhōng, zhīzhōng* can also express this concept. However, they sound more formal (Lü, 2007) and, in addition, there are differences in the kinds of lexical combinations they can enter into (cf. Xing, 1996). Support in Mandarin is mainly expressed by *shàng*[6] including *shàngmian, shàngbian, shàngtou* that are completely interchangeable with *shang*. Again, *shangbian* and *shangtou* are less formal than *shang*. The lexical category of Mandarin locative particles is debatable. They are considered as postpositions (Ernst, 1988; Tai, 1973), parts of circumpositions (Liu, 2002), or nouns by most scholars. In this paper, they are being called postpositions. Moreover, in addition to its spatial meaning, *shang* and *li* also have other non-spatial meanings. Even when *shang* and *li* are used for their spatial meaning, other than as postpositions, they can also act as adjectives or nouns depending on their position and function in the sentences. In this paper, only the static topological spatial meanings which are expressed through the combination of noun+ *shang* /*li*, are discussed.

Just like in English, the simplest static locative expression in Mandarin is composed of a postposition and two nouns or noun-phrases. However, in Mandarin, the RO precedes the postposition. For example, *zhuozi* (table) *shang* (on) *de* (the marker, indicating possession) *beizi* (cup) (*the cup on the table*), or *wan* (bowl) *li* (in) *de* (the marker, indicating possession) *pingguo* (apple) (*the apple in the bowl*).

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[6] Similarly to *li*, the postposition *shang* individually is pronounced in the fourth tone and marked as *shàng*. However, it is pronounced in the neutral tone in combination with nouns and marked as *shang* (Wu & Wei, 2007). In this paper, it is marked as *shang* henceforth.

To form a sentence, a location expression can be combined with the word *zai* that usually occurs with other verbs to indicate location. (The lexical category of *zai* is controversial, some researchers consider it as a coverb, and others take it as a preposition, indicating a coarse location, which is similar to English *at*. See Li and Thompson (1981) for a discussion on the lexical category of *zai*. In this paper, *zai* will be translated as *at*). For example, *Beizi (cup) zai (at) zhuozi (table) shang (on)* (*The cup is on the table*). A location expression can also be combined with the verb *you* to form an expository sentence. For example, *Zhuozi (table) shang (on) you (exist) yi (one) ge (classifier) beizi (cup)* (*There is a cup on the table*).

4.3 The comparison of English *on* and Mandarin *shang*

4.3.1 Overlaps of the use types of *on* and *shang*

Most of the uses of English *on* also apply to Mandarin *shang*. This is shown in the following use types.

Use type 1: LO supported by RO

(1) *the cup on the table*

zhuozi (table) *shang* (on) *de(*the marker, indicating possession) *beizi* (cup)

(2) *the coat on the hanger*

yijia (hanger) *shang* (on) *de* (poss.) *waitao* (coat)

(3) *the knob on the door*

men (door) *shang* (on) *de* (poss.) *fushou* (knob)

(4) *the shoes on her feet*

ta (her) *jiao*(feet) *shang* (on) *de*(poss.) *xie* (shoes)

In this category, the ways that the RO interacts with and provide support for the LO can vary. The most prototypical situation is when the LO rests on a horizontal, upward facing surface of the RO, as in (1). The LO can also hang, be joined by devices or be restricted by its position to the RO, as in examples (2)-(4) respectively. All the situations can be expressed with *shang* in Mandarin.

Use type 2: LO is accident/object part of RO

(5) *the carving on the stone*

shitou (stone) *shang* (on) *de* (poss.) *zi* (carving)

(6) *the freckles on his face*

ta (his) *lian* (face) *shang* (on) *de* (poss.) *queban* (freckles)

(7) *the handle on the basket*

lanzi (basket) *shang* (on) *de* (poss.) *tishou* (handle)

In this category, the LO is part of the RO. As Herskovits (1986) noted,

expressions such as **the surface on the table* is not allowed, because "the LO must

constitute a separate relief, something that appears as if it were "stuck" on the rest of the

object and the rest of the object offered a surface for support" (p. 144). This principle also

applies to Mandarin. The part-whole relationships in (5), (6) and (7) can also be

expressed in Mandarin by *shang,* whereas, the possessive form is needed to expressive

the relationship for surface/table. It is worth noting though, in (5) if the carving is deeply

embedded in the stone, in English preposition *in* has to be used, whereas, in Mandarin

shang should still be used. This point will be discussed in detail later in use type 2 of

section 4.4.2.

Use type 3: LO is attached to RO

(8) *the painting on the wall*

   qiang (wall) *shang* (on) *de* (poss.) *hua* (painting)

(9) *the fly on the ceiling*

   tianhuaban (ceiling) *shang* (on) *de* (poss.) *cangying* (fly)

(10) *a dog on a leash*

   lianzi (leash) *shang* (on) *de* (poss.) *gou* (dog)

(11) *the pears on the branch*

   shuzhi (branch) *shang* (on) *de* (poss.) *li* (pears)

In the above examples, the supporting surface is not upward facing, and thus, the contact is not maintained by gravity alone, but by attachment (Cienki, 1989). In such cases, support might be less relevant than attachment. In Mandarin, the sense of attachment can also be expressed by the same word that expresses the prototypical support relationship. However, it is noted in the literature that in many languages, these two relationships are expressed by two separate words (e.g., Bowerman, 1996a; Levinson et. al, 2003; Levinson & Wilkins, 2006).

Use type 4: LO is contiguous with RO

(12) *the lock on his forehead*

ta (his) *qiane* (forehead) *shang* (on) *de* (poss.) *toufa* (hair)

(13) *the image on the movie screen*

dianying (movie) *pingmu* (screen) *shang (on) de yingxiang (image)*

(14) *sun on the horizon*

dipingxian (horizon) *shang* (on) *de* (poss.) *taiyang* (sun)

(15) *point on the line*

xian (line) *shang* (on) *de* (poss.) *dian* (point)

In this category, support is irrelevant. What is important is the contiguity between the RO and the LO. However, *on* or *shang* is used because the relationship resembles support for both English and Mandarin speakers.

Use type 5: LO over RO

(16) *the dark clouds on the island*

dao (island) *shang* (on)*/shangfang* (over) *de* (poss.) *hei* (dark) *yun* (clouds)

(17) *His eye fixed, through the telescopic sight, upon the crosshair on the soldier's chest.*

Ta (his) *de* (poss.) *shiixian* (line of sight), *touguo* (through) *miaozhunjing* (telescopic sight) *de* (poss.) *jiaochamiaozhunxian* (crosshair), *ding* (fix) *zai* (at) *nage* (that) *shibing* (soldier) *de* (poss.) *xiongkou* (chest) *shang* (on).

In this category, the LO is not in contact with the RO, but over it. As Herskovits stated, such uses of *on* are very rare. In Mandarin, *shang* can be used to refer to the relationship of "*over*" in more situations compared to English (e.g., examples (18), (19) and (20) below). However, the RO in such cases are usually objects such as mountain, river or head. In addition, such use of *shang* in a lot of cases must be used in combination with verbs (such as *xuangua* (hang)) as in (20). Furthermore, there is a postposition *shangfang* that is used specifically for this type of relationship when contiguity is not involved between the LO and RO and that can be used in example (16) and the following three examples as well. Another point that needs to be added is that Zhao (1979) argued

that *shang* should be pronounced in the fourth tone, instead of the neutral tone, when it is used to mean "above". Similarly, he also pointed out that this use of *shang* is much narrower than when it is used to mean "on".

(18) *shan* (mountain) *shang* (on)/*shangfang* (over) *de* (poss.) *yun* (cloud)

   the cloud over the mountain

(19) *he* (river) *shang* (on)/*shangfang* (over) *de* (poss.) *tielu* (railroad) *qiao* (bridge)

   the railroad bridge over the river

(20) *Zai* (at) *tuanji* (turbulent) *de* (poss.) *he* (river) *shang* (on)/*shangfang* (over) *gao* (high) *xuan* (hang) *zhe* (particle) *yi* (one) *lun* (quantifier) *canlan* (bright) *de* (poss.) *hong* (red) *ri* (sun) (Xu, 2004).

   There is a bright red sun hanging high over the turbulent river.

In general, the use of *on* and *shang* correspond to the above-discussed use types. This seems to indicate that the cognitive principles that trigger the above uses work for both Mandarin and English speakers. However, a small portion of uses of *on* may not apply to *shang*.

4.3.2 **The non-correspondence of *on* and *shang* (uses of *on* covered by *shang*, *li* and other postpositions)**

Use type 6: LO contiguous with edge of geographical area

(21) *a garden on the lake*

hu (lake) *pangbian/bian* (beside) *de* (poss.) *huayuan* (garden)

(22) *a city on the ocean*

   dahai (ocean) *pangbian/bian* (beside) *de* (poss.) *chengshi* (city)

(23) *a house on the park*

   gongyuan (park) *pangbian/bian* (beside) *de* (poss.) *fangzi* (house)

The LO is contiguous with the edge, but outside of the area occupied by the RO. This particular type of relationship cannot be expressed by *shang*, but by postposition *bian* or *pangbian* in Mandarin.

Use type 7. LO located on geographical location

In English, either *in* or *on* can be used to indicate the simple location of an object to a geographical region, depending on the specific names of the geographical region. In Mandarin, the situation is more complicated by the fact that other than *li* or *shang*, preposition *zai* can also be used. This use type will be discussed in use type 4 of section 4.4.2.

