EXTENDING THE LANGUAGE OF SPACE INTO ABSTRACT CONTEXTS IN CHILD HUNGARIAN

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ABSTRACT

This dissertation investigates the acquisition of abstract locative expressions (e.g., on Saturday) by child speakers of Hungarian from the perspective of conceptual metaphor theory (e.g., Lakoff & Johnson, 1980, 1999) and usage-based language development (e.g., Tomasello, 2003).

Adult abstract language is often studied from the perspective of conceptual metaphor theory, an approach which claims that people understand and speak about abstract concepts in terms of concrete ones. Given that abstract domains must be organized in terms of concrete ones under this view, we should expect children to extend what they know about concrete space into the abstract domain. Research into child language development, however, suggests that children are able to memorize and use linguistic chunks before they fully understand them. This raises the question of whether children think and speak about abstract concepts from a concrete foundation, or whether they gradually learn the correspondences between abstract and concrete concepts and lexical items as their linguistic knowledge increases.

Five experiments were conducted to investigate whether preschool-aged children apply what they know about concrete locative marking to their production and comprehension of abstract expressions. Experiment 1 asked whether and for how long children would use concrete locative marking more accurately than abstract marking. Experiment 2 investigated the source of a common error with the time marker -kor (at (a time)), asking whether its source was conceptual
or linguistic. Experiments 3 and 4 asked whether children would apply their knowledge of concrete locative systematicity (e.g., that into is the opposite of out of) in novel and unusual domains. Finally, Experiment 5 used a priming task to ask whether children would exhibit a lexical or conceptual connection between the abstract and concrete senses of locative markers.

Taken together, these experiments suggest that there is an essential difference in how children produce and comprehend abstract locatives when compared to adults. It seems likely that children only gradually build relationships between the abstract and concrete senses of locative markers as their semantic knowledge increases. This suggests that in adults, as well, concrete locative systems provide only a secondary means of organization for abstract locative expressions.
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Table of Contents

ABSTRACT .............................................................................................................................................. II IV

ACKNOWLEDGEMENTS ........................................................................................................................ IV

TABLE OF CONTENTS ............................................................................................................................. V

INTRODUCTION ........................................................................................................................................ 1

PART 1: BACKGROUND ........................................................................................................................... 7

1 CONCEPTUAL METAPHOR THEORY ......................................................................................................... 7
  1.1 INTRODUCTION ..................................................................................................................................... 7
  1.2 LAKOVIAN APPROACH TO CONCEPTUAL METAPHORS ......................................................................... 8
      1.2.1 Organizing the abstract in terms of the concrete ................................................................................. 9
      1.2.2 Embodiment and image schemas ........................................................................................................ 13
      1.2.3 The role of conceptual metaphors in language processing .................................................................... 17
      1.2.4 Summary ......................................................................................................................................... 18
  1.3 EVALUATING CONCEPTUAL METAPHOR THEORY .................................................................................. 19
      1.3.1 Methodological interlude ................................................................................................................ 19
      1.3.2 Empirical tests of conceptual metaphor theory ................................................................................ 21
      1.3.3 Summary ......................................................................................................................................... 29
  1.4 ATTRIBUTIVE CATEGORIZATION AND ANALOGY ................................................................................. 30
      1.4.1 Critiques of conceptual metaphor theory ........................................................................................ 30
      1.4.2 Attributive categorization ................................................................................................................. 32
  1.5 CONCLUSION ..................................................................................................................................... 33
5.2 EXPERIMENT 2 .......................................................................................................................... 89
5.2.1 Method ...................................................................................................................................... 91
5.2.2 Results ....................................................................................................................................... 94
5.2.3 Discussion ................................................................................................................................. 96
5.3 CONCLUSION ............................................................................................................................... 96
6 COMPREHENSION TASKS: EXPERIMENTS 3 AND 4 .......................................................... 98
6.1 EXPERIMENT 3 ........................................................................................................................... 99
6.1.1 Method ..................................................................................................................................... 101
6.1.2 Results ..................................................................................................................................... 111
6.1.3 Discussion ............................................................................................................................... 114
6.2 EXPERIMENT 4 ........................................................................................................................... 116
6.2.1 Method ..................................................................................................................................... 118
6.2.2 Results ..................................................................................................................................... 120
6.2.3 Discussion ............................................................................................................................... 121
6.3 CONCLUSION ............................................................................................................................... 122
7 PRIMING TASKS: EXPERIMENT 5 .......................................................................................... 124
7.1 EXPERIMENT 5A ......................................................................................................................... 125
7.1.1 Method .................................................................................................................................... 126
7.1.2 Results .................................................................................................................................... 131
7.1.3 Discussion ............................................................................................................................... 137
7.2 EXPERIMENT 5B ......................................................................................................................... 138
7.2.1 Method .................................................................................................................................... 138
7.2.2 Results .................................................................................................................................... 139
7.2.3 Discussion ............................................................................................................................... 143
7.3 DISCUSSION OF EXPERIMENT 5 ............................................................................................. 143
CONCLUSION ......................................................................................................................................... 175

APPENDICES .......................................................................................................................................... 176

APPENDIX A: STIMULI FOR EXPERIMENT 1........................................................................................................ 176
APPENDIX B: STIMULI FOR EXPERIMENT 2........................................................................................................ 182
APPENDIX C: STIMULI FOR EXPERIMENT 3........................................................................................................ 184
APPENDIX D: STIMULI FOR EXPERIMENT 4........................................................................................................ 189
APPENDIX E: STIMULI FOR EXPERIMENT 5........................................................................................................ 191

REFERENCES ......................................................................................................................................... 195
Introduction

Children typically begin to communicate about intangible concepts, such as beliefs and thoughts, between the third and fourth year of life (Bartsch & Wellman, 1995; Naigles, 2000; Shatz, Wellman, & Silber, 1983). In recent years, increasing numbers of studies have begun to investigate how this process occurs (Gleitman, Cassidy, Nappa, Papafragou, & Trueswell, 2005; Papafragou, Cassidy, & Gleitman, 2007; Snedeker & Gleitman, 2004). Very little research, however, has focused on how children understand and describe relationships within this abstract domain (e.g., believe in X, on Saturday). Abstract locative expressions like these are interesting because they potentially offer a glimpse into how children comprehend, produce, and even conceptualize abstract language. Research in this area might be able to tell us, for example, what on means to a 4-year-old child when she says something like “on Saturday.” Does this child have a sense that the abstract on is the same locative marker that she already uses to describe physical support (e.g., on the table)? Does the acquisition of abstract expressions like these change her understanding of what on means? Could it perhaps even give her the sense that Saturday is an entity which provides support to events like tables do to objects?

With this area for investigation in mind, the present study asked two basic questions for empirical examination: (1) How do preschool-aged children produce and comprehend abstract locative expressions in Hungarian? (2) How do production and comprehension of these expressions change over time? Looking at this empirical study in the context of previous research into adult abstract language and child linguistic development, we further investigated a

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1 Notationally, I will use *italics* when mentioning a word, expression, or affix, “quotes” for utterances and CAPITAL LETTERS for concepts. This latter usage follows the tradition in conceptual metaphor theory (e.g., Lakoff, & Johnson, 1980).
third question: (3) How can understanding the development of abstract locative expressions inform us about the representation and processing of abstract language in both children and adults? In order to make our approach to these questions and the answers we propose clear, the rest of this section will briefly introduce the study of abstract language and the perspective from which we will address it here.

Currently, the state of knowledge regarding the representation and processing of abstract language, both in adults and developmentally, is still rather limited. In adults, much of the research into abstract language has been conducted from the perspective of conceptual metaphor theory (Fauconnier, 1994; Gibbs, 1994; M. Johnson, 1987, 2007; Lakoff, 1987; Lakoff & Johnson, 1980, 1999). This approach argues that abstract concepts are organized by and deeply related to concrete concepts. Hearing or producing the expression *grasp an idea*, for example, is argued to employ the same neural pathways that would be activated by thoughts of literal grasping (Gallese & Lakoff, 2005; M. Johnson, 2007). From this perspective, in other words, there is little cognitive difference between grasping an idea or a cup. This type of embodied relationship between abstract and concrete concepts is thought by some to be pervasive in the linguistic system, even down to the level of grammar (M. Johnson, 2007), making the acquisition of abstract senses of locative markers particularly interesting. Specifically, as will be detailed in Part 1, much of the work in conceptual metaphor theory expects the spatial content of markers such as *in* and *on* to govern their use in abstract contexts in the same way it does in concrete ones.

Looking at abstract language from the perspective of child development, a somewhat different possibility emerges. There are two things to consider here. First, from research in lexical development, it is clear that the development of the lexicon unfolds slowly over the
course of years and that children are able to use vocabulary items, both abstract and concrete, before they understand the nuances of their meanings. For example, children as young as 2 and 3 are able to use abstract terms such as *think* and *know*; however these lexical items are not reliably distinguished from one another in production or comprehension until around age 4 (C. Johnson & Maratsos, 1977). Similarly, a recent study of time words having to do with duration, Shatz, Tare, Nguyen & Young (2010), has found that children’s knowledge of duration terms (e.g., *ten minutes, a long time*) is still incomplete in production and comprehension at age 6. Here again, though, this research suggests that children are able to use such terms before they fully understand the nuances their adult meanings. This type of finding suggests that initial memorization of lexical items, followed by the gradual specification of each lexical entry, is common in the development of the abstract lexicon, and probably vocabulary more generally (e.g., Carey & Bartlett, 1978). A specific sense or context for a word is acquired and then its full meaning is fleshed out over time.

A similar developmental pattern seems to be present in grammatical acquisition. Research into usage-based language development (e.g., Tomasello, 2003) suggests that there is an important role for memorization in early syntactic development. This approach argues that children initially acquire chunks of language from which they extract grammatical structure using general cognitive abilities such as pattern finding and sensitivity to frequency. From this perspective, young children simply learn expressions to enable communication. Over the course of years of exposure, a child’s understanding, use, and even mental representation of grammar becomes more detailed and more readily accessed, leaving adults with a more functional and efficient system than the ones children have.
If we apply these insights from language development research, it seems likely that when children first acquire abstract locative expressions, as well as other abstract expressions, they are memorizing chunks of language as fixed expressions to communicate in specific contexts. As they acquire more and more such chunks, children are gradually able to extract the underlying structure and develop an interconnected semantic map of the relevant areas of language, allowing them to communicate in the more flexible way adults do. This developmental shift means that (1) children and adults might use different strategies when producing and comprehending abstract language and that, (2) adults might have more than one way to process abstract utterances.

Investigating the development of abstract locative expressions, then, might be valuable for two reasons. First, empirical research with adults into conceptual metaphor theory has yielded an unclear picture of the representation and processing of abstract language. Some studies have found apparently clear-cut evidence for a concrete, embodied foundation of abstract language (Glenberg, et al., 2008), while others have found either no relationship between the processing of abstract and concrete expressions (Aziz-Zadeh, Wilson, Rizzolatti, & Iacoboni, 2006) or factors which modulate the relationship (Mashal, Faust, Hendler, & Jung-Beeman, 2007). Developmental research might be able to shed some light on this type of ambiguity. Secondly, conceptual metaphor theory has drawn heavily on research in spatial cognition (Mandler, 2004) and sees spatial concepts such as CONTAINMENT and SUPPORT as being fundamental to the organization of our conceptual systems. For this reason, understanding how the language that describes these relationships develops is important to research in this area.

In order to explore this issue further, we conducted five experiments to determine how children produce and comprehend abstract language and how this changes over time. Each task used abstract expressions involving the nine basic spatial relationships in Hungarian,
CONTAINMENT (*in*), SUPPORT (*on*), and PROXIMITY (*at*), as well as movement to and from these positions. The reason for concentrating on these nine relationships is that they are among the earliest to be acquired in Hungarian as well as cross-linguistically (H. Clark, 1973; Johnston, 1988), and they form the core of the Hungarian spatial case marking system (Kenesei, Vago, & Fenyvesi, 1998). The specific expressions to be examined are abstract in the sense that they deal with intangible concepts, such as mental states (*believe, think*) desires (*want, hope*), emotions (*surprise, fear*) and time (*Saturday, summer*).

Experiment 1 asked if children are more accurate with concrete locative marking than abstract and at what age their performance reaches adult-like levels of accuracy. Experiment 2 investigated the source of a common error found in Experiment 1 with the time marker -kor (at (a time)), asking whether this was a conceptual or a linguistic error. Experiments 3 and 4 asked whether children would apply their knowledge of the systematicity of concrete locative markers (e.g., that *into* is the opposite of *out of*) in novel and unusual domains. Finally, Experiment 5 asked whether there is a lexical and/or conceptual connection between the abstract and concrete senses of locative markers using a priming task. Taken together, these experiments suggest that there is a fundamental difference in how children produce and comprehend abstract locatives when compared to adults. It seems likely that children initially memorize abstract locative expressions and then gradually integrate them into a more richly interconnected semantic network. This suggests that adults can use their knowledge of concrete locative relationships to produce and interpret abstract locative expressions, but this is not required.

This dissertation will be divided into three parts. Part 1 will provide background for the study, arguing that by examining theories of abstract language in adults from the perspective of child development, we can potentially enhance our understanding of abstract language in both
populations. It will discuss literature in conceptual metaphor theory, usage-based language development, and lexical acquisition. Locative marking and its acquisition will also be introduced, both in Hungarian and cross-linguistically. Part 2 will present the empirical study, providing evidence that (1) 4-year-old children do not seem to be producing and comprehending abstract locative expressions in the same systematic way that adults do, (2) this changes across the preschool years, and (3) even in adults, there are important language-internal factors, such as lexical selection and frequency effects, which call into question the essential locative organization of abstract language argued for by Lakoff and his colleagues. Finally, Part 3 will discuss these findings, arguing that in the context of the previous literature, these results suggest that initially memorized abstract expressions are gradually integrated into an increasingly rich and interconnected semantic network, but that, even in adults, this remains a non-obligatory means of organization. For conceptual metaphor theory, this implies that the role played by embodiment and conceptual metaphors in abstract linguistic cognition is limited.
Part 1: Background

This section will provide the background to the experiments to be described in Part 2. First, conceptual metaphor theory as an approach will be described in more detail. Next, the potential contributions of a developmental perspective to understanding the representation and processing of abstract language will be described. Finally, the present study will be introduced. Overall, this section will argue that applying what we know about child language development to theories of abstract language in adults could enhance our understanding of abstract language in both populations.

1 Conceptual Metaphor Theory

1.1 Introduction

The questions addressed by the experiments to be described in Part 2 are founded largely on research in conceptual metaphor theory (Croft & Cruse, 2004; Fauconnier, 1994; Gibbs, 1994; M. Johnson, 1987, 2007; Lakoff, 1987; Lakoff & Johnson, 1980, 1999). The central premise of this approach to the psychology of abstract language is that the mind is embodied, meaning that every aspect of our thought and experience ultimately derives from physical interaction with our environment. For example, in adult language it is well known that abstract relationships are described cross-linguistically using concrete locative markers. For example, we can talk about objects being in a box, people participating in a group, or events happening in a year. From the perspective of conceptual metaphor theory, this is the case because our minds do not distinguish between abstract and concrete CONTAINMENT. Groups contain people in the
same way that boxes contain objects. Lakoff & Johnson (1980, p. 287), for example, claim that when we comprehend or produce the utterance, “Harry is in the Elks,” we are conceptualizing the group *the Elks* as being, in some sense a container, within which Harry is metaphorically encompassed. This happens because, from this point of view, there is actually no other way to understand abstract concepts except through concrete ones. Abstract expressions involving spatial language actually *are* spatial in our minds.

The discussion of conceptual metaphor theory will be organized as follows. First, section 1.2 will introduce the theory and major tenets of conceptual metaphor theory. Next, section 1.3 will look at the theory from an empirical perspective, providing evidence from research with adults both for and against the conceptual metaphor perspective. Section 1.4 will conclude the discussion. The picture that emerges from the data is a rather ambiguous one. On the one hand, there are some intriguing points to be made in favor of embodiment and the conceptual metaphor program, and there is evidence that adult abstract language interpretation can be influenced by physical factors under certain circumstances (e.g., when individuals are asked to interpret sentences in a specific physical context). On the other hand, however, the effects of the concrete on the abstract are context dependent, and there are theoretical reasons to be cautious about assuming an embodied foundation for all language representation and processing. Based on this groundwork, Section 2 will go on to argue that research into the development of abstract language can potentially help to clarify this ambiguity.

### 1.2 Lakovian approach to conceptual metaphors

First, we will describe the Lakovian approach to conceptual metaphors (Croft & Cruse, 2004; Fauconnier, 1994; Gibbs, 1994; M. Johnson, 1987, 2007; Lakoff, 1987; Lakoff & Johnson, 1980, 1999) in more detail. The Lakovian position will be our focus here because Lakoff and
Johnson (1980) were the first to expound this position and theirs is generally considered to be the mainstream view on conceptual metaphor theory (Evans & Green, 2006). There are three main points that should be made regarding this perspective on the psychology of abstract language. First, conceptual metaphors are thought to organize our abstract concepts and language by mapping what we know about the concrete world onto the abstract realm. In this way, the systematicity and structure of any concrete domain is reflected in the corresponding abstract domain. Second, the foundation of our concepts, both abstract and concrete, is argued to be a set of basic, embodied image schemas that provide a bridge between the physical and mental. In other words, there is a direct line between abstract concepts and the body. Finally, because of this embodied connection, the relationship between the abstract and the concrete is seen as being an active, processing relationship that is employed in our on-line interpretation of abstract language.

1.2.1 Organizing the abstract in terms of the concrete

A conceptual metaphor is a mapping between two domains (one abstract and the other concrete), such that the abstract domain is organized in terms of the concrete one (e.g., Evans & Green, 2006). For example, DISEASE IS AN ENEMY. Cancer *invades* a body; patients and doctors work together to *fight* it; the patient may ultimately win or lose the *battle* (e.g., Kövecses, 2000). Talking about diseases as enemies gives the domain of DISEASE a structure.

The reason conceptual metaphors have been proposed has mainly to do with embodiment. Specifically, if the body is our main, or perhaps only, way of understanding the world (M. Johnson, 2007) then abstract language also must trace its meaning back to physical experience. As abstract concepts are, by definition, intangible, their meaning must derive from conceptual metaphors. For instance, when we think about intangible concepts such as LOVE or
LIFE we must do so in terms of more concrete, tangible physical experiences such as JOURNEYS, COMMODITIES, GAMBLING GAMES, and CONTAINERS (Lakoff & Johnson, 1980). Without some connection to physical experience, abstract words can have no meaning. Thus, what we mean when we talk about LOVE or LIFE is intimately bound up in how we understand the tangible concepts we use to define them.

An important derivative of this claim, which should be briefly mentioned, is the notion that the structure of abstract language can inform us about the structure of the underlying concepts. As the cognitive linguists Gibbs & Perlman (2006, p. 214) put it, “in many cases, cognitive linguists assume a direct, or motivated, relationship between systematicity in language with people’s underlying cognitive reality, including their unconscious mental representations and brain structures…” In short, we speak in metaphor because we think in metaphor. An effect of this position is that words and expressions are often thought of as literally representing concepts, and the existence of semantically related groupings of linguistic expressions is often taken as evidence for the underlying conceptual metaphor. In other words, the structure of language is the structure of thought. Kövecses, (2008, p. 132), for example, explicitly claims that the conceptual metaphors of emotion he describes are assumed to be the actual conceptual representations of these emotions. The following conceptual metaphors, for example, are argued to provide the conceptual structure for HAPPINESS (which is a subset of the larger concept EMOTION) (p. 135):

(1) HAPPINESS IS A FLUID IN A CONTAINER She was bursting with joy
HAPPINESS IS HEAT/FIRE Fires of joy were kindled by the birth of her son.
HAPPINESS IS A NATURAL FORCE I was overwhelmed by joy
HAPPINESS IS A PHYSICAL FORCE He was hit by happiness.
HAPPINESS IS A SOCIAL SUPERIOR They live a life ruled by happiness.
HAPPINESS IS AN OPPONENT She was seized by joy.
HAPPINESS IS A CAPTIVE ANIMAL All joy broke loose as they opened presents.
This view, (1) that language can inform us regarding the structure of thought and (2) that linguistic expressions provide evidence for underlying conceptual metaphors, which, in turn, provide the motivation for the linguistic expressions, is somewhat problematic (e.g., Murphy, 1996) and will be discussed in subsequent sections.

A second facet of the conceptual metaphor view that the abstract is structured via the concrete is also reflected in example (1) above, namely, that diverse metaphors can be used to structure the different facets of a given abstract concept (Lakoff & Johnson, 1980, 1999). HAPPINESS is multifaceted and so are the conceptual metaphors that structure it. To give another example (Lakoff & Johnson, 1980, p. 51), LIFE is partially structured using both the LIFE IS A CONTAINER metaphor and the LIFE IS A GAMBLING GAME metaphor, among others. From the former metaphor we get expressions such as: I’ve had a full life; life is empty for him; there’s not much left for him in life; her life is crammed with activities, etc. The latter metaphor can be seen in expressions such as: I’ll take my chances; the odds are against me; I’ve got an ace up my sleeve; he’s holding all the aces; it’s a toss-up; if you play your cards right, you can do it; etc. Each of these conceptual metaphors is argued to describe a different aspect of LIFE. Similarly to Kövecses (2008), Lakoff & Johnson argue that by collecting and dissecting the different conceptual metaphors which structure the way we talk about life, we can gain insight into the nature of the underlying concept. In short, then, conceptual metaphor theory claims that we understand and speak about the abstract world in terms of the concrete, physical world around us. By understanding the metaphorical underpinnings of abstract language, we can also understand how we conceive of the abstract realm.
This relationship between the abstract and the concrete goes beyond specific conceptual metaphors such as LOVE IS A JOURNEY. Lakoff and Johnson (1980, 1999) also argue for what they call primary metaphors. These are the basic mappings from the physical to the mental world which are argued to provide the foundation for conceptual structure as a whole. Some examples are: UP IS GOOD/ DOWN IS BAD, THOUGHTS ARE CONTAINERS, and FUTURE IS FORWARD/ PAST IS BACK. If one knows that a THOUGHT IS A CONTAINER, for example, that means he also knows that the language of containment is relevant to any given type of thought. Such primary relationships do not just hold for certain abstract concepts, but rather, for larger classes or whole domains of concepts. As will be discussed below, these primary metaphors are thought to derive from image schemas (e.g., M. Johnson, 1987; Lakoff, 1987; Mandler, 2004), which pre-linguistically encode the structure of the spatial world in the brain and provide the foundation for all conceptual development. The next section will introduce image schemas in more detail.

Finally, because of primary conceptual metaphors, image schemas, and their foundation in the spatial world (see the next section), spatial language and spatial cognition are central in research into conceptual metaphor theory (e.g., M. Johnson, 2007). Deriving from this privileged place of space in cognition, the last point to be made about the relationship between the abstract and the concrete under conceptual metaphor theory has to do with systematicity. We have seen that the structure of abstract domains is claimed to be derived from the structure of corresponding concrete domains. In the context of primary conceptual metaphors and their reliance on spatial concepts such as CONTAINMENT and UP, this suggests that the structure of space (and by extension, spatial language) should be reflected in the structure of abstract language.
Spatial language, it is well known, employs categorical terms arranged in relationship to one another (up/down, into/out of, left/right, north/south/east/west, front/back, etc.) (e.g., Newcombe & Huttenlocher, 2000). Primary conceptual metaphors imply that this systematic organization of the spatial domain should be reflected in the abstract realm as well. If the MIND IS A CONTAINER, then we should be able to put things into and take things out of it, like we do with any container. As we will see, there is some evidence that this is the case for adults; Experiments 3 and 4 address this issue in child language development.

1.2.2 Embodiment and image schemas

The second important aspect of the conceptual metaphor approach to the psychology of abstract language has to do with the embodiment of cognition and the role of image schemas (Fauconnier, 1994; M. Johnson, 1987; Lakoff, 1987; Langacker, 1987; Mandler, 2004). In essence, these researchers argue that there is a direct line, via image schemas, from abstract concepts to the body. This claim will first be situated historically, as knowing its origins make the nature of the argument more transparent. Then the psychological nature of embodiment and image schemas will be explored in more detail.

1.2.2.1 Embodiment

The historical foundation for the embodiment view of conceptual metaphor theory comes from a critique of theories of the representational mind, especially as exemplified by researchers such as Jerry Fodor. Lakoff (1987) and Johnson (1987, 2007) contrast what they call an “objectivist” view of the mind with their preferred “embodied” one.\(^2\) As Johnson (2007) sees it, for example, from a traditional representational (objectivist) perspective, the mind is understood to be a symbolic logic machine that develops or acquires symbolic representations of objects and

\(^2\) This distinction has been strongly criticized in the philosophical literature. See, for example, Haser (1978; 2005).
ideas in the world, which it then manipulates. These representations are fundamentally depictions of the objects and ideas they stand for; they are about those objects, as opposed to being direct representations of the objects themselves. Thus, thought from the objectivist perspective (as seen by Johnson) is essentially the process of accessing and structuring disembodied symbols based on their semantic properties (using feature lists, semantic networks, etc.), and computing truth conditions to assess the nature of interactions between entities. Implicit in this approach to the mind, Johnson argues, is the notion that the way the mind works is in some way fundamentally dissociated from the physical experience of our bodies move through their environments. Thinking is special.

Lakoff, Johnson and their colleagues, by contrast, argue for an embodied view of cognition whereby human interactions with their environments are stored (in the form of image schemas) and serve as the foundation of our conceptual understanding of the world. Under this view, the human brain does not so much manipulate symbols as it does map out the world around it and use this understanding of the physical world to engage with concepts ranging from physical chairs to seats in parliament. The central premise of the embodiment view, then, is that the human mind understands the world because of the way our bodies physically move through the world. Our experience of the physical world is the fundamental organizing principle of our conceptual minds.