Use type 8: LO transported by a large vehicle

(24) *the children on the bus*

   gonggongqiche (bus) *li* (in)/*shang* (on) *de* (poss.) *haizimen* (children)

(25) *the travellers on the plane*

    feiji (plane) *li* (in)/*shang* (on) *de* (poss.) *lükemen* (travellers)

In English, when the vehicle has large surface or floor that supports the travellers, *on* is used, e.g. *on the bus*. On the contrary, if the vehicle is relatively small, *in* is used, e.g. *in the car*. However, in Mandarin as long as there is full enclosure, *li* can also be used. The role of full enclosure is more evident in the following example:

(26) *He is sitting in the canoe.*

    Ta (he) *zuo* (sit) *zai* (at) *dumuzhou* (canoe) *li* (in)/*shang* (on).

Here, canoe is considered a small vehicle and thus, *in* is used in English. Whereas, canoe does not provide the extent of a full enclosure like bus or plane does, therefore, *shang* is more acceptable than *li* in Mandarin. A frequency check revealed that *li* occurred 8 times, whereas *shang* occurred 17 times. It seems that unlike English, the size of the vehicle is not a determining factor for the choice of *li or shang* in Mandarin; rather, what is important is whether the vehicle is fully enclosed.

Other than geometry, the object's function also affects the choice of prepositions. Fillmore (1983) pointed out that if the vehicle is no longer used as a means of transportation, *in* would be more appropriate than *on* in English.

(27) *The children were playing in an abandoned bus in a field.*

    Haizimen (children) *zai* (at) *yi* (one) *liang* (quantifier) *ting* (park) *zai* (at) *yi* (one)

    pian (quantifier) *kongdi* (field) *shang* (on) *de* (poss.) *feiqide* (abandoned)

    gonggongqiche (bus) *li* (in)/*shang* (on) *wan* (play).

In Mandarin, although vehicle is no longer used as a means of transportation, still, both *li* and *shang* can be used.

The use of *on* with large vehicles can also be explained by historical reasons. Talmy (1983) pointed out that the use of *on* to originally topless carts has become conventional and "inflexibly imposed on new objects" (p.267).

4.4 Comparison of English *in* and Mandarin *li*

4.4.1 The overlap of English *in* and Mandarin *li*

Use type 1: LO is fully or partially contained in a three-dimensional, hollow object.

(28) *the jam in the jar*

guanzi (jar) *li* (in) *de* (poss.) *guojiang* (jam)

(29) *milk in the glass*

bolibei (glass) *li* (in) *de* (poss.) *niunai* (milk)

(30) *the baby in the cradle*

yaolan (cradle) *li* (in) *de* (poss.) *yinger* (baby)

(31) *apple in the bowl*

wan (bowl) *li* (in) *de* (poss.) *pingguo* (apple)

In this category, the RO has a relatively clear boundary and interior. The LO is either fully or partially enclosed in the RO. This use type reflects the most prototypical situations of containment. In Mandarin, the above examples can all be expressed by postposition *li*.

Use type 2: LO is part of a group of objects

(32) *the girl in the line*

    duiwu (line) *li* (in) *de* (poss.) *nühai* (girl)

(33) *a page in a book*

    shu (book) *li* (in) *de* (poss.) *yi* (one) *ye* (page)

(34) *planets in the solar system*

    taiyangxi (solar system) li (in) *de* (poss.) *xingqiu* (planets)

The RO is a group of objects and the LO is one of its members. As the literature acknowledged, the part-whole relationship has special status crosslinguistically. In many languages, this type of relationship cannot be expressed from the spatial perspective (Levinson & Wilkins, 2006). Just like in English, the part-whole relationship in Mandarin can also be expressed as containment, however, with a condition that the RO has to be a group of objects. When the RO is singular, *shang* has to be used (see use type 3 in section 4.4.2).

Use type 3: LO is "hidden" in a group of objects

(35) *the snake in the grass*

 *caocong (*cluster of grass*) li* (in) *de* (poss.) *she* (snake)

(36) *the mushrooms in the woods*

 shulin (woods) *li* (in) *de* (poss.) *mogu* (mushroom)

(37) *a bird in the bush*

 shucong (bush) *li* (in) *de* (poss.) *niao* (bird)

(38) *the lice in the hair*

 toufa (hair) *li* (in) *de* (poss.) *shizi* (lice)

As in use type 2, the RO in this category also consists of a collection of objects, however, the LO is not a member of it, but is located amongst the RO and is not to be seen straightforwardly. Herskovits (1986) stated that in this case, the outline of the RO is conceptualized as a container that holds the LO. Note that for (38), *shang* can be used in Mandarin if the lice can be seen easily.

4.4.2   The non-correspondence of English *in* and Mandarin *li*

Use type 1: LO in a vaguely bounded interior

(39) *the chair in the corner*

jiaoluo (corner)/*qiang jiao* (corner of the wall) *li* (in)/*shang* (on) *de* (poss.) *yizi* (chair)

(40) *the foot in the stirrup*

    madeng (stirrup) *li* (in)/*shang* (on) *de* (poss.) *jiao* (foot)

(41) *the man in the armchair*

    fushouyi (armchair) *li* (in)/*shang* (on) *de* (poss.) *nanren* (man)

(42) *the man in the chair*

    yizi (chair) *shang* (on) *de* (poss.) *nanren* (man)

(43) *the bird in the tree*

    shu (three) *shang* (on) *de* (poss.) *niao* (bird)

(44) *The kids are playing in the street.*

    Haizimen (kids) *zai* (at) *jie* (street) *shang* (on) *wan* (play).

(45) *The man is standing in the doorway.*

    Na (that) *ge* (quantifier) *nanren* (man) *zhan* (stand) *zai* (at) *menkou* (doorway).

(46) *He held a pipe in his teeth.*

    Ta (he) *yong* (use) *yachi* (teeth) *jia* (hold between) *zhe* (particle) *yandou* (pipe).

(47) *The chair is in the middle of the room.*

 Yizi (chair) *zai* (at) *fangjian* (room) *zhongyang* (middle).

  In this category, the RO does not provide a clearly bounded interior. Instead, a geometrical imagination is needed for mentally creating the boundaries (Herskovits, 1986). Although an imagined boundary is also needed for situations that involve the incomplete enclosure, the extent of the imagination needed for the latter case is much weaker than the one for the former case. For the later situation, such as example (31) under section 4.4.1, *the apple in the bowl*, a plane is mentally created through the rim of the bowl, so that the concavity that is partially enclosed by the material of the bowl is conceptualized as part of the bowl (Cuyckens, 1993; Herskovits, 1986; Hottenroth, 1993). Whereas, in examples of this category, such as (39), in order to conceptualize the corner as offering an interior for the LO, a volume is mentally created which is defined by the two sides of walls, the ceiling and the floor, and at last mentally completed by an imaginary surface (Herskovits, 1986). It seems that the degree and range of the application of the geometrical imagination is weaker in Mandarin than in English. In English, a wide range of spatial relationships between the RO and the LO can be conceptualized as containment by mentally creating a vague boundary to enclose the LO. However, in Mandarin, many spatial relationships cannot be conceptualized as containment because it is hard to mentally create a boundary in which the LO can be located; instead, the spatial relationship of support or a relationship other than containment and support is used, e.g., examples (42)-(47). Even if in some cases the concept of containment can be applied, the alternative conceptualization of support can

usually be equally applicable, and often even more frequently used, e.g., examples (40) and (41). The above discussed situations will be discussed in detail in the following.

Examples (39), (40) and (41) are expressed in English by *in*, but in Mandarin both *li* and *shang* can be used. As stated above, for (39), *corner in a room* can be conceptualized as offering an interior. Except for the type of corner in (39), there are other types of corners: corner of a letter, corner of a table, corner of a street, corner of an eye and etc. According to Herskovits (1986), except for the corner of a street, all other types of corners in English can be imagined as two lines meeting at an angle, which defines a vague interior. In Mandarin, when corner refers to the space inside a room, it can be used with both *li* and *shang*. As the experimental study revealed, the frequency for *li* exceeds *shang*: *li* = 17; *shang* = 3, while all 25 English speakers used *in.* However, when the corner refers to a place that is part of a two-dimensional surface, only the relationship of support is used in Mandarin, e.g., *zhuo jiao shang de huaping* (the vase on the corner of the table).

In (40), although the geometrical inclusion is present, the extent of inclusion provided by the torus shaped RO – "stirrup" is very limited in the sense that only a small part of foot is literally included in the stirrup. Just like the case with "corner", imagination is involved in order to create an interior. As Cuyckens (1993) stated, the stirrup offers an interior "bounded by the material object itself and imaginary planes through its sides" (p.46). Most importantly, the reason why *in* can be used in (40) when there is no clear interior is that the stirrup controls the position of one's foot (Cuyckens, 1993). As Cuyckens further argued, a coin placed in the same position as the foot would not be refereed as ***in*** the stirrup, because its movement cannot be controlled by the stirrup.

However, in Mandarin, both *li* and *shang* can be used for this spatial situation and the frequency of *shang* exceeds *li*: *li* = 8; *shang* = 17. Meanwhile, all 25 English speakers used *in*. It seems that the strong functional control that the stirrup exerts on the foot does not necessarily restrict the scene to be conceptualized solely as *li* in Mandarin.

Similarly, the geometrical imagination is also involved in (41). However, compared to (42), "armchair" certainly has a relatively more clearly bounded interior than "chair" because of the additional boundary provided by the two arms. In English, both *in* and *on* can be used with "chair". The frequency of *on* exceeds *in*: in = 6, on = 19. For armchair, however, the use of *in* exceeds *on*: *in* = 21, *on* = 4. The pattern is different in Mandarin. The word "chair" normally can be used with *shang* only: *shang* = 25, *li* = 0. In contrast, "armchair" can be used with both *li* and *shang*. The frequency of *shang* exceeds *li*: *shang* = 15, *li* = 10. It seems that it is more difficult for Mandarin speakers to imagine the chair as a container. Even when this can be done with "armchair" which has a clearer boundary, the support relationship still takes precedence over containment. In contrast, Herskovits (1986) stated that in English, if there is both support *and* containment, then containment generally takes precedence over support.