Applied to the psychology of language, Johnson (2007), Lakoff & Gallese (2005) and their colleagues argue that language and cognition are literally embodied – that is, in order to process language and think about the world around us on a day-to-day basis, we are constantly accessing our image-schematic and even sensorimotor representations of space. This is argued to be true for both abstract and concrete language. Some conceptual metaphor theorists make this
claim more strongly than others. Johnson (2007), for example, argues that concepts, both
congept and abstract, are products of our embodied minds. Discussing the UNDERSTANDING
IS GRASPING metaphor, for example, he writes the following (p. 167):

The embodied meaning hypothesis proposes that when we conceptualize acts of understanding
via the UNDERSTANDING IS GRASPING metaphor, we are activating the grasp schema
described by Gallese and Lakoff [2005]. It is this activated schema that permits us to reason
and draw inferences about what it means to understand an idea, sentence, or theory. All of the
internal structure of the grasp schema is made available for making sense of acts of
understanding.

In other words, Johnson argues that when we reason about UNDERSTANDING we are actively
using our knowledge about physical acts, such as GRASPING. Going further, Johnson also
extends this claim to grammar, writing that, “image schemas and conceptual metaphors and
metonymies are not the only embodied structures of abstract thinking. All aspects of grammar –
the binding of form and meaning – and all aspects of logical relations need to be accounted for
through ties to body-based meaning…” (p. 170). Thus, basically every aspect of conceptual and
linguistic structure is argued to be embodied. However, it should be pointed out that not all
conceptual metaphor researchers go to this length. Gibbs and Pearlman (2006), for example are
open to the idea that embodiment might not pervade language so deeply. This will be discussed
in a future section.

1.2.2.2 Image schemas

The way embodiment is argued to translate our physical experience with the world into
organizing structures for thought and language is through image schemas (Fauconnier, 1994;
Gallese & Lakoff, 2005; M. Johnson, 1987; Lakoff, 1987; Langacker, 1987; Mandler, 2004). The
central idea behind image schemas is that they are pre-conceptual structures that emerge from the
way infants physically experience the world – they are essentially stored memories of paths and relationships experienced in the physical environment. Take, for example, the following basic spatial image schemas: CONTAINMENT/CONTAINER, PATH-SOURCE-GOAL, UP-DOWN, FRONT-BACK. The CONTAINMENT image schema represents our understanding that objects can reside within the boundaries of other objects. The PATH-SOURCE-GOAL schema represents our knowledge that people and objects can travel along a path from somewhere to somewhere else. The UP-DOWN and FRONT-BACK schemas store our awareness that objects have inherent spatial orientation. (See Hampe & Grady, 2005, for a more comprehensive list of common image schemas). These very basic physical patterns, then, are thought to underlie the development of thought and language, giving rise to primary conceptual metaphors. Image schemas are our bridge from physical experience to psychological concepts. In this way, all concepts are ultimately embodied.

Although image schemas were originally proposed in the conceptual metaphor literature (M. Johnson, 1987; Lakoff, 1987), they have been grounded from a psychological perspective by Mandler (2004). According to Mandler (p. 86), image schemas are rooted in the infant’s perception of space. In her view, space is fundamental to conceptual development because this is the first type of information about the world available to babies. She argues that during the first few months of life, when infants are first trying to extract meaning from the world around them, their perceptual abilities are limited. Observed movement and spatial orientation are their most reliable cues to what is going on in their environment. Thus, since spatial meaning is likely to be the first type to develop, it provides the foundation for later conceptual development (although the exact way this happens is still not completely clear).
Ultimately, spatial meaning extends all the way to the development of abstract concepts. Connecting the privileged position of spatial cognition to the later development of abstract concepts, Mandler writes (p. 89):

Needless to say, infants in the first year of life have not yet used their conceptions of space to understand highly abstract domains such as marriage or comprehension. In principle, however, they already have the means at their disposal to do as adults do when constructing abstract concepts, namely to use spatial analogies to understand abstract realms…

From this perspective, there is a pre-linguistic conceptual reason to believe that children’s understanding of the abstract world derives from their concrete understanding of the space around them. There is a direct link from the body to the abstract mind.

1.2.3 The role of conceptual metaphors in language processing

This view of embodied language structured via conceptual metaphors and image schemas has an important corollary when thinking about the psychology of abstract language, namely, that the relationship between the abstract and the concrete should be relevant for on-line language processing. This aspect of the theory will be discussed in subsequent sections so will only be briefly introduced here.

The idea that the embodied structure of abstract cognition is the source of how we produce and comprehend abstract language on-line, during our daily conversations has been made explicit in recent research into conceptual metaphor theory. Gallese & Lakoff (2005), for example, present an account of the neuroscience of action concept processing, focusing on concepts such as GRASP and KICK. They provide a detailed account of how such concepts could be processed neurologically, namely by using sensory-motor schemas that are activated by
the actual performance or imagination of these physical actions (via mirror neurons\(^3\)). As they write (p. 456), “Consider a simple sentence, like ‘Harry picked up the glass.’ If you can’t imagine picking up a glass or seeing someone picking up a glass, then you can’t understand that sentence.” Gallese and Lakoff take a similar approach to abstract concepts and language, predicting the following (p. 472), “…the sentence *He grasped the idea* should activate the sensory-motor grasping-related regions of the brain. Similarly, a metaphorical sentence like *They kicked him out of class* should activate the sensory-motor kicking-related regions of the brain.” Thus, they expect abstract concepts to be structured and used in language in the same way action concepts are.

**1.2.4 Summary**

To summarize, mainstream conceptual metaphor theorists take a strong view on embodiment, which claims that there is a direct line connecting (1) abstract language and concepts to (2) concrete language and concepts to (3) image schemas to (4) the physical interaction of a body with its environment. The idea of a conceptual metaphor, a mapping between an abstract domain such as HAPPINESS and a concrete one such as HEAT, derives from this embodied view. Because abstract concepts can only be understood and discussed in terms of concrete domains, the structure of abstract language (in the form of semantic groupings of expressions) is thought to be informative regarding the structure of the underlying concepts. Ultimately, the foundation of our concrete conceptual systems can be traced back to image-schemas which derive from our early physical experiences. In this way, the processing of

\(^3\) Mirror neurons are neurons which fire when an individual performs an action (e.g., grasping, kicking), watches an action being performed, or, hears a description of an action (e.g., Aziz-Zadeh & Damasio, 2008). They will be discussed in more detail in Part 3.
abstract language is also thought to depend on concrete representations. Section 1.3 below will examine the empirical support for these claims, as well as evidence that has challenged them.

1.3 Evaluating conceptual metaphor theory

Looking at conceptual metaphor theory from an empirical perspective, support for this approach to the psychology of abstract language is equivocal. Conceptual metaphor researchers, as we have seen, argue for an embodied view of abstract language in which concrete conceptual domains provide the structure for abstract ones, and embodied cognition is the root of linguistic meaning. As we will see in this section, there is some support for this claim, but also a number of reasons to be cautious. First, we will look the empirical evidence bearing on conceptual metaphor theory, both in favor and opposed. Next, alternative ways of looking at both the theoretical and empirical evidence will be considered. Taken together, the picture that emerges of abstract language in adults is ambiguous.

1.3.1 Methodological interlude

As many of the experiments described here involve psychological methodologies, specifically priming and lexical decision tasks, which may not be familiar to all readers, these will be introduced briefly here. Priming in general refers to the basic finding in psychology that exposure to some particular stimulus will affect how any subsequent stimuli are processed. In other words, if a person has been exposed to a word or concept, he will recognize it more quickly on subsequent exposure. Priming is often measured using a lexical decision task, a term also coined by Meyer & Schvaneveldt (1971). This adaptation of a simple reaction time experiment for language studies asks participants to read (or listen to) words or phrases and determine as quickly and accurately as possible whether the word/phrase was real or nonsensical. The more quickly and accurately a person is able to make this judgment, the faster he was able to access
the relevant concept or word. By measuring the difference in speed/accuracy under different conditions it is possible to infer how given concepts or words are related to one another.

In psycholinguistic research, several different types of priming have been found. Lexical/semantic priming involves exposure to one word affecting how subsequent words are processed. For example, if a person hears the word doctor he will recognize and respond to the word nurse more quickly because they are semantically related (Meyer & Schvaneveldt, 1971). Similarly, if this person hears the word on used in the sentence on the table this might allow him to recognize, or cause him to use, the expression on time more readily than he otherwise might because of the lexical and semantic relationship between these two senses. In this example, lexical and semantic priming might be able to be distinguished by comparing the processing facilitation in semantically related locatives (e.g., in the box vs. on the table) and lexically identical ones (e.g., on the table vs. on the dresser) with the facilitation observed in the abstract and concrete locative examples provided above. In the experiments to be described here, however, it is not possible to distinguish between lexical and semantic facilitation using priming alone. Multiple task types were compared for this purpose.

Structural priming is another common type. In structural priming, participants are more likely to use a particular grammatical construction after hearing that construction used. For example, hearing a purse described as “the purse that is red” as opposed to “the red purse” leads participants to more frequently describe other objects (e.g., a flat football) with subordinate clauses as opposed to pre-nominal adjectives (Branigan, McLean, & Jones, 2005). Finally, in research on conceptual metaphor theory, the notion of conceptual or physical priming is also important. This happens when a person’s choice of linguistic expression or their speed of word recognition is affected by exposure to non-linguistic stimuli (e.g., Boroditsky & Ramscar, 2002).
1.3.2 Empirical tests of conceptual metaphor theory

Turning back to the empirical studies, the evidence that has been used to evaluate conceptual metaphor theory belongs to three broad types: linguistic, psycholinguistic, and neurolinguistic. First, as we have seen, a number of studies employing linguistic taxonomy have investigated the conceptual-metaphoric structure of various domains of abstract language. Zoltán Kövecses, notably, has extensively examined metaphors in the domain of emotion (Kövecses, 1986, 1988, 1990, 2000) and has compiled an impressive taxonomy of conceptual metaphors in many other domains (2002), as well as across cultures (2005). Such studies provide the linguistic basis of proposed conceptual metaphors which serve as the foundation for psycho- and neurolinguistic empirical studies. As our interest here is centrally on the underlying psychology of such metaphors, however, we will not go into detail regarding different proposed conceptual metaphors here.

The other two groups of studies are relevant for our purposes. First, psycholinguistic studies have typically involved priming and aim to investigate whether conceptual metaphors, concrete language, or non-linguistic concrete stimuli (location of testing, sounds, shapes, etc.) affect abstract language processing, thereby suggesting the psychological relevance of these stimuli to abstract language. Second, neurolinguistic studies have generally investigated whether the same brain areas underlie the processing of apparently related abstract and concrete language, or whether brain areas involved in motor control appear to be involved in the processing of abstract language. A representative sample of such studies will be described in what follows, divided by their conclusions regarding conceptual metaphor theory. The picture that emerges from these studies, taken together, is that concrete primes (both linguistic and non-linguistic) do affect the processing of abstract language, but, importantly, the source of this effect is unclear. It
does not seem that concrete representations are necessary for the production and comprehension of abstract language, just that they are available.

1.3.2.1 Studies providing support for conceptual metaphor theory

First, a number of psycholinguistic studies have investigated the relationship between abstract and concrete language and the role of conceptual metaphors in language processing. These experiments have often involved lexical decision tasks following the reading of a passage containing expressions derived from a given conceptual metaphor (e.g., Allbritton, McKoon, & Gerrig, 1995; Gibbs, Bogdonovich, Sykes, & Barr, 1997; Nayak & Gibbs, 1990). Gibbs and colleagues (1997), for example, investigated the effects of conceptual metaphors, such as ANGER IS HEATED FLUID IN A CONTAINER, on on-line processing. Using a lexical decision task, they presented participants with stories about normal activities which ended either in an expression based on the conceptual metaphor, e.g., “he blew his top,” or literal phrases having the same meaning, e.g., “he was angry.” In the lexical decision items that followed, participants who read sentences related to the metaphor were faster to recognize related words, such as heat, than unrelated words, such as lead. There was no difference in response time for the participants who read the literal sentences. Gibbs and colleagues argue that this type of result shows that people can access conceptual metaphors quickly during on-line tasks (because otherwise there should have been no priming effect for apparently unrelated words such as heat). They are quick to point out, though, that such evidence does not necessarily mean that such conceptual metaphors are required for the processing of abstract language, just that there is a conceptual relationship.

Other psycholinguistic research has also provided evidence that non-linguistic stimuli can affect abstract language processing, thereby suggesting a role for embodiment (e.g., Boroditsky
Boroditsky & Ramscar (2002) provide some evidence that the physical context of language processing can affect how ambiguous abstract sentences are interpreted. They found that the ambiguous temporal sentence “Wednesday’s meeting was moved one day forward” was more likely to be interpreted as meaning that the meeting had been moved to Thursday as opposed to Tuesday if the participant was asked to process the sentence while physically moving toward a goal, such as progressing to the end of a lunch line. Moreover, the closer participants were to reaching their goal, the more likely they were to choose the later date (i.e., Thursday). The authors argue that this result suggests an “intimate relationship between abstract thinking and more experience-based forms of knowledge” (p. 188). However, they also argue that their evidence does not support the view that the processing of abstract language is based on the use of actual sensorimotor representations, but rather that it is based on representations of spatial motion that can be functionally separated from these basic motor representations.