In examples (43) and (44), *in* is usually used in English, whereas *shang* is usually used in Mandarin. In (43), an imagined outline is created and projected onto the volume of the tree so that the tree is conceptualized as a container (Cienki, 1989; Herskovits, 1986) and the bird is located within the space defined by the outline of the tree. In Mandarin, a tree is usually not conceptualized as a container. In fact, the mental image of native English speakers upon hearing a phrase such as *There is a bird in the tree* in English perhaps is different than that of native Mandarin speakers upon hearing the

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corresponding Mandarin sentence *Shu* (tree) *shang* (on) *you* (exist) *yi* (one) *zhi* (quantifier) *niao* (bird). The former one would probably be that a bird is sitting on a branch of a leafy tree and the latter would be that a bird is sitting on a branch of a tree, which has only a few branches and leaves. Another possible reason for this difference between English and Mandarin is that the particular part of the RO that is involved in the relationship, termed as "active zone" by Cuyckens (1993), is different between the two languages. When encoding a particular spatial relationship, often only a particular part of the RO is involved. It is very likely that the same principle applies to the spatial descriptions in most of the languages. For example, "She is under the tree" in both English and Mandarin means that she is under the branch part of the tree (Herskovits, 1986). However, in (49), the active zone in English might be the outline formed by all the branches and leaves, whereas in Mandarin – only the branches. The use of *li* would trigger the trunk of the tree as the active zone. In (44), the street and the buildings on both sides of the street were imagined as providing a volume in English, just as what happened with the tree in (43). Again, the active zone in Mandarin might only be the street itself, but does not include the surrounding buildings.

Finally, in examples (45), (46) and (47), neither *li* nor *shang* are used in Mandarin. In all three examples, the boundary of the region is even more blurry. For example, in (45) the boundary is reduced to a ring (Hottenroth, 1993). In (46), a vague outline around the teeth is mentally created (Cienki, 1989). In (47), the boundary is more blurry than in the previous two examples. All these examples cannot be expressed by *li* or *shang*. Instead, they either have to be expressed by the general spatial locative term *zai* (as for (45) and (47)), or they cannot be treated as spatial at all (as for (46)).

Use type 2: LO is embedded in the RO

(48) *the nail in the board*

  banzi (board) *shang* (on) *de* (poss.) *dingzi* (nail)

(49) *the hole in the wall*

  qiang (wall) *shang* (on) *de* (poss.) *dong* (hole)

(50) *the crack in the cup*

  beizi (cup) *shang* (on) *de* (poss.) *liefeng* (crack)

(51) *the deep wrinkles in his forehead*

  ta (his) *etou* (forehead) *shang* (on) *shenshen* (deep) *de* (poss.) *zhouwen* (wrinkles)

(52) *earing in the ear*

  erduo (ear) *shang* (on) *de* (poss.) *erhuan* (earing)

(53) *flowers in the hair*

  toufa (hair) *shang* (on) *de* (poss.) *hua* (flowers)

In this category, the LO is included "in the normalized region defined by the RO, that is, in the part of space its shape would occupy prior to penetration" (Herskovits, 1986, p. 150). The LO can be negative objects like a hole, a gap or a crack, but also can be other non-negative objects, and the ROs are solid chunks of material. Hottenroth (1993) argued that the cognitive principle behind the use of *in* for this category is the "basic

metaphorical process creating a structural analogy between the hollow region bounded by a layer of solid material, and a piece of solid material bounded by its own outer surfaces" (p.209).

In Mandarin, the above spatial relationships have to be expressed by *shang*. This difference is partly attributed to the difference in the active zone involved between Mandarin and English. In English, the active zone of the RO evoked in (50) is the solid shell of the cup. In contrast, in Mandarin the use of *li* in this example would activate the empty, three-dimensional space bounded by the solid material of the cup, something that would not make any sense because the crack cannot be contained in an empty space as can a liquid. A similar reason applies to (48), (49), (51) and (52). Take (48) for example. Upon decoding the expression in English, the combination of the semantic meanings of preposition *in* with knowledge of the world, such as the properties and functions of nails and wood as well as the way that a nail is inserted into wood, evokes the surface of the wood as the active zone (Herskovits, 1986). However, although Mandarin speakers have the same knowledge about nails and wood and their possible interactions as do English speakers, the use of *li* in this situation will usually evoke an active zone that is the space completely bounded by the solid material of the wood. Note however, the use of *shang* in this situation can be ambiguous. Two active zones can be evoked: one that involves the surface of the wood (e.g., the nail is lying on the surface of the board) and the other that does not (e.g., the nail is embedded in the board). If a Mandarin speaker wants to specify the exact location of the nail, for the latter spatial relationship one has to employ a verb (such as *cha*) that describes the movement of a nail being nailed into the wood, and for the former an extra explanation is needed, such as the nail is not inserted into the wood,

but is just placed on the board. In contrast, *the nail on the board* in English is not ambiguous. Only the former relationship will be actualized, i.e., the nail is lying on the surface of the board. It is worth noting that if the RO is changed to cupboard, then the expression "the nail in the cupboard" would become ambiguous in English (Cuyckens, 1993), but not in Mandarin, because the active zone in this case for English will either be the interior or its outer shell, but in Mandarin, only the interior.

A question may arise, then, about why there is such a difference in the active zone between Mandarin and English. One possibility is that the extent of geometrical inclusion required for the semantic meaning of Mandarin *li* is stricter than the one for the English *in*.

Upon studying the semantics of English prepositions *in* and *on*, two major factors were found to be important: geometry and function. Geometry is, without doubt, the important factor affecting the meaning of the prepositions *in/on* and this has been acknowledged by many researchers (e.g., Bennet, 1975; Cooper, 1968; Leech, 1969; Miller & Johnson-Laird, 1976). The geometrical inclusion of the LO by the RO and the contiguity of the LO with the RO is crucial for defining the meanings of *in* and *on,* respectively. The geometrical account can easily explain the meaning in examples like *apple in bowl* or *cup on table.*

However, function has been found to have a critical role in the meaning of *in/on*, too (Coventry, 1999; Coventry & Clibbens, 2004; Coventry & Garrod, 2004; Coventry & Prat-Sala, 2001; Feist, 2000; Vandeloise, 1991; 1994). A well-known example to show the role of function is the following. Imagine that a bowl is full of apples that are protruding over the rim of the bowl and that on top of the pile of apples there lies a pear.

The pear can still be said to be in the bowl although geometrically it is completely out of the interior of the bowl. The reason for the use of *in* is that the bowl controls the movement of the pear in the sense that if the bowl moves, the pear moves together with it (Coventry & Garrod, 2004). Similarly a book can be said to be on the table even if it lies on top of a pile of books placed on the table. Although the book is not contiguous with the table, the latter still functionally controls the position of the former (Coventry & Garrod, 2004).

Feist (2000) found that geometry and function affect the spatial terms used to describe spatial scenes involving containment and support, not just in English but also in a variety of languages. Indeed, these two factors play an important role regarding the Mandarin postpositions *li/shang* too. For example, a book can also be said to be on the table in Mandarin, even if it is located on top of a pile of books. However, the relative importance of geometry and function might be different in Mandarin compare to English. For example, in the previous example, if the pear were to be lying on the apples and protruding a little bit above the rim of the bowl, then in Mandarin one could say that the pear is "in" (li) the bowl. Nevertheless, it is doubtful that one would say in Mandarin (unlike in English) that the pear was in the bowl if it were located high atop a pile of apples that were themselves in the bowl.

Compare example (51) *the deep wrinkles in his forehead* with example (6) *the freckles on his face* cited in section 4.3.1. In English, the use of *in* in the former indicates that the wrinkles have penetrated, and thus geometrically included, into the skin, whereas the use of *on* in the latter reflects the conceptualization of the relationship between the freckles and the skin as resembling the relationship of contiguity and support. Unlike in

English, however, in Mandarin both examples would be expressed by *shang,* indicating

that the two relationships are similar for Mandarin speakers and that the penetration of

the wrinkles into the skin does not trigger a different conceptualization. The stricter

extent of the geometrical inclusion required for *li* is more evident in the following

examples:

(54) *the cork in the bottle*

    pingzi (bottle) *shang* (on) *de* (poss.) *pingsai* (cork)

(55) *the light bulb in the socket*

    dengtou (socket) *shang* (on) *de* (poss.) *dengpao* (light bulb)

In these two examples, the extent of the geometrical inclusion of the LO in the

RO is limited in the sense that a large portion of the LO is actually outside the boundary

of the RO and can be seen from the outside. For these situations, *shang* is used. Again,

the use of *li* would mean that the cork or the bulb is fully included in the interior of the

bottle or the socket. Despite the limited geometrical inclusion of the LO in the RO, *in* is

used in English for these situations. The reason is that the RO controls the movement of

LO which, as mentioned previously, is one of the important properties of the semantic

meaning of *in*. In contrast, the functional control of the RO on the LO did not trigger the

use of *li* in Mandarin.

Together, the above discussion and findings regarding the Use type 2 seem to

indicate that geometry is weighted more than function for the use of Mandarin *li*, whereas

function is weighted more than geometry for English *in.* Mandarin *li* perhaps is closer in meaning to the English preposition *inside* than to *in.*

Note that when the RO is a quantity of substance, such as liquid, or an unbounded region such as air or the universe, then the word *li* can be used in Mandarin.