Wilson & Gibbs (2007) and Fekete & Babarczy (submitted) both provide evidence that a congruent physical prime (a body movement in the former case, a sound in the latter) can speed processing of metaphorical sentences when compared to an incongruent prime. Fekete & Babarczy, for example, presented participants with sentences describing fictive sounds (e.g., “the press sounded the alarm”) together with either a congruent sound (a gong, following the literal meaning of the Hungarian expression – *the press sounded the alarm gong*), an incongruent sound (a whistle), or no sound. They found that sentence processing (using a lexical-decision-type task)

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4 Under unbiased circumstances, 50% of people typically choose each option (earlier vs. later).
5 The claim that sensorimotor representations should be engaged in abstract language derives from the mirror neuron literature – its proposed role is described clearly by Lakoff & Gallese (2005).
was faster in the congruent condition than in the incongruent or no-sound conditions. Similarly, Wilson & Gibbs (2007) investigated processing of expressions such as “push the argument” after participants made a congruent body movement (pushing), an incongruent movement (chewing), or no movement. They found that participants responded more quickly after performing or imagining a congruent action than after an incongruent or no action. They argue that this result is “consistent with the idea that some aspects of linguistic processing are tied to what the body is doing at any one moment” (p. 729), but they stress that this type of study cannot determine exactly what type of representation is being recruited (sensorimotor or otherwise) or how metaphors are activated during processing.

Finally, Glenberg and colleagues (2008) used transcranial magnetic stimulation (TMS) and electromyography (EMG)\(^6\) to compare motor activity in the hand during the processing of concrete and abstract sentences involving transfer (e.g., “You gave the papers to Marco” vs. “You delegated the task to Anna”). Specifically, TMS was used to stimulate a motor response in the brain, which was then measured in a hand muscles using EMG while reading different types of sentences. They asked whether this motor response would be greater after participants read transfer when compared to non-transfer sentences and whether this would differ depending on whether the transfer context was abstract or concrete. They also applied the TMS during different points in processing, either during the presentation of the verb or after the sentence was complete, because they were interested in whether the motor response would be related to the actual sentence processing or perhaps to motor imagery after the fact. They found that (1) motor responses related to transfer sentences (e.g., “You delegate the responsibilities to Anna”) were greater than those related to non-transfer sentences (e.g., “You discuss the responsibilities with

\(^6\) TMS is a technique which uses magnets to change the flow of electric currents in the brain in order to stimulate neuronal activity in a particular region. EMG is a technique for measuring electrical activity in muscles.
Anna”), (2) responses during the verb were greater than after the sentence, and (3) there was no difference between abstract and concrete sentences. These authors claim that the “simplest explanation of the set of data is that embodied mechanisms, such as using an action schema, are an integral part of the comprehension process” (p. 917).

1.3.2.2 Studies which challenge conceptual metaphor theory

There are also psycho- and neuro-linguistic studies which have failed to find support for conceptual metaphor theory. First, several studies have suggested that abstract language may not share the same neurological bases as concrete language (Aziz-Zadeh, et al., 2006; Kemmerer, 2005), and that there is a neurological difference between how conventional and novel abstract language are processed (Mashal, et al., 2007; Schmidt, DeBuse, & Seger, 2007). Additionally, psycholinguistic studies have (1) questioned the effect of conceptual metaphors on abstract language processing (Glucksberg, Brown, & McGlone, 1993; Glucksberg, McGlone, & Manfredi, 1997; Keysar, Shen, Glucksberg, & Horton, 2000), (2) demonstrated that the effect of concrete language on abstract linguistic processing does not necessarily imply a deeper psychological connection between the two (Kranjec, Cardillo, Schmidt, & Chatterjee, 2010) and (3) suggested the extraction of conceptual metaphors from abstract linguistic expressions may be illusory (Keysar & Bly, 1995).

First, Kemmerer (2005) investigated the use of concrete and abstract locative prepositions by aphasic patients with different types of brain lesions. Using standard tests of semantic production and comprehension of prepositions in locative and temporal contexts (e.g., in a box versus in February), this study found a double dissociation such that some patients showed impairment with the spatial meanings of locative prepositions in English, but not with the temporal meanings of the same prepositions, and vice versa. Especially for the patients who lost
the spatial meanings of their locative prepositions, this finding suggests that there cannot be an obligatory processing relationship between abstract locative markers and the spatial concepts underlying them. Kemmerer argues that space may be useful and even important to our reasoning about time, but that processing of abstract language can occur without traversing the concrete.

Similarly, Aziz-Zadeh and colleagues (2006) used an fMRI study to investigate the involvement of the premotor cortex (associated with mirror neurons) in (1) the visual processing of concrete actions (e.g., watching a video of a hand grasping an object), (2) the auditory processing of literal sentences describing such actions, and (3) the auditory processing of abstract sentences involving the same action (e.g., hearing a sentence involving the expression *grasp an idea*). They found premotor cortical activation in the first two cases, suggesting that mirror neurons are involved in the processing of literal action language. However, they did not find such activation in the third, abstract, case. Thus, Aziz-Zadeh and colleagues conclude that access to sensorimotor representations is not likely to be necessary when processing abstract language under normal circumstances.

Discussing the findings of Aziz-Zadeh and colleagues (2006) in a later review, Aziz-Zadeh & Damasio (2008) suggest that once metaphors are stored in memory, their physical/concrete underpinnings no longer need to be accessed in processing, even though the same metaphors might have been initially processed using embodied representations. Evidence for this claim comes from two neurolinguistic studies which investigated the processing of novel metaphors, Mashal and colleagues (2007) and Schmidt and colleagues (2007). Mashal and colleagues, for example, compared brain activity using fMRI while participants read word pairs that were literal (*water drops*), conventional metaphors (*bright student*), novel/poetic metaphors
(pearl tears) or unrelated (road shift) and made judgments about whether or not the words were metaphorically related. This experiment found greater activation in certain areas of the right hemisphere during the processing of novel metaphors (but not novel unrelated pairs) when compared to conventional metaphors. This result provides support for the view that the right hemisphere is more involved in processing distant semantic relationships while the left hemisphere is more involved in close relationships. For our purposes, however, the important finding of this study is that different brain regions are implicated in abstract linguistic processing according to whether the collocation is novel or conventional. From an embodiment perspective, such differences would not be expected.

An interesting psycholinguistic study involving the influence of concrete language on the interpretation of ambiguous abstract sentences comes from Kranjec and colleagues (2010). They compared participant responses to ambiguous sentences either including or excluding a locative preposition (e.g., “The meeting at noon has been moved forward 2 hours. At what hour is the meeting now that it has been rescheduled?” versus “The noon meeting has been moved forward 2 hours. What hour is the meeting now that it has been rescheduled?”) and asked whether the inclusion of the locative marker would influence participant responses (which are typically evenly balanced between “10 o’clock” and “2 o’clock – McGlone & Harding, 1998), thereby suggesting that the semantics of the locative marker has an effect in the abstract context. This experiment found that participants did respond differently to these questions depending on whether the preposition was included or not, suggesting that locative markers do affect the interpretation of abstract sentences in adults. However, the authors of this paper argue that their study provided no persuasive evidence for an “ontologically deep or psychologically obligatory relation between spatial and temporal representations” (p. 115).
A study that runs counter to the research exemplified by Gibbs and colleagues (1997) comes from Glucksberg and colleagues (1993) (see also Glucksberg, et al., 1997). Glucksberg and colleagues (1993) conducted a reading experiment very similar to the one used by Gibbs and colleagues (based on Nayak & Gibbs, 1990), but instead of presenting the paragraphs all at once, they presented them line-by-line as a timed reading task. They reasoned that if metaphors were automatically activated during the processing of metaphors, then this different method should not affect any subsequent priming. We should still expect to find that words related to conceptual metaphors, such as heat primed by the expression he blew his top via the metaphor ANGER IS HEATED FLUID IN A CONTAINER. On the contrary, Glucksberg and colleagues found no difference in the processing of related and unrelated words using this method. They argue that, rather than being caused by access to conceptual metaphors, the results of Gibbs & Nayak, (1990), and similar studies can be attributed to participants in these studies having enough time to make reasoned judgments.

Finally, research by Keysar & Bly (1995) suggests that the strategy of looking for conceptual metaphoric underpinnings in groups of related abstract expressions may give rise to illusory categories with little psychological reality. Their study looked at participant intuitions about the meanings of out-of-use idioms such as, the goose hangs high and to find an elephant in the moon in different contexts. Each idiom was placed in a text that would tend to either lead readers towards the idiom’s original meaning, the opposite meaning, or an unrelated neutral meaning. In the case of finding an elephant in the moon, for example, paragraphs were constructed that suggested the original meaning, “to make a spurious discovery; an illusion,” or a contradictory meaning, “to point out something that should have been obvious to all” (p. 94). Participants were asked to read the paragraphs, guess what the italicized idiom meant, and then
rate their confidence about their guess on a 15 point scale. After this learning phase, participants were then given the same idioms in a neutral context and asked to say how they thought an uninformed reader would interpret the idiom’s meaning. Participants were significantly biased to claim that uninformed readers would interpret the idioms in the way their own initial paragraphs had suggested. The learned meaning became more transparent to participants and the unlearned meaning became correspondingly less transparent. On the basis of this study, the authors argue that it is important not to underestimate the impact of convention on the perceived transparency of idiom meaning. As Keysar & Bly suggest (p. 104), the idiom *the goose hangs high* might draw on the conceptual metaphor GOOD IS UP, or it might be considered negative based on metonymy (hanging can represent a negative event). Alternatively, as suggested by McGlone (2007), the negative interpretation might derive also from the FAILURE IS DEATH metaphor. In any case, a given conceptual-metaphoric source for a given idiom might be nothing more than an elephant in the moon.

### 1.3.3 Summary

Thus, to summarize, the empirical evidence presented here suggests that conceptual metaphors and concrete context/stimuli can affect how abstract language is processed, but that this connection between the abstract and the concrete is not necessarily activated during normal production and comprehension of abstract language (this point has been raised by several of the authors cited above). Thus, from the standpoint of evaluating conceptual metaphor theory, the evidence for a strongly embodied view of abstract language is weak; the nature of this relationship remains debatable. The next section will present an alternative perspective that might also be able to adequately explain these data.
1.4 Attributive categorization and analogy

An alternative to the conceptual metaphor approach to abstract language in adults derives from our understanding of semantic processing and the interconnectedness of adult semantic and lexical representations. Because of the density of lexical and conceptual networks, conceptual structures of the type described by conceptual metaphor theory and spatial representations might be available during the processing of metaphoric language without requiring that they play a fundamental role in the representation of abstract language (Bortfield & McGlone, 2001; Glucksberg, 2003; Glucksberg & McGlone, 2001; Keysar, et al., 2000; McGlone, 2007; McGlone & Manfredi, 2001; Murphy, 1996). After briefly pointing out some of the critiques that have been levied against conceptual metaphor theory, this section will describe this alternative view in more detail.

1.4.1 Critiques of conceptual metaphor theory

Over the years, a number of researchers have raised concerns regarding conceptual metaphor theory as a model of the psychology of abstract language (Glucksberg & McGlone, 2001; Keysar, 1989; McGlone, 2007; Murphy, 1996). First, along the lines of the Keysar & Bly (1995) study described above, researchers have pointed out that extracting conceptual metaphors from groups of semantically related utterances is likely to give rise to spurious generalizations. Such groupings might simply emerge from structural similarity between domains and/or analogy (McGlone, 2007; Murphy, 1996), rather than having any significant psychological reality. Similarly, Murphy (1996) further points out that using linguistic expressions as evidence of underlying psychological structure, which, in turn, is claimed to be the source of the linguistic expressions is the same circular reasoning that led Whorf to propose so many Inuit words for...
snow (Pullum, 1991). In short, there may be multiple possible psychological explanations for any given linguistic grouping.

Moreover, these researchers also point out that it is impossible for abstract concepts not to have some independent lexical and conceptual structure. As Murphy (1996) asks, if a concept such as IDEA had no structure other than what was provided to it by conceptual metaphors such as IDEAS ARE BUILDINGS, what would prevent us from attributing all the properties of buildings (e.g., sprinkler systems) to ideas? Furthermore, the conceptual metaphor claim that abstract concepts can be organized in terms of multiple domains of concrete language presumably requires the abstract concepts themselves to maintain some type of conceptual structure that is distinct from the source domains it culls properties from. If abstract concepts develop (or initially have) their own lexical and conceptual structure, what prevents them from being accessed directly like any other concept? Why is the active mediation of conceptual metaphors necessary at all?

Several other critiques of this model can be grouped, together with the alternative proposals that have been made, under the heading: there is an easier way to explain the data. Writing about psycholinguistic evidence arguing in favor of conceptual metaphor theory (of the type presented in the previous section), Bortfield & McGlone (2001) present an interesting discussion of what they term availability as opposed to [obligatory] access. They point out that, as conceptual structures, conceptual metaphors would have to be stored in semantic memory in the same way as the concepts and expressions which they purportedly underpin. Representation in semantic memory is what makes a conceptual structure available for use in language processing. However, just because a given conceptual structure is available, doesn’t mean it is necessarily accessed; this depends on factors such as the time allotted to processing.
conceptual metaphor is a type of conceptual structure (and it’s hard to see what else it could be), then there is no reason to think that activating a conceptual metaphor would be easier under normal circumstances than, say, simply activating a metaphoric vehicle (e.g., a rollercoaster ride) and searching for relevant attributes which might usefully be applied to a target such as LOVE (e.g., exciting, dangerous, etc.). Given enough time and motivation, the conceptual structures described by conceptual metaphor theory might be accessed in order to enrich one’s understanding of a given figurative expression, but abstract expressions should be able to be productively interpreted and used without this deeper level of processing.

1.4.2 Attributive categorization

With such critiques in mind, McGlone (1996) prefers an attributive categorization approach to metaphor processing (based on research going back to (Glucksberg, 1991)). This approach argues for a more traditional view of metaphor processing, namely, that people process metaphors by transferring properties from a source domain (e.g., sharks) to a target domain (e.g., lawyers). Since an expression such as *my lawyer is a shark* cannot plausibly be interpreted literally, we look for properties (e.g., viciousness) from the source that might reasonably be applied to the target, using the normally assumed connections between semantic categories in the lexicon. In McGlone’s view, metaphor is still an essential part of thinking about abstract concepts, but its importance does not necessarily mean metaphor processing is underlain by embodied conceptual metaphors.

Expanding on this approach, Bortfield & McGlone (2001) argue that metaphor interpretation might make use of more than one type of processing, depending on the context and the metaphor in question. First, these authors compare the attributional approach above with the domain-mapping view (Gentner & Clement, 1988). From the attributional perspective, as
described above, people process metaphors such as *our love has been a rollercoaster ride* by looking for properties (e.g., excitement, volatility, etc.) which can be usefully transferred from the metaphoric vehicle (rollercoaster ride) to the target (love). The analogical or domain-mapping approach, by contrast, sees metaphor comprehension as mapping semantic roles between domains; so, the lovers in the metaphor above would be the rollercoaster riders, the love would be the car, and so forth. Both of these types of analysis can plausibly proceed without the aid of conceptual metaphors. Next, they employ the psychological finding that people routinely apply previously-successful processing methods to solve new problems (so-called processing sets), to argue that both of these methods of metaphor comprehension might be applied to different types of metaphors or in different processing circumstances (p. 81). For example, the metaphor *marshmallows are clouds* might lend itself to an attributional approach (because of the clear physical similarities) whereas the metaphor *sarcasm is a veil* might prefer analogical processing (where sarcasm plays the role of the veil and the veiled object is whatever is being hidden by the sarcasm). This type of approach allows for flexible metaphor processing making use of generally accepted structural features of lexical and semantic networks.

1.5 Conclusion

To summarize, the picture presented here of the psychology of abstract language in adults is an ambiguous one. On the one hand, researchers in conceptual metaphor theory argue for an embodied view of cognition in which there is a direct line running, via image schemas and conceptual metaphors, from our physical experience of the world to concrete concepts and ultimately abstract language. Evaluating this view empirically, it seems that physical context and concrete stimuli can affect the processing of abstract language in psycholinguistic tasks and that the processing of abstract transfer language might even trigger non-linguistic motor responses.
However, there are also neurological and behavioral differences between how concrete and abstract language are processed, as well as context sensitivity in the relationship between these domains. There are also alternative ways to account for the data which require less proposed cognitive machinery. Thus, the psychology of abstract language remains unclear. Given this state of affairs, it seems possible that research into the development of abstract language might have something to contribute to this discussion. Section 2 will explore this possibility in more detail.
2 A Developmental Perspective

Given the issues that have been raised with regard to the Lakovian perspective on conceptual metaphors and the ambiguous empirical results bearing on this approach, it seems reasonable to wonder if research into language development might have anything to contribute to the investigation into the representation of abstract language. This section will describe research into the basic psychology of language development, specifically lexical acquisition and usage-based grammar, that suggests a common process involving initial memorization, followed by a gradual restructuring of the acquired system as the child’s knowledge increases. In other words, development is often protracted and children are able to use many aspects of language in particular communicative contexts before they understand all the nuances of their meanings. If this approach is applied to the development of abstract language, it seems quite possible that children initially memorize abstract locative expressions, rather than relying on their understanding of the semantics of concrete locatives in their initial forays into this domain. Further, this perspective suggests that only over a relatively extended period of time are children likely to develop a working understanding that abstract language can be structured in terms of the concrete. The relationship we see in adults between the abstract and the concrete may be emergent.

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7 As will be discussed in subsequent sections, researchers into conceptual metaphor theory typically support the usage-based approach to development, and vice versa. The reason for this seems to be that they tend to focus on different areas of language – abstract language in adults versus the early stages of (typically concrete) language development in children. Applying both approaches to the development of abstract language, however, leads to contradictory predictions.

8 The focus here on usage-based language development, opposed to other theoretical perspectives, is due to the basis of this approach in developmental psychology research and methods. Its relative merits as a grammatical theory (compared to linguistic-theoretical alternatives) will not be considered here.
2.1 Gradual development in the lexicon

Lexical development, both abstract and concrete, proceeds gradually. Children first acquire new words and then only slowly determine their full meanings over the course of months or even years. This two-tiered process seems to exist in both the abstract (e.g., Shatz, et al., 2010) and the concrete (e.g., Ameel, Malt, & Storms, 2006; Carey & Bartlett, 1978) lexicon; although the way development proceeds and the reason it is gradual seem to be different in each context.

Four types of lexical development: of object terms, perceivable properties of objects, abstract terms, and figurative expressions, will be briefly described here. In all cases, the pattern of initial memorization followed by a slow fleshing out of the semantics and reorganization of the relevant lexical domain seems to hold.

In the concrete lexicon, the acquisition of both object labels and visible properties (e.g., color) have been studied extensively (e.g., Bloom, 2000). In this domain, the focus has often been on fast-mapping, the child’s ability to rapidly acquire a new word that fills a recognized lexical gap, even after a single exposure. Carey & Bartlett (1978) coined this term to describe children’s acquisition of a new color term, chromium. Their study suggested that even after a single exposure to this new color word, juxtaposed with a known color word, many 4-year-old children could form a new lexical entry for the unknown word and use the word on subsequent exposures. Carey and Bartlett, however, also described a second phase of lexical learning, which has received considerably less attention in the literature. As Carey and Bartlett put it, “the second phase, the long, drawn out mapping, extended over the entire period of several encounters with the word. Even after four months, many children had not progressed beyond their initial partial reorganization of their color lexicons” (p. 18). The existence of this second phase of lexical learning, slow mapping, suggests that children first use new terms based on an incomplete and
holistic understanding on what they mean. Placeholder lexical entries are fleshed out based on subsequent encounters with the words in question.

Similarly, even in the acquisition of concrete object terms, there is evidence that it takes children some time to work out the precise meanings of terms within a given domain (e.g., Ameel, et al., 2006; Andersen, 1975). Ameel and colleagues (2006), for example, looked at how children name cooking vessels (pots, pans, etc.) in Dutch and found that child usage of these terms continues to evolve towards the adult pattern up to age 14. Andersen (1975), similarly, found that children do not divide cups and glasses in the same way adults do until age 12. Thus, even in the case of concrete and tangible objects, it takes children time to fully converge on the adult denotations of these words.

For concrete lexical items, the delay in developing a fully-specified entry for a new word seems to come mainly from the time it takes to work out exactly where the adult boundaries are between related categories (e.g., what exactly differentiates a pan from a skillet). In the abstract lexicon, on the other hand, gradual development is even more pronounced and seems to have a different source. According to Gleitman and colleagues (2005), there are potentially both informational and conceptual issues at work. Informationally, because abstract words refer to intangible categories, children need to be rather sophisticated linguistically in order to learn what an abstract word means. A child cannot understand words like idea or Spring or nation unless someone can explain them to him using language. This linguistic barrier is in addition to any conceptual issues that might arise with intangible concepts such as time or thought. Abstract language, as Gleitman and colleagues put it, is hard.
It is hard, and it’s also slow. As described above, for example, mental content verbs such as *think* and *know* are only reliably distinguished from one another in either production or comprehension about a year after they are first produced (C. Johnson & Maratsos, 1977). The study conducted by Johnson and Maratsos was based on a false belief task where one character in a story moved a hidden object while the other character wasn’t looking. After being presented with the picture story, children were asked comprehension questions about what the different characters *thought* as opposed to what they *knew*. The character who moved the object, for example, *knew* its present location, whereas the other character merely *thought* he knew. The production task involved retelling the story, and the result was that 4 year olds were able to succeed at these tasks, whereas 3 year olds were not. A substantial amount of subsequent research has found that the development of mental state verbs parallels the growing understanding of false belief between 3 and 5 years of age (see Naigles, 2000, for a review).

Other abstract domains, such as number, seem to follow the same course of development. As reviewed by Carey (2004) and Le Corre and Carey (2007), children begin to produce number terms in the context of the count list (i.e., counting from 1 to 10) as early as 2 years of age. After learning this routine, though, it takes more than a year for children to even begin to figure out what these words actually mean. About a year and a half after beginning to count, a child will become what Carey calls a “one-knower.” This child will be able to correctly respond to requests for one of something, but will interpret all the other numbers as meaning simply “more than one.” After another 6 to 12 months, this child becomes a “two-knower,” and then, a couple of months later, a “three-knower,” until the more generalized concept of number develops around the time he learns the meaning of *four* (2 to 2.5 years after learning to count). Based on this extremely extended period of development followed by the rapid acquisition of a NUMBER
concept once the child gets to the point of understanding what *four* means, Carey (2004) argues that this shift represents an important conceptual reorganization for the child.

This pattern of development, in which children seem to initially be communicating with words they don’t yet fully understand can also be seen in later lexical development. In a recent study of time words having to do with duration, Shatz and colleagues (2010), for example, found that children’s knowledge of such terms (e.g., *a few minutes* vs. *a few days*) is still incomplete in production and comprehension at age 6. Similar to findings with mental content verbs and number, duration terms also seem to be used appropriately in production before children fully understand what they mean. Shatz and colleagues conducted production and comprehension (picture-selection) tasks with duration terms. In the comprehension task, for example, children were simultaneously shown pictures of two events (e.g., a baby taking a bath and a family visiting the zoo) and asked to point to the event which takes, in this example, ten minutes. Only children in the older group (mean age 4;11) were reliably different from chance on this task. The production task involved asking preschoolers (aged 3;9 to 5;4) similar questions about duration using question of the “how long…” or the “how much time…” types. The latter question form was used in order to give children a clue regarding the relevant vocabulary domain. Overall, they found that more than 80% of responses in all age groups were about time, and more than 40% of responses were appropriate, that is, included both a quantifier and a duration term (e.g., *a lot of weeks*). However, only 12% of responses were correct, that is, included a reasonable estimate of the time required for the activity (e.g., some amount of minutes for bathing, some amount of years for aging). This result is argued to suggest that children first collect words into a given abstract lexical domain (e.g., *time*) before working out the relationships of words within that domain.
Finally, a corpus study conducted by a cognitive linguist, Rice (2003), found little or no
evidence that children develop their abstract uses of locative markers from concrete uses, but
rather found gradual development based on lexical learning. She investigated the longitudinal
development of nine prepositions (*in, on, at, to, for, from, with, by* and *of*) in transcripts from two
speakers of English available on the CHILDES database (MacWhinney, 2000). As described by
Rice, conceptual metaphor theory views mechanisms such as metaphor, metonymy,
schematization (= grammaticalization) and image-schema transformations as the primary
mechanisms driving the polysemy found in prepositional semantics, both synchronically and
diachronically⁹. In other words, from a conceptual metaphor perspective, in both child and
historical development we should find a trajectory in which the concrete, conceptually basic
senses of the prepositions are primary and serve as the foundation from which other senses are
extended using basic cognitive mechanisms such as metaphor (p. 244). She argues that, rather
than finding this course of development, the developmental data suggest that each child
approached each preposition from favored lexical expressions, which were not always
conceptually basic, and used these initially acquired senses to begin developing a semantic
network for that preposition. This developmental period, again, was rather extended. She argues
that this type of developmental data needs to be incorporated into and accounted for by
conceptual metaphor theory.