(56) *fish in the water*

    shui (water) *li* (in) *de* (poss.) *yu* (fish)

(57) *the sugar in the coffee*

    kafei (coffee) *li* (in) *de* (poss.) *tang* (sugar)

(58) *the meat in the soup*

    tang (soup) *li* (in) *de* (poss.) *rou* (meat)

(59) *bird in the air*

    kong (air) *zhong* (in) *de* (poss.) *niao* (bird)

It seems that this type of embeddedness is not conceptualized by Mandarin speakers as being the same as when the RO is solid. In addition, when the LO has a quality of unboundedness, in Mandarin the postposition *zhong* is more often used than *li* [7](Xing, 1996*),* as in (59).

Use type 3: LO is part of a single object

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[7] The postposition zhong is not part of the focus in this paper. See Xing (1996) for the discussion of the difference between *li* and *zhong.*

(60) *the muscles in his legs*

      ta (his) *tui* (legs) *shang* (on) *de* (poss.) *jirou* (muscles)

(61) *the curve in the road*

      lu (road) *shang* (on) *de* (poss.) *guaiwaner* (curve)

(62) *points in the line*

      xian (line) *shang* (on) *de* (poss.) *dian* (points)

(63) *knot in the rope*

      shengzi (rope) *shang* (on) *de* (poss.) *jie* (knot)

The preposition *in* is used in English for this use type, just as it is for the similar use type 2 of section 4.4.1 where the RO is part of a group of objects. In Mandarin, although *li* can be used when the RO is a group of objects, *shang* must be used when the RO is a single object. The part-whole relationship perhaps is not a focus for Mandarin speakers in the same way it is for English speakers. All the examples in this use type reflect the contiguity relationship, as in use type 2 of section 4.4.1. For (60), although the muscle is physically embedded in the leg, it nevertheless is treated by Mandarin speakers as though it can be seen from the outside. In (62) and (63), the ROs are considered as one-dimensional objects. It is not very common to use *in* with one-dimensional objects in English (Herskovits, 1986). In Mandarin, *li* cannot be used with one-dimensional objects at all, and only *zhong* can be used with them occasionally. For example *Sheng* (rope)

zhong (in) *zha* (tie) *zhe* (particle) *yi* (one*) kuai* (quantifier) *hong* (red) *bu* (cloth) (*There is a piece of red cloth tied in the middle of the rope*) (Yang, 2007). Compare the frequency of terms used in (62) and (63). For (62): (Mandarin) shang = 24, zhong = 1, li=0; (English) *on* = 21, *in* = 4. For (63): (Mandarin) *shang* = 25, *zhong* = 0, li = 0; (English) *in* = 22, *on* = 2, *in the middle of* = 1. The use of *zhong* in the combination of "*sheng (rope) zhong (li)*" is not fully comparable to the use of *in*. *Zhong* is more focused on the sense of "in the middle" (Yang, 2007) than is *in*. In other words, the mental image upon hearing the former sentence in Mandarin is that the red cloth is located near the middle of the rope. This is in contrast to the translation equivalent in English which involves the preposition *in*, whose mental image is not necessarily focused on the middle of the rope.

Use type 4: LO in a flat area

In this use type, English and Mandarin can overlap in the use of locatives when the ROs are geometrical objects that have clear boundaries, such as in the following example:

(64) *the circle in the rectangle*

changfangxing (rectangle) *li* (in) *de* (poss.) *yuanquan* (circle)

However, English and Mandarin may not fully overlap when the RO is a clearly delineated flat area, as can be seen in example (65).

(65) *the man in the picture*

zhaopian (picture) *li* (in)/*shang* (on)/ *de* (poss.) *nanren* (man)

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In (65), the active zone involved is the content—the image representation of the picture, which requires the use of *in* in English. The use of *on* would activate the other zone which is the surface of the picture, for example *a stain on the picture*. In Mandarin, both *li* and *shang* can be used when the active zone is the content of the picture. Furthermore, *shang* is also used when the active zone is the surface of the picture. It is worth noting that just like in English, one can only say *jingzi* (mirror) *li* (in) (*in the mirror*) in Mandarin, perhaps because of the more vivid representation of the reflected reality in the mirror. Here, the function of the man-made object affects the choice of the spatial terms in both English and Mandarin.

Another factor that seems to influence English and Mandarin in the use of presentations with flat objects is the conventional conceptualization of objects. For example, in English "plate" is usually combined with *on* (*on the plate*), whereas Mandarin uses *li* (*panzi* (plate) *li* [*on the plate*]). The typical function of a plate may be conceptualized by English speakers as different from that of a bowl. Although both bowl and plate exist in the Chinese culture and are also named differently, the function of a plate and a bowl seem to be considered as the same by Mandarin speakers as evidenced by the use of *li* with both objects.

When the RO is a flat geographical surface that does not have clear boundaries, *in* can still be used in English. The preposition *on* may also be used depending on the specific name and type of geographical areas. Herskovits (p.147) provided a list of geographical locations that can be combined with both *in* and *on* (e.g. island, peninsula, land, continent, plain, prairie, pasture, estate) and those that can be combined only with

on (e.g. shore, beach, coast, promontory, cape, earth, ranch, farm, campus, mountain (in the singular only), any landing or playing field, floor, and block). Herskovits further stated that this choice of *in* or *on* depends on linguistic conventions. However, the author also seems to think that the use of *in* implies that the RO is bounded, at least mentally, by stating that when *in* is used with a piece of surface, the surface has to be a subdivision of an area, so that the contrast can be made of the inclusion of one region versus the other.

In Mandarin, only few geographical areas can be used with *li*, e.g. bay, campus, farm, field, desert and lake. Among them, the last three objects can also be used with *shang*. Most other flat geographical areas are limited to use with *shang* in Mandarin, e.g. meadow, prairie, island, peninsula, land, continent, plain, prairie, pasture and etc. Furthermore, some geographical areas indicating locations by themselves should not or may not be used with *li* or *shang*. They are proper nouns that are expressed by so called inherent place words (Qu, 1999), such as Beijing or Canada, and are not to be used with either *in* nor *on* but with *zai,* which just indicates the general location. In addition, objects that indicate locations by themselves expressed by so called optional place words such as garden, restaurant or company, have the option to be combined with *li/shang* or not (Qu, 1999). It seems that while referring to geographical areas, *in* in English has much wider application than *li* in Mandarin. The reason for this difference might be complicated. First, in contrast to English, Mandarin seems to require a more or less clear perceivable boundary for flat areas that is conceptualized as having an interior, e.g., bay or lake. The previously discussed finding that geometry is weighted more than function for the semantic meaning of Mandarin *li* than for English *in* provides support for this claim. Some geographical areas may have some kind of boundary, but it may not be salient

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enough for the person who is located on it (Zublin & Svorou, 1984). In a number of such cases, Mandarin speakers use *shang* or *zai*, whereas English may use *in*, for example:

(66) *in Beijing*

   zai (at) *Beijing*

(67) *in Germany*

   zai (at) *deguo* (Germany)

(68) *rabbits in the prairie*

   caoyuan (prairie) *shang* (on) *de* (poss.) *tuzi* (rabbits)

Second, historical reasons may account for some differences. For example, one often says "*zoulang* (hallway) *shang* (on)" in Mandarin, although hallway often has a well delineated three-dimensional interior. The search in the corpus of old Chinese language (CCL Corpus) for the word "*lang* (porch)", which is closely related to "*zoulang*" in both semantics and form, revealed that "*lang*" is often combined with the postposition *shang*. This is very likely due to the fact that in ancient China, "lang" was often built without roofs. This use then has become conventional and has been imposed on to the related word "zoulang".

Third, English and Mandarin may differ in how they refer to the "functional relation" between a person and an institution.

(69) *the man in jail*

zuo (sit) *lao* (jail) *de* (poss.) *nanren* (man)

In example (69), the combination of *in + jail* without articles indicates that the man must be a prisoner (in contrast with *the man in the jail*). Similar examples are *in school*, *in the hospital* (with the article "the" in this case), etc. The subject of the former must be students (not the teachers) and of the latter must be patients (not the doctors). In Mandarin, this meaning has to be expressed by verb phrase, such as *zuo* (sit) *lao* (prison). However, it is worth noting that the functional relation between RO and LO may equally affect both Mandarin and English. In an example like *There are a lot of women working at the factory*, the phrase *at the factory* may not only refer to the building itself, but to the institution, i.e. The women may be on vacation but not actually inside the factory at the moment. Similarly, for this meaning, in Mandarin the postpositions *li* or *shang* whose focus is on the more specific spatial location is usually not used, instead, only the word "zai' is used: *Henduo* (a lot of) *funü* (women) *zai* (at) *zhe* (this) *jia* (quantifier) *gongchang* (factory) *gongzuo* (work).

Fourth, some differences between English and Mandarin seem to lie in the conventional conceptualization of the geographical regions or institutions in each culture. For example, *on* is used with "campus" and "farm" in English, whereas *li* is used in Mandarin with these objects.

4.5 Semantic and conceptual factors responsible for the differences

In general, English and Mandarin differ in the range of the uses of the topological spatial meaning of *in/on* and *li/shang*. As reported above, it was found that English and Mandarin correspond in some of the use types, including the prototypical uses of *in/on* and *li/shang*. However, it was also found that while most use types involving English *on* correspond to Mandarin *shang*, many use types involving English *in* are also covered by *shang* in Mandarin. Consequently, the range of the uses of *shang* is wider than of *on* and, on the other hand, the range of the uses of *li* is narrower than of *in*. It seems that the differences in the cut-off points between English *in/on* and Mandarin *li/shang* can be attributed to both semantic and conceptual factors.