Similar to the development of abstract lexical items, the acquisition of figurative
expressions also takes place over the course of years. A number of different types of metaphoric
understanding have been tested across the years. Winner, Rosenstiel & Gardner (1976), for

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⁹ Definitions: *diachronic* vs. *synchronic* = across historical time vs. at the present time. In other words, the meanings
of words may change *diachronically*, but children have to learn them *synchronically*. *Polysemous* vs. *homonymous*
= one word with multiple semantically-related senses vs. multiple unrelated words which happen to sound the same.
For example, the word *bank* (financial institution vs. side of river) is homonymous; the word *bank* used as a verb
(e.g., you can *bank* on it), however, is polysemous with the financial sense of the noun *bank*. 40
example, examined metaphors of the form X is Y (e.g., the prison guard is a hard rock) and found that only between 8 and 10 years of age did children preferentially choose genuine metaphoric interpretations (i.e., that the prison guard was mean and uncaring) as compared with primitive metaphoric ones (i.e., that the prison guard was physically tough and muscular). This type of metaphoric interpretation is particularly difficult in that it requires an active, on-line ability to map between two domains. Looking at less demanding expressions, research in the conceptual metaphor paradigm by Ozcaliskan (2005, 2007) investigated expressions based on metaphorical motion (e.g., time flies by, thoughts pass through one’s mind) in preschool aged children (Turkish and English speakers), and found earlier use and comprehension of metaphoric language.

Ozcaliskan (2005), for example, used two tasks to test Turkish-speaking children’s understanding of metaphorical motion. The children were first told stories including two expressions based on a given conceptual metaphor (e.g., time flies and goes away quickly and hours pass by were used in a single story as instantiations of the metaphor TIME IS A MOVING ENTITY). They were then given a forced-choice comprehension task regarding the reason the event in the story occurred to test their understanding of the metaphor. The stories were designed so that, without the metaphorical expressions, adults chose between the competing explanations at random. This task found that 3 year olds (mean 3;6) performed at chance on this task. Four and 5 year olds (mean 4;5 and 5;5, respectively) were significantly more accurate than the 3 year olds, but significantly different from the adults, who performed with nearly 100% accuracy. This task was supplemented by a semi-structured interview which asked children to justify their choices. Here again, the 3 year olds were not successful at this task, but performance improved
with age. Some degree of metaphor comprehension was present in the 4 year olds and the ability to reason productively about these metaphors was demonstrated by the 5 year olds.

Taken together, the same path of gradual development based on lexical learning and extended subsequent periods of expansion and restructuring appears across the lexicon. In abstract contexts, especially, children seem to initially acquire lexical placeholders which they fill in over the course of months or even years.

2.2 Usage-based grammatical development

2.2.1 Introduction

In the usage-based grammatical development literature (e.g., Goldberg, 2006, 2009; Tomasello, 2003), the same picture of gradual development and production based on incomplete knowledge also appears. Broadly speaking, research in usage-based language development argues that children extract grammatical generalizations and build linguistic systems from chunks of language they’ve acquired for specific communicative purposes. As a result of this learning process, many properties of the adult grammar are argued to be emergent. This approach provides a coherent (if not uncontroversial) proposal for how a complex cognitive system might plausibly develop from its initial to mature stages.

Under a usage-based model, child and adult grammars differ fundamentally from one another because child grammars are still in the process of being constructed from lexical representations. Specifically, because the usage-based learning process involves extracting linguistic generalizations from memorized phrase- and sentence-level chunks, child grammars are substantially more lexically constrained and disjointed than adult ones. Adult grammars revolve around meaningful structural patterns known as constructions or schemas (e.g., Croft,
Schemas can be fully general (like the transitive – *the girl watered the plants*) or tied to particular classes of lexical items (like the middle construction – *that book sells well*). A construction is chosen for use by a speaker because it expresses the appropriate meaning both semantically and pragmatically. Constructions are organized into an integrated network, which includes all lexical and grammatical material, from words up to fully general constructions, arranged according to semantic and grammatical relationships. This network of dense lexical, semantic, and grammatical connections, which is structured along the lines of a standard neural net, takes time to develop and gives rise to emergent categories (e.g., Noun, Verb) as well as relationships between words and constructions (e.g., the semantic relationship within which *needle* might prime recognition of both *thread* and *nurse*), which would not initially exist in the child’s grammar. Children build up such a network of representations over time.

In what follows, the basic usage-based perspective on grammatical development will be briefly described and some recent empirical work supporting this view presented. This sketch will broadly follow the overview presented by Tomasello (2003), which is often cited as the standard account, supplemented and updated with more recent findings where appropriate. Following Tomasello (2003), then, the usage-based perspective sees language acquisition in general as a case of complex skill learning driven by communicative interaction in society. From this perspective, the child starts life with innate social predispositions which drive him to engage and communicate with those around him. Over time, he begins to discriminate and decipher what he hears using pattern-finding abilities (statistical learning, e.g., Saffran, Aslin, & Newport, 1996; Gomez, 2002; Gomez & Maye, 2005), which are constrained by general cognitive mechanisms such as entrenchment, which is the notion that children who have heard a given verb
frequently in one construction are less likely to use that verb in a novel construction without evidence (Braine & Brooks, 1995; Brooks, Tomasello, Lewis, & Dodson, 1999; Theakston, 2004). Initially, this process involves memorizing chunks of language together with basic information about their meaning and use (following the procedure described above for lexical acquisition). As development proceeds, these memorized chunks are deconstructed and the underlying grammatical rules and patterns (constructions) extracted. Thus, for our purposes, the important points to be made regarding this approach are that (1) children are able to use linguistic expressions to communicate in specific contexts before they have a nuanced understanding of their full range of meaning and (2) the adult grammar has properties which emerge from the acquisition process and which are not present in the child grammar.

2.2.2 Communicative intent and statistical learning

Underlying this gradual course of development are two particularly important abilities for language development: an understanding of communicative intent and statistical learning. First, an understanding of communicative intent refers simply to the child’s knowledge that his interlocutor is making noise so he will attend to something. This understanding requires two abilities, both of which seem to be present by 12 months of age: triadic joint attention (i.e., being able to track one’s interlocutor’s attention to oneself as well as to the objects around them (see Butterworth, 2001, for a review)), and a basic understanding of intentionality (i.e., the notion that the behavior of other individuals is goal-directed (e.g., Gergely, Nádasdy, Csibra, & Bíró, 1995)). From an understanding of communicative intent comes the possibility of cultural learning, which happens when children begin to reproduce the intentional actions of adults on outside objects, which can be seen in the typical imitation behaviors of young children (see also: Csibra & Gergely, 2006; Gergely, Egyed, & Király, 2007; Tomasello, 1999). This type of
learning by understanding what another person is trying to do and reproducing that action to achieve the same effect is thought to be crucial to the acquisition of knowledge of the conventional use of tools as well as of linguistic symbols.

Pattern-finding abilities comprise the other biological component which is central to language development from a usage-based view. In terms of pre-linguistic infants, the most important of these is the ability to extract patterns from the speech stream. This ability has been demonstrated to exist in young infants by, for example, Saffran and colleagues (1996) who found that 8-month-olds prefer to listen to familiar syllable patterns as opposed to the same syllables in unfamiliar orders. Subsequently, Marcus, Vijayan, Bandi Rao, & Vishton (1999) tested 7-month-old infants on syllable patterns and found that they preferred to listed to the same pattern even when it included different syllables (e.g., if they were familiarized on wididi, they subsequently preferred to listen to other ABB patterns such as bapopo). It is important to note that these basic pattern-finding abilities cannot be sufficient for language development as they are not specific to humans. Tamarin monkeys have also demonstrated the ability to extract word-like patterns from running speech (Ramus, Hauser, Miller, Morris, & Mehler, 2000).

However, as human children grow older, their pattern-finding abilities become more robust and begin to outstrip the abilities of their non-human cousins. Around 18 months, children can begin to track long-distance dependencies over syntactic distances (Gomez, 2002; Gomez & Maye, 2005). Gomez (2002), for example, reports on a study which familiarized children with strings generated by miniature artificial grammars of the type aXb using the standard looking-paradigm task employed in other statistical learning studies (e.g., Saffran et al., 1996). She found that 18 month old children were able to acquire the relationship between the “a” and “b” items, in spite of the intervening material. Similarly, Gerken, Wilson & Lewis (2005) found that
children at this age are able to use this information to form grammatical categories. English-speaking children in this study were exposed to masculine- and feminine-marked Russian nouns (using two different markers for each gender) to determine if they would be able to distinguish grammatically from ungrammatically marked nouns. Eighteen-month-olds were able to make this distinction in the presence of correlated phonological cues (e.g., palatalization) to category membership. These abilities to track long-distance dependencies and grammatical categories have not been demonstrated in non-human primate species (e.g., Fitch & Hauser, 2004).

2.2.3 Stages of development

In a usage-based account of child language development, then, these general human abilities allow the child to acquire pieces of language, gradually recognize grammatical structure in the input he receives and restructure his own representations accordingly. This course of development can be divided into four basic stages based on the type of utterances the child produces: holophrases, pivot phrases, item-based constructions, and general syntax. At each stage of development, the child is progressively restructuring his understanding of grammar to arrive at more general and productive grammatical representations. The summary of these phases here will, again, broadly follow the overview presented by Tomasello (2003). However, it should also be pointed out that descriptions of these or similar stages can be traced much further back in the developmental literature; they did not originate with the usage-based account (e.g., Braine, 1963, 1976; Bloom, 1973; Brown, 1973). Following this brief overview, additional empirical evidence will be presented to substantiate the claim that children are able to store and use phrase-length pieces of language and explore how they might form generalizations from these acquired chunks.
The first two stages of grammatical development typically last until the child’s second birthday and are not thought to be based on syntax as typically defined for adults. First, beginning between about 9 and 12 months of age, children starts to extract meaningful linguistic symbols from the speech stream around them. When they begin to produce language themselves, it comes in the form of holophrases, which are holistic, linguistically unanalyzed utterances with a single communicative intent. As children at this stage generally use a limited number of holophrases to communicate about a range of topics, they often have somewhat idiosyncratic meanings which can shift over time. For example, during this stage Tomasello’s daughter used the phrase *play-play* first to accompanying her playing the piano, and then to name the object (p. 37). Holophrase use generally continues until about 18 months, and is not believed to be based on any underlying syntax. From this point, the next stage in development is the use of pivot schemas, the child’s first linguistic abstractions. According to Tomasello (p. 114) these are patterns consisting of one stable word or phrase which determines the communicative function of the utterances, combined with a variable slot that can contain other linguistic item(s), for example, *Want X* (e.g., *Want ball, Want milk, Want cookie*). Pivot schemas can be quite productive, even leading to novel utterances; the famous *allgone sticky* (Braine, 1963), for example, could have been produced from a pivot schema *allgone X*, with sticky misconstrued as an object. It is important to note, however, that children at this stage do not generalize across pivot-schemas; each is what Tomasello calls a constructional island (2003, p. 115), which means that pivot schemas do not have syntax. That is, the ordering of constituents is stable, but not meaningful – the child is basically making use of productive lexical patterns.

Syntax in the traditional sense can only be seen with the development of the item-based construction around 24 months of age, the next stage on the road to mature syntactic
Item-based constructions go a step beyond pivot-schemas in that they include things like agreement endings and case marking to indicate the grammatical roles of the lexical items involved. These constructions do have syntax, but they are still based concretely on particular verbs, and children do not seem to generalize existing constructions to new items during this phase. Thus, to take another example from Tomasello’s daughter (p. 117), during the same stage in development she used cut in just one construction cut X (where X is a variable object), while draw was used in several draw X, draw X on Y, draw X for Y, and Y draw on X.

New uses of verbs seemed to be based on previous uses of that verb without generalizations across lexical items. Finally, between about 2;6 and 3 years of age, children begin to develop fully abstract constructions which can be generalized to new verbs in similar syntactic contexts. These new abstract constructions are presumably generalizations based on many dozen item-based constructions, and they initially tend to be found in what Tomasello calls argument-structure constructions, which are used to refer to abstract experiential scenes such as people acting on objects, objects changing state or location, or people experiencing psychological states (p. 144).

Thus, from a usage-based perspective, the child’s grammatical representations are fundamentally restructured over time. He goes, over the course of several years, from using memorized chunks of language with undifferentiated communicative function to being able to apply general syntactic patterns in the same way adults do. Even later in development, it is likely that children continue to fine-tune both their lexical and grammatical representations as they continue to collect input from various domains of language and learn more about how adult speakers use their language. Finally, in the adult grammar as well, the usage-based model expects that the frequent chunks acquired during development continue to comprise part of the
adult’s linguistic representations, and that new frequent expressions can be added to the “constructicon” as lexical chunks. This is argued to facilitate on-line production and comprehension (see also: Pickering & Garrod, 2004).

2.2.4 Recent empirical studies

Finally, in recent years, there have been an increasing number of empirical studies which have sought to test various aspects of the usage based program. For the purposes of this study, the most important evidence is that (1) children can store and use phrase-length utterances and (2) that these stored utterances can form the basis for later syntax, thereby supporting the possibility that adult grammar might show emergent properties that would not be present in the child.