Semantically, English and Mandarin may differ in the relative importance of geometry and function for the semantic meaning of *in* and *li*. As discussed previously, geometry seems to be weighted more than function for Mandarin *in* than English *li*. This explains why *shang,* instead of *li* is used in Mandarin to refer to particular situations when geometrical inclusions actually occur, such as use type 2 of section 4.2. Another possible reason that is responsible for the difference in the spatial specificity is the different extent of the cognitive focus that is being put on the RO and LO between English and Mandarin. English and Mandarin differ in the order of encoding RO and LO. As discussed previously, in Mandarin the RO is often placed before the LO, whereas, in English the RO is always placed after the LO. Xu (2004), in a comparative study of

Mandarin and Russian, argued that Mandarin also tends to cognitively focus more on the RO than on the interaction between RO and LO. The author further argued that as a result, the Mandarin postposition *shang* is used for a wide variety of situations. This is because the specific location of the LO in relation to the RO — for example, the interior of the RO or the surface of the RO — may not have as much influence as English does, on the choice of the postpositions to be used.

Other than semantic factors, conceptual factors also seem to play a role. It was noted earlier that when the RO does not have a clear boundary there is a stronger tendency for English speakers to create mental boundaries for the RO through geometrical imagination than do Mandarin speakers (as can be seen in use type 1 and 4 of section 4.4.2), and the language affords the possibility of doing this. In addition, even in cases where vague boundaries can be created mentally by Mandarin speakers, it often happens that the alternative conceptualization reflected by the use of *shang* can also be used and in many cases this latter conceptualization exceeds the former. In contrast to English, Herskovits (1986) stated that when both containment and contiguity/support are present in English, the former usually takes precedence over the latter (Of course, this trend does not apply to all the situations, for example, *the food on the plate*. It was also found that English and Mandarin differ in the construals they support of particular objects. For examples, plate is conceptualized by Mandarin speakers as an object that contains the food, whereas it is conceptualized by English speakers as a supporting surface. Nevertheless, it is worth noting that some of the conventional differences might be traced back to the historical reasons. As discussed previously, some of the uses of spatial terms

may be shaped by historical forces and have since become fixed and imposed onto new subjects (Talmy, 1983).

4.6 The relevance of the findings to existing crosslinguistic data

As noted earlier, wide crosslinguistic variations in the linguistic encodings of the topological concepts of containment and support have been documented in the literature. Meanwhile, semantic and conceptual universals at a more abstract level have also been reported. How do the findings of this study fit into this larger picture?

First, if we set English as a basis for comparison, it was found that some languages have stricter criteria for determining what may constitute an interior, and others have looser criteria. Cienki (1989) conducted a contrastive study of the semantics of *in/on* and their translation equivalents in Polish (*w/na*) and Russian (*v/na*). It was found that *in* is used in English with a broader range of two-dimensional ROs than is *w* in Polish. Moreover, Russian *v* seems to fall between these two extremes. Unlike Mandarin, however, Polish and Russian use the same criteria for determining what constitutes an interior with a non two-dimensional RO, as English does. For example, bird/tree, nail/board, muscles/leg can all be expressed in terms of the containment relationship. In French, the boundary of a region can even be reduced to a point, as in *l'insecte dans les pincettes* (the insect gripped by the tweezers) (Hottenroth, 1993). In general, the image schema of containers is fundamental to human cognition of space and is extended to other domains (Lakoff, 1987). However, what may be expressed as performing the containing

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function crosslinguistically can be thought of as constituting a continuum on which different languages lie on different places depending on the extent to which they require speakers to conceptualize "containers" through cognitive principles like geometrical imagination, mental completion of boundaries, etc. Feist (2008) in her paper found that geometry and qualitative physics constrain the meaning of spatial terms crosslinguistically. Furthermore, these two factors were found to be varied on gradable dimensions, based on the extent of the vertical position of the LO and the extent of the locational control exerted by the RO. The notion of gradable dimensions of variation discussed in Feist's paper is related to the continuum idea proposed in this paper. However, the generalizability of this continuum idea to a much larger sample of languages merits further investigation.

Second, it is interesting to consider what might be the status of *shang* in terms of its spatial specificity among other crosslinguistic terms. Feist (2000), in a study involving 16 languages from 12 language families, examined the meaning of spatial terms that express the topological relationship of containment and support. She found there were two types of terms. The meaning of the first type follows this general pattern, i.e., "if situations involving either the presence of contact (including inclusion) or a difference in vertical position between the two entities are included in the range of application of a term, the term will communicate information about at least one of these attribute values. Further, such terms are more likely to communicate information about only one of these than to communicate information about both" (p. 112). In addition, there is another set of terms that do not follow the general pattern and they are called "general location terms" communicating only the fact of location. An exception to these general patterns that

puzzles the author is the Cantonese word *seungbin* (it bears many similarities to Mandarin *shang*). It does not belong to the category of general spatial term, whereas, it does not follow the general pattern of meaning shown by the first type of terms. In other words, the meaning of *seungbin* is not general enough for it to be put in the category of general spatial terms, nor is it specific enough to be put in the other set of terms. It seemed hard to identify what exactly the term expresses. Feist also stated that Bowerman and Pederson (cited in Feist, 2000) in a similar study, also reported the same problem with Mandarin *shang.* There are two possible explanations for this problem. First, as discussed before, the use of *shang* may be restricted in situations where the RO is not in contact with LO. In such cases, the RO is usually restricted to objects like house, head, mountain or river. If for the moment we set aside these expressions, then it would seem that Mandarin *shang* and Cantonese *seunbin* express a permanent attribute, namely "contact". Alternatively, if we accept the above-mentioned restriction, then the non-specific meaning of *shang* and *seungbin* would put them in the middle of the hierarchy that ranges from general to specific spatial terms.

Finally, it was noted previously that the spatial element "attachment" has special status crosslinguistically, i.e. it is often separated from the spatial relationship of support and expressed by separate words in many languages (Levinson & Wilkins, 2006). There also seems to be a continuum reflecting the extent to which this element is conceptualized and encoded. At one end lie Mandarin and English, to which the element of attachment is not distinguished from other types of support. . At the other end is German, in which a separate spatial term *an* is used for instances of support involving attachment, e.g. *the paining on the wall* (Bowerman, 1996a). In between is Polish, in which, *na* (on) is used

just for some cases, and a separate spatial term, *przy*, has to be used elsewhere, e.g., when a handle is attached to a door or a button is attached to a shirt.

The identification of a continuum that reflects the crosslinguistic pattern of the extent to which a particular semantic attribute can be expressed has important potentials to contribute to the "typological prevalence hypothesis" raised by Gentner and Bowerman (2009), which argues that "All else being equal, within a given domain, the more frequently a given way of categorizing is found in the languages of the world, the more natural it is for human cognizers, hence the easier it will be for children to learn" (p.467). The continuum can also reflect which ways of carving up a spatial domain is more frequent crosslinguistically.

4.7 Conclusion

Important similarities and differences between the use of English *in/on* and Mandarin *li/shang* were identified in this study. These differences can be accounted for by both semantic and conceptual factors. Most importantly, the study points out to the possibility of a continuum of spatial conceptualization, on which the differences between languages are reflected by the different places that they occupy on that continuum. The findings have important implications for both the research on semantics of spatial terms and on the conceptual structure of spatial relationships.

Chapter 5.

General Conclusion

The findings in the three studies of this dissertation point to the important role of language in forming specific conceptualizations of the topological relationships of containment and support. The findings have important theoretical, methodological and pedagogical implications.

Theoretically, the finding that English and Mandarin differ in the linguistic categorization and semantic structure of containment and support adds to the existing literature on crosslinguistic differences and is in line with the following claims made in previous research. First, the topological concepts of containment and support are not universal holistic concepts (Levinson, Meira, & The language and cognition group, 2003; Levinson & Wilkins, 2006), but componential concepts consisting of a set of properties (Feist, 2000, 2008; Levinson, Meira, & The language and cognition group, 2003; Levinson & Wilkins, 2006) characterized by family resemblance in the sense proposed by Rosch and Mervis (1975) (Vandeloise, 1991; 1994; 2003). The differences among languages in the categorization of containment and support can be accounted for by the difference in the number and pattern of combination of these properties (Vandeloise, 1994, 2003). Second, variations coexist with similarities across languages. The meaning of spatial terms is built from a universal set of abstract attributes, such as geometry and function. Languages differ in the relative importance of these attributes.

The findings of this dissertation also make their own contribution by emphasizing the importance of construal in driving the different linguistic expressions of containment

and support both across languages and within languages. From the point of view of

cognitive linguistics, the notion of construal plays a central role in human

conceptualization of the world (Croft & Cruse, 2004; Langacker, 1987). A particular

situation can be construed in different ways by the speaker and this is reflected by the

different ways of encoding the linguistic message. For example, the same person can be

seen as either "coming" or "going" to Paris, depending on the vantage point of the

observer (Langacker, 1987). The role of construal for the topological concepts of

containment and support within a language has also been mentioned in the literature. For

examples, the choice between *in the field* and *on the field* is a matter of the speaker's

construal, but not of the denotation of the field (Taylor, 1988). However, the cross-

linguistic differences in the categorization of containment and support have been mainly

analyzed and discussed in terms of their componential attributes. For example, as just

discussed above, Levinson and Wilkins (2006) argued that languages differ by using

different patterns of combination of notions such as contact, containment, vertical

positioning, adhesion, horizontal supporting surface, etc. /Coventry & Garrod, 2004;

Coventry & Guijarro-Fuentes, 2008; Coventry, Guijarro-Fuentes & Valdés, 2011; Feist,

2000). While these claims are certainly true, the three studies reported in this dissertation

revealed that languages can also differ in what is construed as, for example, inclusion.

Languages can differ in the construal of a particular object, as mentioned in the literature

(e.g. Cienki, 1989). For example, plate is a supporting surface for English speakers,

whereas a container for Mandarin speakers. Languages can also differ in the construal of

the nature of the interaction between LO and RO. For example, for Mandarin speakers,

the relationship between hole/wall is construed as a relationship of support, whereas for

English speakers it is a relationship of containment. More interestingly, languages can differ in the type of construal that their speakers generally favor. For example, Mandarin *shang* has much wider application than English *on*. A large number of objects or spatial situations are conceptualized in Mandarin as support, but in English as containment. In addition, even when both *shang* and *li* can be used for a particular spatial situation, *shang* is often used more than *li*.

In addition, the second study with the L2 speakers provided useful data for a less researched area—the conceptual transfer of L1 to L2. It also provided additional accounts regarding the importance of language in forming particular construals of containment and support relationships from the relatively less studied L2 perspective.

Methodologically speaking, comparison of the findings in the first (the empirical study) and the third studies (the descriptive study) indicates that once any interesting patterns are revealed through the TRPS methodology, further descriptive work is needed to identify the true nature of the patterns discovered across languages. This is because the TRPS methodology alone cannot reveal the full range of meanings of particular terms and the specific concepts that they convey, and thus possibly making it difficult to discover the true nature of any linguistic differences observed across languages. In addition, a descriptive contrastive study of the meaning of spatial terms is able to reveal more linguistic instances where spatial terms are used but may be hard to convey through pictures. On the other hand, descriptive studies of the semantics of spatial terms might not lead one to discover important individual differences, as did Study 1 in this dissertation, because descriptive studies are usually based on the assumption that speakers within the same language group all describe a particular spatial relationship the

same way. Furthermore, differences in frequency of use of one term over another in a particular situation is not easily accessible to a researcher's intuition. All this underscores the need for experimental study of these phenomena.

Finally, the findings also have important implications for pedagogy. More and more researchers have recognized the importance of recent findings in cognitive semantics in resolving a question that has long been bothering L2 learners and teachers, namely the difficulty with acquiring prepositions (e.g. Boers & Demecheleer, 1995; Lindstromberg, 1996; Tyler & Evans, 2004). The difficulties people have observed range from literal to metaphorical meanings of prepositions (e.g. Davy, 2000). How can teachers find a better way to teach prepositions? Take the preposition *over*, for example. Tyler and Evans (2004) showed that the