Evidence for point (1) comes from recent studies by Bannard and Matthews (2008) and Arnon and Snider (2010). Bannard and Matthews (2008) present experimental evidence from a repetition experiment suggesting that 2- and 3-year-old children store and use multiword sequences (e.g., cup of tea) in language processing. From a dense corpus (1.7 million words) of maternal speech, Bannard and Matthews extracted high and low frequency multiword utterances. For example, they found that cup of tea was a highly frequent sequence, while cup of milk was significantly less frequent. The pairs of phrases were matched for syntactic structure as well as for the frequency of the nouns; thus, in this example, tea and milk appeared with approximately equal frequency in the corpus. The experimental task asked the children to repeat the expressions in exchange for the preferred compensation of children worldwide, stickers. Responses were coded for accuracy and speed of repetition. On both these measures, children were more successful at repeating frequent expressions as compared with infrequent ones, suggesting that they are able to store and access such multiword expressions as chunks. In a similar study, Arnon
& Snider (2010) looked at adult processing speeds of four word sequences of varying frequencies (e.g., *be able to go* vs. *be able to see*). They found a similar processing advantage for frequent over infrequent sequences, suggesting, as would be expected under a usage-based account, that adults continue to represent and employ frequent phrases as chunks.

Evidence for point (2) is, of necessity, more indirect; it’s difficult to provide more than suggestive evidence for how a child might use memorized chunks of language to create and restructure mental representations over time. Traditionally, the usage-based developmental approach has been supported by collecting evidence that pivot schemas and item-based constructions exist, in that these are the proposed intermediate stages between memorized holophrases and fully productive grammars. Lieven and colleagues (2003), for example, looked at a very dense corpus of daily recordings plus maternal diaries from one 2 year old child’s speech and used this corpus to examine the syntactic variability in the child’s last hour of recorded speech. They found that 63% of all the child’s utterances during that hour had been produced verbatim before in the corpus. Furthermore, an additional 29% of utterances could be formed by changing a single word in a previous utterance or by adding a word to the beginning or end of a previous utterance. This left only 8% novel utterances. Lieven and colleagues argue that this suggests that most of what children say is not constructed on-line from scratch, but rather built up from changes to larger stored chunks. Related to this is the finding that 29% of this child’s utterances were created by making one change to a previous utterance. This provides some evidence that children are able to create and use pivot-schema-type constructions.

A related experiment comes from Kidd, Lieven, & Tomasello (2006), who looked at construction-level lexical frequency effects in child language development. They asked children to repeat sentences containing relative clauses where the verb either frequently appeared with a
relative clause (e.g., think) or did not (e.g., pretend), as determined by an analysis of data from six children in the CHILDES corpus. The authors reasoned that children should be more successful in imitating sentences which contain verbs that frequently appear with relative clauses because frequent exposure to a verb in a given construction would help the children to form their own representations of that construction. They found that children provided more accurate repetitions of the sentences containing verbs that appeared frequently with relative clauses and were more likely to correct their own errors in the repetition of these sentences. This suggests that frequency and lexical effects are important in predicting children’s grammatical production.

A somewhat different line of evidence comes from Ambridge & Rowland (2009), who investigated the hypothesis that negative wh-questions involving do-support (e.g., what doesn’t she want?) might be acquired by combining a schema for positive wh-questions (e.g., what does she want?) with a negative indicative schema involving do-support (e.g., she doesn’t want…). They reasoned that if negative questions were acquired in this way, then only children who are able to produce both positive wh- questions with do-support and negative indicatives with do-support would make the characteristic auxiliary doubling error, *what does she doesn’t want?*. They tested this hypothesis using an elicitation experiment, and, indeed, they found that only children who were able to produce both the positive questions and indicative statements with do-support also produced auxiliary doubling errors in negative questions. This suggests a possible way in which children might begin to form new grammatical generalizations, by combining two existing schemas in their developing grammars.

A new and perhaps more compelling line of evidence for how children form generalizations comes from Matthews & Bannard (2010), who investigated two possible drivers of generalization in language development, slot entropy and semantic density. Slot entropy refers
to the variety of items which might be present in a given variable slot. For example, hypothetically, if the frame *a piece of X* can appear with 20 different items whereas the frame *let’s have a X* can only appear with 10, then *a piece of X* has greater slot entropy. *Semantic density* refers to the probability that the items which typically fill a variable slot will be semantically related. The more closely related (as judged by distribution in maternal speech and adult judgments), the more likely the child is to have created a semantic category which can help predict what belongs in that slot. This might be expected to facilitate the processing of typical semantic items for that slot and/or help the child to create a variable position in that schema. The authors asked children to repeat unpredictable phrases based on common three-word frames combined with an unusual final element (e.g., *a piece of X* instantiated as *a piece of brick*) using the procedure described by Bannard & Matthews (2008).

In this study, Matthews and Bannard (2010) were interested in exploring how children make generalizations based on stored lexical expressions. They hypothesized that slot entropy and semantic density would predict 2 and 3 year old children’s ability to repeat such novel sequences. The authors reasoned that frames with higher slot entropy should lead children to more readily create a construction in which the slot is variable (as opposed to relying on the memorized expressions). This should make them more able to process and repeat unexpected sentences such as *a piece of brick*. The result of this investigation was that children were more successful at repeating novel expressions both with high slot entropy and with high semantic density, but they found no effect of semantic typicality on repetitions. This study provides some evidence that children are able to store and use pivot-schema-type constructions and that distributional analysis might be used to form such generalizations.
Overall, then, it is clear that our understanding of how exactly children might move from lexical memorization to more general grammatical representations is still incomplete. However, recent evidence regarding lexical storage of multiword utterances, the existence of pivot-schema-type constructions, and possible drivers of generalization is suggestive. These studies provide, at a minimum, support for the proposal that grammatical development is gradual and that it requires the memorization of phrase-level chunks at some level.

2.3 Conclusion

Taken together, research into lexical and grammatical acquisition suggests that children’s initial forays into abstract language are likely to also involve memorization. For example, when a young child learns an abstract expression such as *in trouble*, it is possible that, instead of conceiving of *trouble* as a metaphorical kind of container, she might simply memorize the expression as a lexical chunk without necessarily considering its internal semantic structure. From this perspective, it would not be necessary for this child to even make even an implicit connection between the *in* belonging to this abstract expressions and the *in* which means CONTAINMENT. She might simply associate the expression *in trouble* with a meaning and use it as a fixed lexical unit. With increasing exposure to such expressions, the child might develop more detailed representations which include a compositional role for the locative marker and an understanding that these markers can be used in a similar way in both abstract and concrete contexts. This developmental scenario would give rise to the processing effects of the concrete on the abstract that were described in Section 1, without the necessity that the same representations be attributed to children. Part 2 will describe how this hypothesis was investigated in the present study.
3 Locative Marking and its Acquisition

Finally, as the present study focuses on abstract locative marking in Hungarian, some background will be necessary regarding the basics of locative marking and its acquisition, both in Hungarian and cross-linguistically. This section will first introduce locative marking in general and then provide additional detail about the Hungarian system and how it develops.

3.1 Locative marking: grammatical and spatial perspectives

For the purposes of this investigation, locative marking will be defined as any system of adpositions or case marking used cross-linguistically to mark spatial relationships, either static (e.g., in, on) or dynamic (e.g., into, off of). The term locative marker will generally be preferred over more specific terms such as case because it can encompass the full range of linguistic possibilities for indicating these relationships. The present study will concentrate on nine basic mono-referential spatial relationships indicated in Table 1 below:

<table>
<thead>
<tr>
<th>CONTAINMENT</th>
<th>SUPPORT</th>
<th>PROXIMITY</th>
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</thead>
<tbody>
<tr>
<td>GOAL</td>
<td>into</td>
<td>onto</td>
</tr>
<tr>
<td>STATE</td>
<td>in</td>
<td>on</td>
</tr>
<tr>
<td>SOURCE</td>
<td>out of</td>
<td>off of</td>
</tr>
</tbody>
</table>

Markers indicating these relationships will be our focus as they are among the earliest-acquired in Hungarian, as well as cross-linguistically (e.g., Johnston, 1988; MacWhinney, 1974), and have previously been found to be used accurately and productively in their concrete forms by 3 years of age (Pléh, Palotás, & Lőrik, 2002). The remainder of this section will briefly introduce three issues related to locative marking: cross-linguistic differences in locative marking, the
grammatical and lexical properties of locative markers, and the relationship between spatial language and cognition.

3.1.1 Cross-linguistic differences in locative marking

First, languages differ substantially in how they lay out their linguistic spatial systems. Not only are there different ways of carving up space, for example the division of the SUPPORT relationship in German into a preposition for vertical support (*an*) and one for horizontal support (*auf*), there are also different types of linguistic marking systems. In additional to the familiar (to English speakers) prepositional systems, languages can also make use of spatial postpositions as in Japanese, agglutinating case systems as in Hungarian, or a combination of prepositions and syncretic case markers as in Russian or Latin, among others (see, for example, Blake, 2001). To give a more concrete example of some of the variation possible in locative marking systems, take the example in Table 2, which compares English, Hungarian and Slovenian:

<table>
<thead>
<tr>
<th>Table 2: English, Hungarian and Slovenian Locatives</th>
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<tbody>
<tr>
<td>Goal</td>
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<tr>
<td>EN</td>
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<td>HU</td>
</tr>
<tr>
<td>SL</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>State</td>
</tr>
<tr>
<td>EN</td>
</tr>
<tr>
<td>HU</td>
</tr>
<tr>
<td>SL</td>
</tr>
<tr>
<td>Source</td>
</tr>
<tr>
<td>EN</td>
</tr>
<tr>
<td>HU</td>
</tr>
<tr>
<td>SL</td>
</tr>
</tbody>
</table>
As can be seen in the table above, Hungarian exhibits transparent locative marking in which each relationship is marked by a single, agglutinating case, agreeing with the nouns it modifies only in vowel harmony. English is similar to Hungarian in that each locative marker has a fixed phonological form, although English uses prepositions while Hungarian has case suffixes. Additionally, source marking in English requires a combination of prepositions (e.g., off of), whereas Hungarian exhibits a one-to-one relationship between semantic role and grammatical morpheme. In Slovenian, by contrast, the system is quite a bit more complex. Locative relationships in this language are expressed by combining a spatial preposition with syncretic case marking on the noun. Case markers agree with the nouns they modify in gender (masculine, feminine, or neuter) and number (singular, dual, or plural), resulting in 8 to 10 possible forms for each case marker. Case markers are lexically selected by the preposition, which are, in turn, often selected by the verb. From these three languages alone, then, it is clear that there is considerable variation in how locative relationships can be marked in different languages.

3.1.2 The lexical and grammatical properties of locative markers

Locative marking systems are also noteworthy from the perspective of linguistic description and theory in that they seem to sit on the fence between lexical items (e.g., nouns, verbs) and grammatical morphemes (e.g., determiners). On the one hand, locative markers such as in and on clearly have some lexical content, which is not typically a property of grammatical morphemes. On the other hand, cases and adpositions, the linguistic classes to which locative markers belong, have well-established grammatical functions, for example, in marking the roles of arguments, as in (2) below:

(2) János adta Mari-nak egy könyv-et
John.NOM gave Mary-DAT a book-ACC
“John gave a book to Mary”
Here, the verb, *ad* (give) has three arguments: the subject, *János* (John), is unmarked and considered to be in the nominative case, the direct object, *egy könyv* (a book), is marked with the accusative case suffix *-et*, and the indirect object, *Mari* (Mary), is marked with the dative case suffix *-nak*.

The locative markers themselves, in fact, often play grammatical roles. One clear English example of this is the preposition *to*, which can be seen in purely locative contexts such as *she’s going to the store*, or grammatical contexts such as *John gave the book to Mary* in (2) above. In the abstract locative expressions we are investigating, as well, locative markers seem to play a primarily grammatical role, in that different markers may be used with semantically similar verbs both within and across languages. In Hungarian, for example, the verb *gondol* (to think) requires the locative marker *-ra* (onto), while the etymologically related and semantically very similar verb *gondolkodik* (to consider) requires the marker *-ról* (off of). There seems to be no semantic motivation for this distinction; it is purely linguistic. Across languages, as well, there are differences in what locative will be used in a given context. In Hungarian, for example, the verb *reménykedik* (to hope) takes the locative marker *-ban* (in), whereas in English the verb *to hope* is marked by the non-locative preposition *for*. In short, abstract verbs lexically select the locative or grammatical morphemes that will mark their arguments. These and related issues in the classification of case and adpositions have led to more than 30 theories of case just since the 1960s (Blake, 2001), together with debates regarding whether cases and adpositions should be considered primarily a grammatical category (e.g., Beard, 1995) or a lexical one (e.g., Jackendoff, 1990), not to mention the possibility that locative markers actually play a semantic role even in contexts where they make no apparent semantic contribution (Lakoff & Johnson, 1980).
3.1.3 Space, language, and systematicity

Third and finally, research into locative marking fits into the broader investigation into spatial language. Given that research into conceptual metaphor theory suggests a basis in spatial language and cognition for abstract relationship marking, it is worth briefly addressing this issue before moving into the empirical data. According to Newcombe and Huttenlocher (2000), there are three issues to address when considering spatial language in adults. First, how do we encode gradated and continuous space into discrete categories (e.g., left vs. right) and how do we use these categories to express location in physical space? Second, how do we use the different frames of reference available to us (viewer-centered, object-centered, or environment-centered) to describe space? Third, how do we encode simultaneous events and properties into temporally linear language? In other words, the question of spatial language is one of translation – how do humans translate the continuous, simultaneous and three-dimensional physical world so that it can be expressed using language, a system which manipulates categories and organizes them sequentially?