multiple senses associated with *over* form a polysemy network that is organized around a central spatial proto-meaning. All additional meanings of *over* are systematically extended from this proto-meaning. They suggest that language teachers can present this semantic network to students to facilitate leaning. However, in practice, there has not been much success in incorporating cognitive linguistics into teaching L2 prepositions (e.g. Matula, 2007), which points to a possible future research area.

The findings of the three studies reported here point to the following possible future directions for research. First, the differences identified between English and Mandarin in the linguistic categorization of containment and support provide interesting new data to experimentally study the intriguing question about the relationship between language and thought, for example, through non-linguistic tasks, such as memory test or through the study of children's L1 development. Second, the studies in this dissertation

did not take the role of verbs into consideration. In fact, the use of *on/in* or *li/shang* may be dependent on the use of verbs. For example, it was found in the second study that speakers from both language groups preferred to use verbs in combination with prepositions/postpositions to describe certain spatial scenes but not others. For example, both English and Mandarin speakers used the verb *hang* or the equivalent Mandarin verb *gua* （挂）to describe the spatial scene of clothes hanging on the cloth line. However, the selection of the particular preposition/postposition to combine with verbs might be different between the two language groups. For the above scene, some English speakers chose to say *hanging from*, whereas, Mandarin speakers still uses the postposition *shang* to combine with the verb *gua*. The nature of such differences should be explored.

All together, the findings in the three studies shed light on both the research on semantics of spatial terms and on the conceptual structure of spatial relationships.

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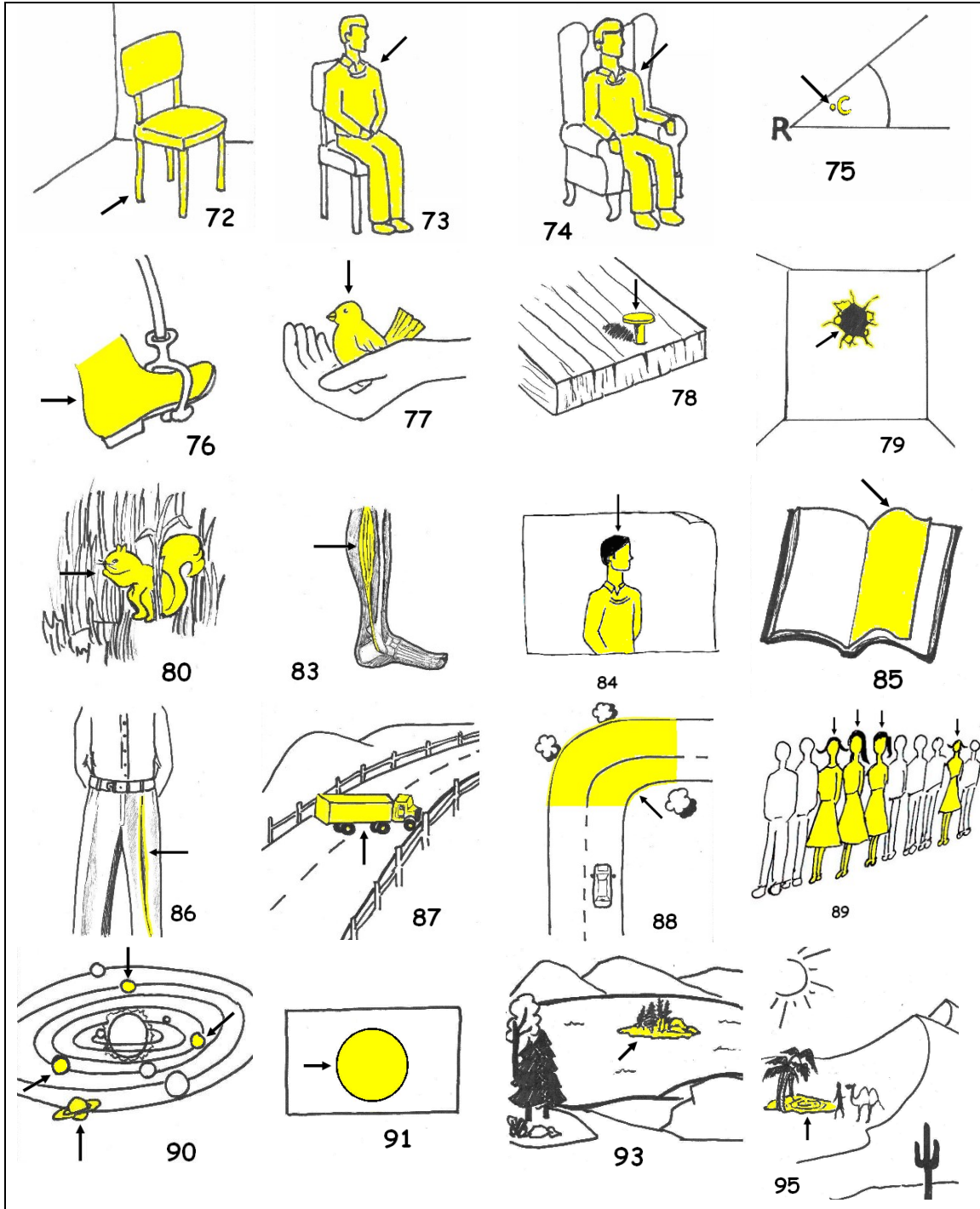
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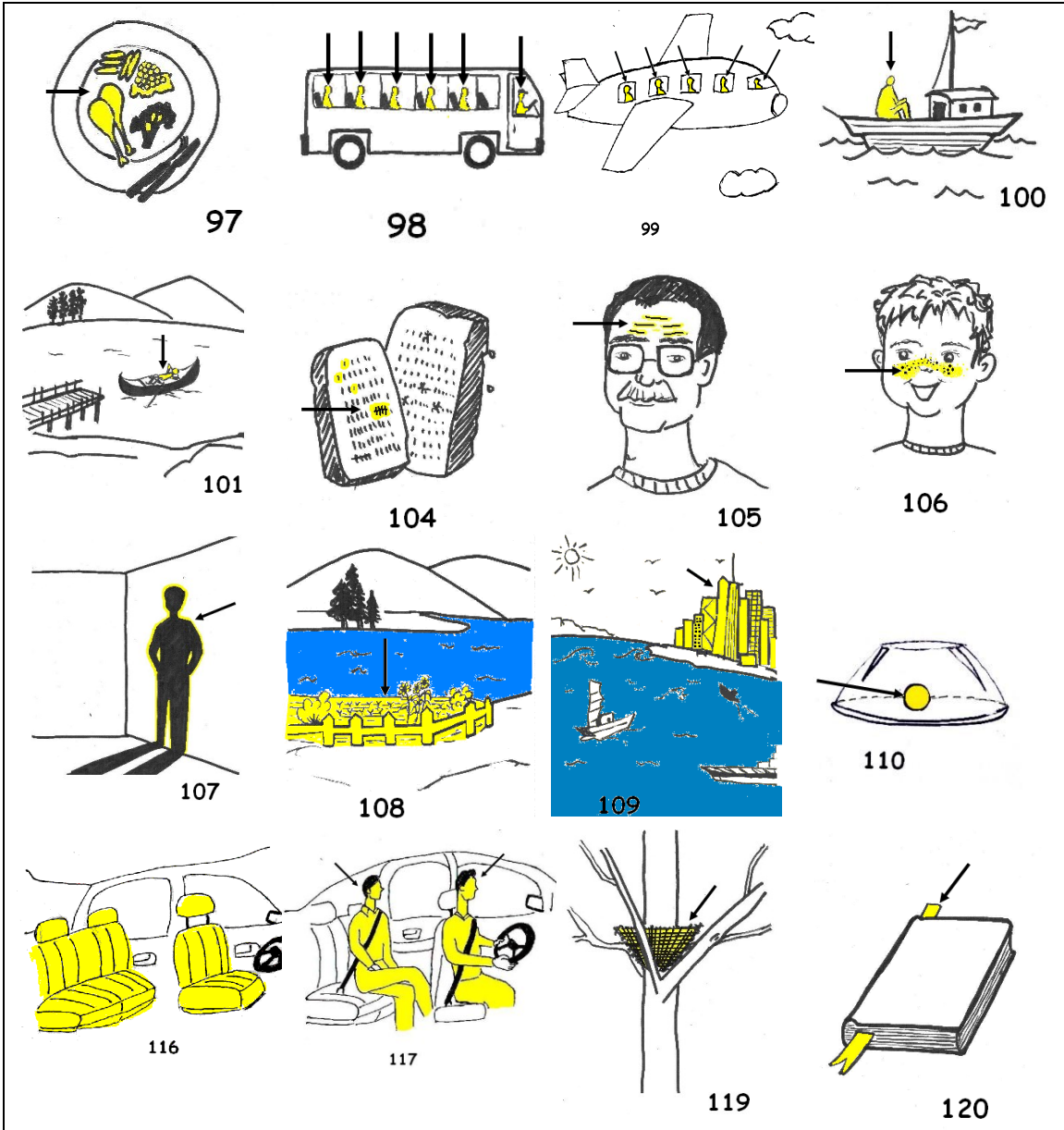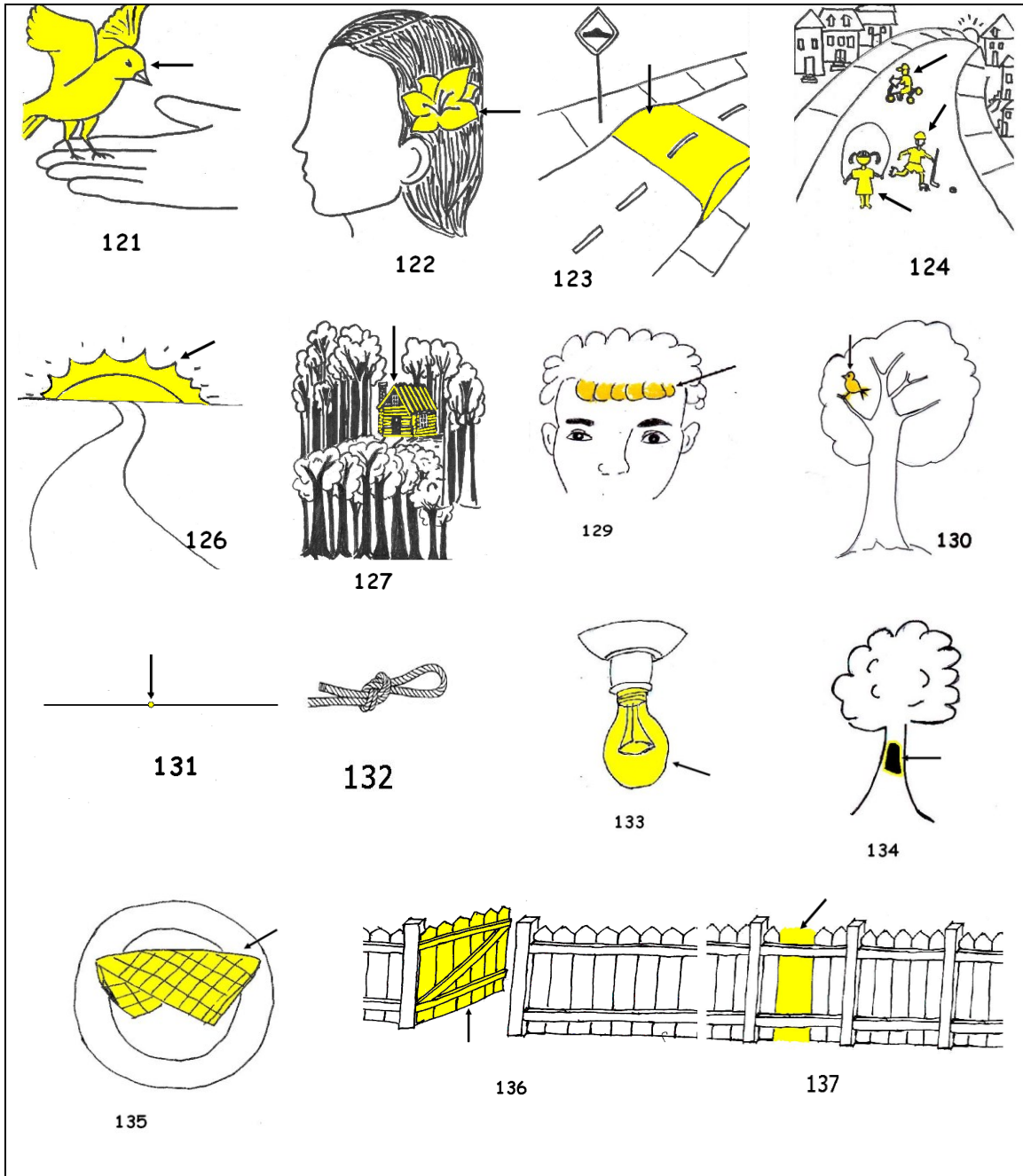
Linguistic Society, 346-358.

Appendices

Appendix 1:

The 51 supplemental elicitation pictures created for use in study 1.

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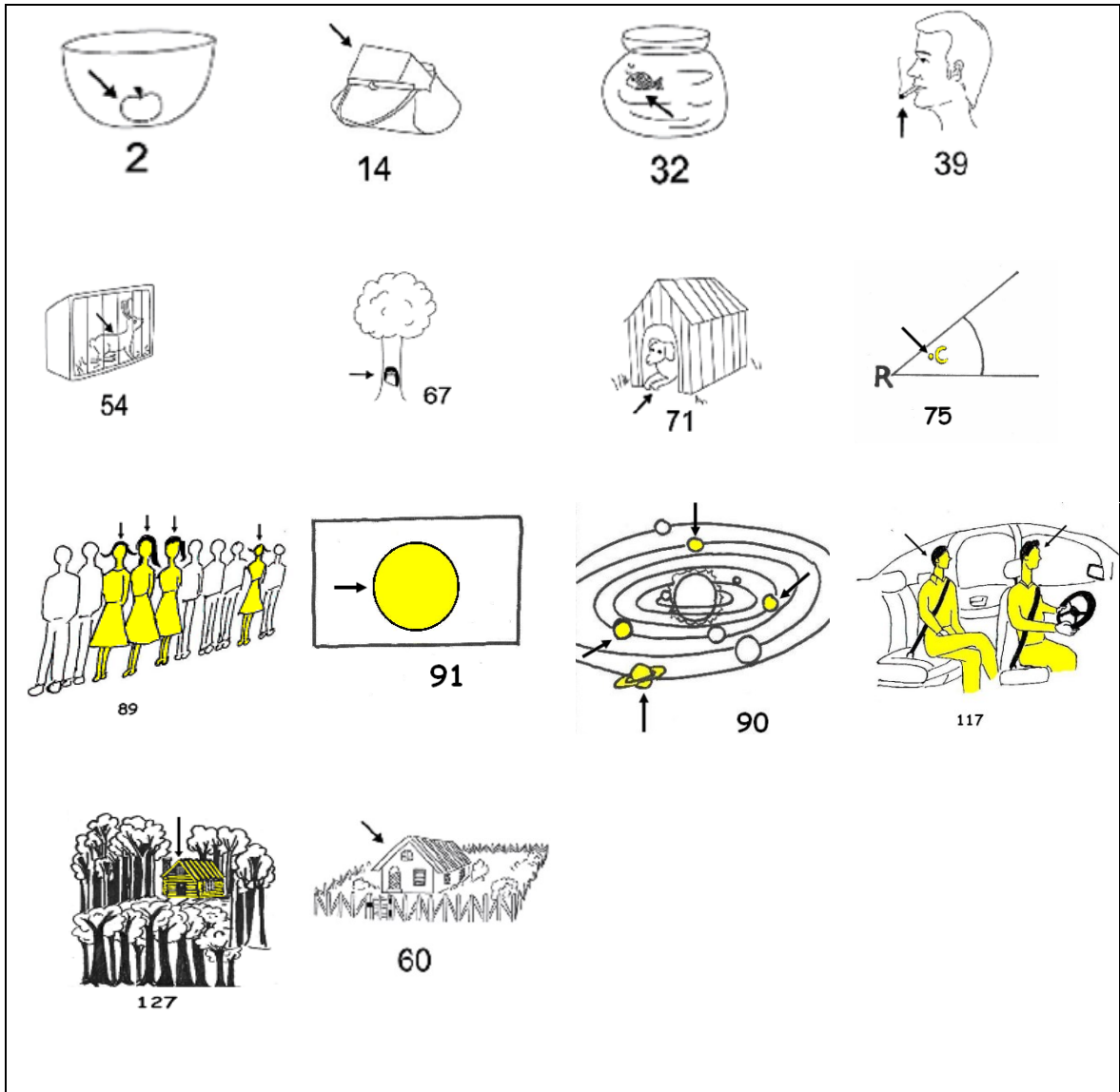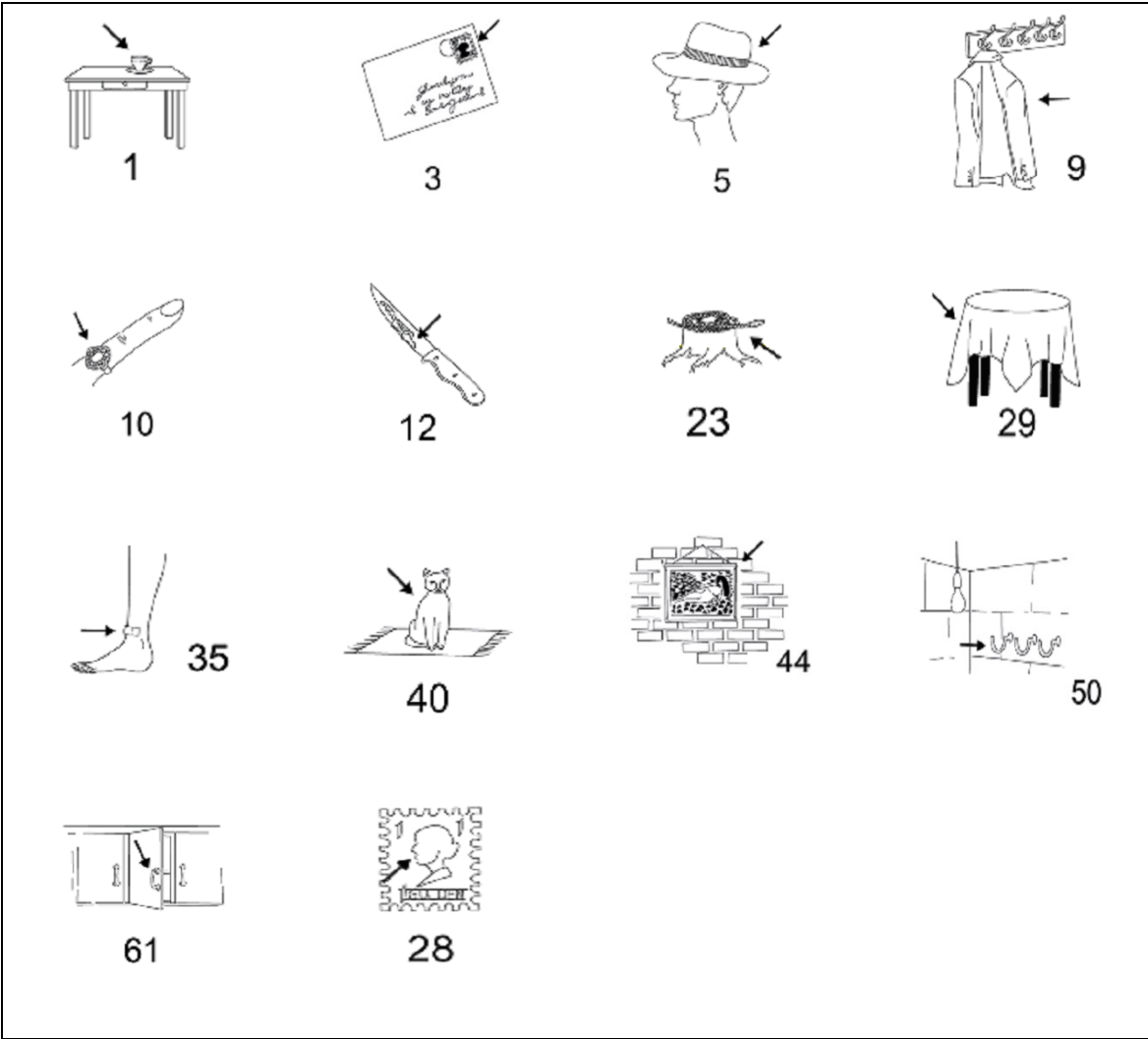
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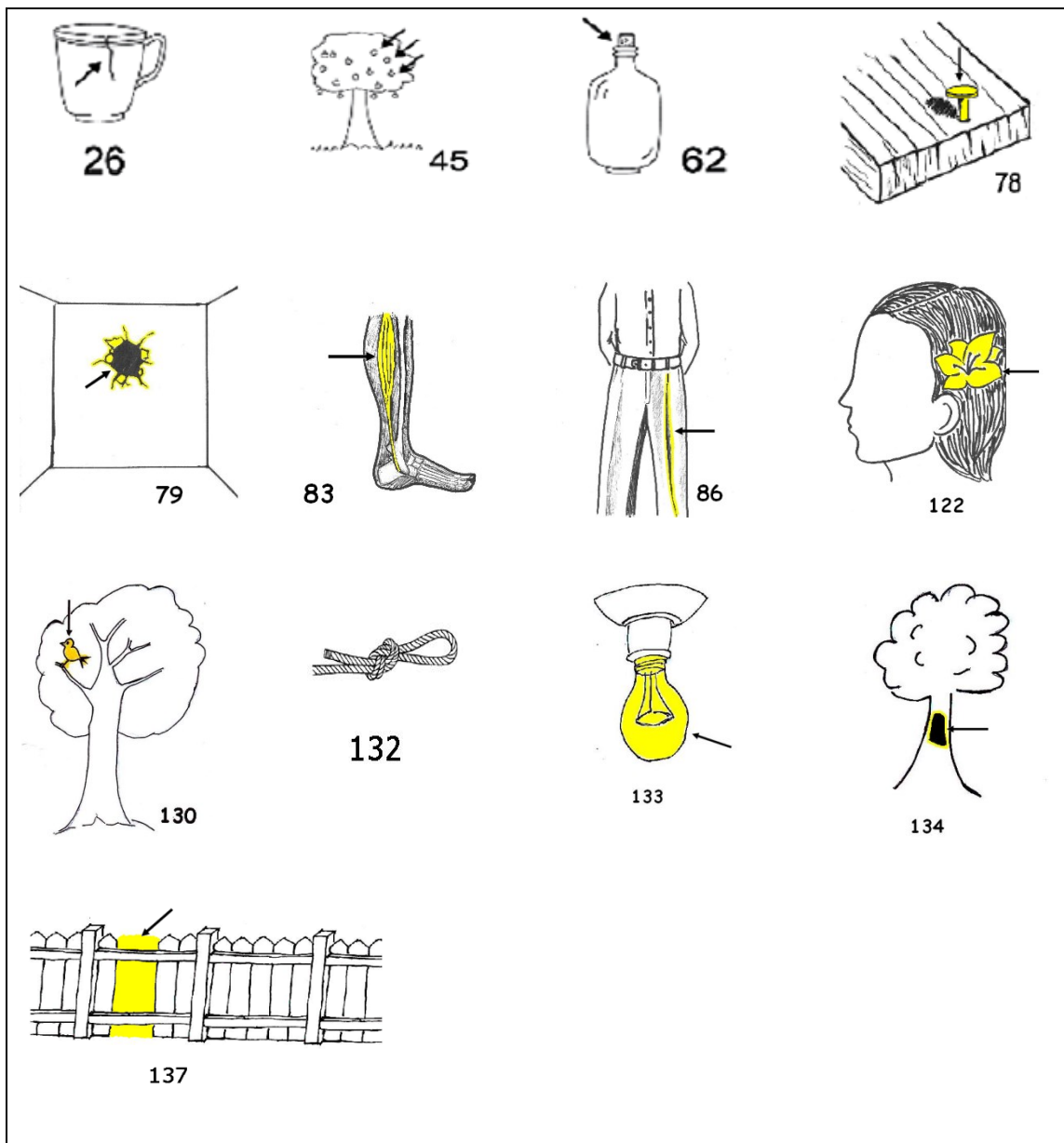
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Appendix 2-1

Congruent IN-IN (from Zhang et al., 2011) pictures used in study 2.

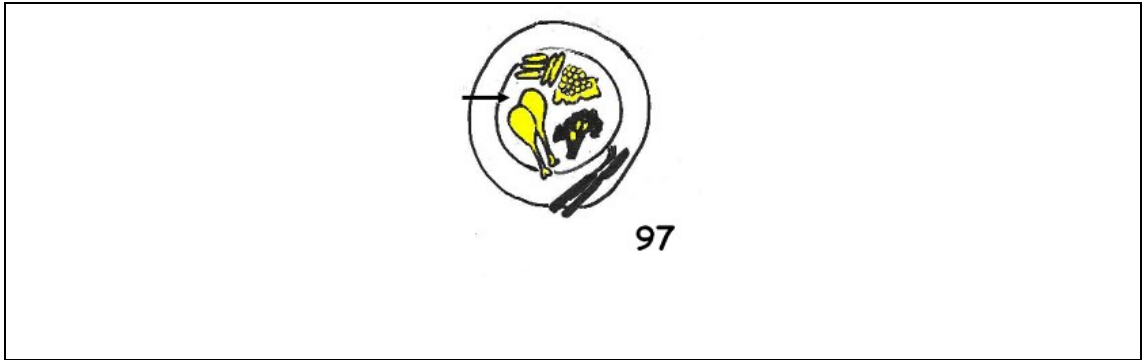Congruent ON-ON (from Zhang et al., 2011) pictures used in study 2.

Non-congruent ON-IN (from Zhang et al., 2011) pictures used in study 2.

Non-congruent IN-ON (from Zhang et al., 2011) picture used in study 2.


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Appendix 2-2: Sample of the picture description task used in Study 2

(the English version)

Name _____   Date _____(dd/mm/yyyy)

For each example, please look at the picture and read the sentence below it. Then circle

one of the underlined words that best completes the sentence describing the picture.

Please note that across all the examples, some of the underlined words may be used more

often than others.

For example, if you saw this picture and sentence, you would circle the word "near".
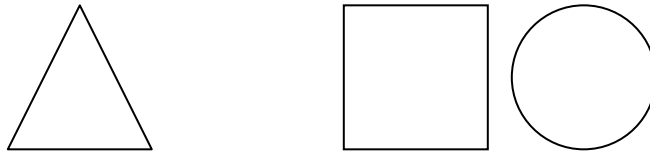
EXAMPLE: The square is (under, in, above, on, near) the circle.

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1. The fish is (<u>under, in, above, on, near</u>) the fishbowl.