Looking at these issues of spatial encoding in detail is beyond the scope of the present study. However, there are a few points to be raised regarding spatial cognition and its relationship to spatial language, especially locative marking. First, although some aspects of our spatial and linguistic representations must be shared in order for us to be able to talk about our spatial experience, it is clear that there is not a complete identity between spatial language and spatial concepts (e.g., Bloom, Peterson, Nadel, & Garrett, 1996; Landau, 2004). To start, the way language packages space is much rougher than the way our non-linguistic spatial cognition encodes it. Milner & Goodale (2006), for example, point out that in order to actually grasp an object, we need fine-grained information about distance, orientation and shape that our spatial
language system cannot express easily. Second, there are clear neurological differences between how the brain processes spatial language and the corresponding spatial relationships. Kemmerer (1999), for example, investigated the terms near and far in relationship to the parts of the brain known to be involved in processing proximal and distal space. He found that the linguistic expressions did not activate the relevant cortical areas and argues that the active processing of these terms does not draw on the underlying spatial cognition. Thus, it is likely that either our linguistic systems draw selectively on spatial cognition, or operate independently of it (e.g., Landau, 2004).

Turning back to Newcombe & Huttenlocher’s (2000) question of how language packages space, it seems that humans form spatial categories that have properties similar to any other categories; they are composed of prototype and marginal members (e.g., Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). A prototype in relationship might be an object in a container, such as a box, whereas a marginal example of in might be an object in a very wide shallow bowl. Because of the need to carve up gradiated space into discrete categories, languages have developed conventionalized systems for expressing space linguistically. We have conventional ways of dividing relationships that vary by language (e.g., in vs. on in English, tight-fitting vs. loose-fitting in Korean (e.g., Choi & Bowerman, 1991), ways to describe the relationship between spatial categories (e.g., into vs. out of), ways of dividing space into quadrants (North, South, East, West; left, right). Because we cannot describe space in the way we perceive it, we have grouped areas of space into categories and arranged those categories in relation to one another. We have created systems for describing space in language. This type of systematicity is inherent to the way languages divide space because of the necessity of chunking gradiated direction into usable categories. One question that we will address in Experiments 3 and 4 is
whether (and when) these systems for talking about space can be extended into abstract contexts. For example, if we know we can fall *in* love, when do we become able to understand what might be meant by falling *out of* love?

Finally, for the sake of completeness, individual languages also make conventional choices regarding how to order these relationships and use these categorical expressions to describe dynamic three-dimensional and temporally sensitive events. For example, languages have different preferences for how certain frames of references are preferred over others. In Tzeltal, for example, a strictly environment-centered frame of reference based on cardinal direction is used. It is possible for objects to be *uphill* (= North), *downhill* (= South) or *across* (= East or West) from one another, but not *left* or *right*. In English, by contrast, we typically prefer to describe location relative to objects and people in the environment (e.g., Levinson, 1996). The way in which spatial relationships are conventionally described also often varies by language. In English, for example, we tend to start with the largest spatial category and work our way down; so, if someone we don’t know asks us where we live, we will typically mention Washington, D.C. first, and then Capitol Hill. In Hungarian, by contrast, the opposite ordering is more common; it is more usual to say that you live in the *Palotanegyed* neighborhood first, and then that it is in Budapest. This preference is even encoded in the way mailing addresses are written. In Hungarian, you start with the zip code, then the city, while in English the reverse order is preferred. The point of these examples is that acquiring the language of space involves learning how our society breaks up gradated space into conventional spatial categories and understanding how these are used in relationship to one another.

It should also be noted that because of the language-specific nature of this division process, the relationship between spatial language and spatial concepts has been central to the
debate regarding the relationship between language and thought. Specifically, the question is whether the way one’s particular language divides up the spatial world affects his underlying perception of space. Can a person’s native language affect the way he thinks? Research on this issue (Bowerman & Choi, 2001; Choi & Bowerman, 1991) has yielded mixed results – categories that exist in one’s own language are easier for individuals to recognize, but not having a linguistic grouping does not preclude us from seeing a given spatial relationship. This issue has important implications for the study of spatial cognition which are outside the scope of the present study.

3.2 Locative marking and its acquisition in Hungarian

This section will provide additional detail regarding why Hungarian was chosen as the focus of this study, how the Hungarian locative marking system works, and how it is acquired by children.

3.2.1 Why Hungarian?

Hungarian was chosen as the language of focus of this study for three main reasons, the first being linguistic complexity. Hungarian has been argued to be less linguistically complex than languages such as Slovenian, in that Hungarian locative cases exhibit a one-to-one correspondence between these nine case relationships and the monosyllabic morphemes which mark them (Johnston & Slobin, 1979; Weist, Lyytinen, Wysocka, & Atanassova, 1997). The notion of linguistic complexity is based on the morphosyntactic and/or semantic properties of the locative system in a given language. Concentrating on morphosyntax, from the perspective of Slobin (1973), the least complex languages have a transparent one-to-one mapping between form and function, as Hungarian does, while the most complex languages have multi-word locative
markers with syncretic agreement, as seen above in Slovenian. Thus, by using Hungarian as the language of investigation, linguistic complexity can be held constant (MacWhinney, 1974).

There are two additional benefits offered by the Hungarian language for this type of research. First, Hungarian is a morphologically rich language in which case markers and other types of inflection are produced very early in development (e.g., MacWhinney, 1974; Pléh, Palotás, & Lőrik, 1997). This is important because it ensures that Hungarian children are fully productive with the concrete senses of the locative markers by the time they begin acquiring abstract language. A final benefit is that Hungarian exhibits reliable path marking in both locative and non-locative contexts, with the exception of CONTAINMENT, where the stative marker (-ban/ben) is optionally reduced to its goal counterpart (-ba/be) (Pléh, 1995). This is not true in many other languages, which tend to collapse goals and states, for example, making the semantic relationships less clear.

3.2.2 Locative system basics

As introduced above, the experiments to be presented in Part 2 focus on the nine basic locative markers in Hungarian repeated, for convenience, in Table 3 below with their English equivalents and traditional grammatical labels:

<table>
<thead>
<tr>
<th>Table 3: Locative Markers of Hungarian</th>
</tr>
</thead>
</table>

10 Generally, cases will be referred to using their English equivalents (e.g., in, on, etc.) for ease of reference.
This section will go into more detail regarding the locative system of Hungarian, detailing how other spatial relationships are marked and some important details regarding the use of case marking in Hungarian.

Hungarian has a very productive morphological system, both derivational and inflectional. Following Kenesei and colleagues (1998) and Rounds (2001), Hungarian has between 17 and 27 agglutinating case markers. The disagreement over the exact number comes from uncertainty regarding the dividing line between derivational and inflectional morphology (Kenesei, et al., 1998, p. 192). Table 4 shows the non-locative cases presented by Rounds (2001, p. 93):

<table>
<thead>
<tr>
<th>STATE</th>
<th>CONTAINMENT</th>
<th>SUPPORT</th>
<th>PROXIMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ban/ben</td>
<td>-on/en/ön/n</td>
<td>-nál/nél</td>
<td></td>
</tr>
<tr>
<td>in</td>
<td>on</td>
<td>at</td>
<td></td>
</tr>
<tr>
<td>inessive</td>
<td>superessive</td>
<td>adessive</td>
<td></td>
</tr>
<tr>
<td>GOAL</td>
<td>-ba/be</td>
<td>-ra/re</td>
<td>-hoz/hez/hőz</td>
</tr>
<tr>
<td>into</td>
<td>onto</td>
<td>to</td>
<td></td>
</tr>
<tr>
<td>illative</td>
<td>sublative</td>
<td>allative</td>
<td></td>
</tr>
<tr>
<td>SOURCE</td>
<td>-ból/ből</td>
<td>-ről/ről</td>
<td>-től/től</td>
</tr>
<tr>
<td>out of</td>
<td>off of</td>
<td>from</td>
<td></td>
</tr>
<tr>
<td>elative</td>
<td>delative</td>
<td>ablative</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Non-locative Hungarian Cases
<table>
<thead>
<tr>
<th>Case Name</th>
<th>Hungarian Marker</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>nominative</td>
<td>none</td>
<td>marks subject</td>
</tr>
<tr>
<td>accusative</td>
<td>-t</td>
<td>marks the direct object</td>
</tr>
<tr>
<td>dative</td>
<td>-nak/nek</td>
<td>to, for</td>
</tr>
<tr>
<td>instrumental</td>
<td>-val/vel</td>
<td>with</td>
</tr>
<tr>
<td>transative</td>
<td>-vá/vé</td>
<td>(turning) into</td>
</tr>
<tr>
<td>causal-final</td>
<td>-ért</td>
<td>for the purpose of</td>
</tr>
<tr>
<td>essive-formal</td>
<td>-ként</td>
<td>as</td>
</tr>
<tr>
<td>terminative</td>
<td>-ig</td>
<td>until, up to (time and space)</td>
</tr>
<tr>
<td>distributive</td>
<td>-(o/a/e/ö)nként</td>
<td>per, each</td>
</tr>
<tr>
<td>temporal</td>
<td>-kor</td>
<td>at (plus time expression)</td>
</tr>
<tr>
<td>distributive-temporal</td>
<td>-(o/e/ö)nta</td>
<td>per, every (plus time expression)</td>
</tr>
<tr>
<td>sociative</td>
<td>-(o/a/e/ö)stul/stüll</td>
<td>(together) with</td>
</tr>
<tr>
<td>locative</td>
<td>-t/(o/e/ö)tt</td>
<td>at</td>
</tr>
</tbody>
</table>

One important non-locative case marker for our purposes is the temporal marker -kor, as it will be the focus of Experiment 2. Etymologically, the temporal marker -kor derives from the noun kor (age); the origin of the noun was the Turkish qur which meant row or line. The point of origin for the case marker is unclear, but its use as an affix was likely derived from similar uses in Turkish (Benkő, 1967). Today, it is used to mark clock time (e.g., ötkor, at 5:00) and some festivals (e.g., karácsonykor, at Christmas). Kor is also found as a fixed form in a number of expressions such as életkor (time of life), kortárs (contemporary), and koros (elderly). For our purposes, -kor has an important property related to wh-questions. In Hungarian, the equivalent of the English what is mi, and this wh-word can be productively inflected for case in questions as shown in (3) below:

(3) a. \textit{Mi-t szeret-n-él?}  
What-ACC want-COND-2SG  
“What would you like?”

b. \textit{Mi-től siet?}  
what-FROM hurry.3SG  
“What is he running away from?”
Typically, when a case-marked question, such as the ones shown in (3), is asked, the response will require the same marker. In (3a), for example, a possible response might be csokit (chocolate-ACC), or in (3b) the answer might be Jánostól (from John). The temporal marker, however, behaves differently. The time word when is mikor, which is derived from combining mi (when) with -kor. In the modern language, however, this relationship is unproductive – mikor is a fixed form which does not have the same case marking requirements as the questions in (3). In fact, as shown in (4) below, most time expressions, are not marked with -kor but with locative markers:

(4)  

a. március-ban  
March-IN  
“in March”  

b. szerdá-n  
Wednesday-ON  
“on Wednesday”

Thus, it is possible, and often necessary, to respond to mikor questions using a case marker other than -kor. This will be raised again in the presentation of Experiment 2.

Returning to our focus on locative marking, the nine basic spatial case markers are supplemented by a number of locative postpositions and verbal particles. Postpositions are distinguished from case markers primarily in that they do not undergo vowel harmony. Additionally, postpositions can be divided into either “dressed,” i.e., can be inflected in the pronominal form, or “naked,” i.e., remain uninflected (e.g., Kiss, 2002). Naked postpositions often occur together with case markers. The examples in (5) below illustrate case marking and both types of postposition.

(5)  

a. a híd-on  
the bridge-ON  
“(case) on the bridge”
b. a híd-on át (naked postposition)
   the bridge-ON across
   “across the bridge”

c. a híd alatt (dressed postposition)
The bridge under
   “under the bridge”

As with case markers, dressed postpositions distinguish path types. A few examples from Kenesei and colleagues (1998, p. 236) are given in Table 5 below:

Table 5: Examples of Path Marking in Hungarian Postpositions

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>STATE</th>
<th>GOAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near</td>
<td>mellől</td>
<td>mellett</td>
</tr>
<tr>
<td>Below</td>
<td>alól</td>
<td>alatt</td>
</tr>
<tr>
<td>Between, among</td>
<td>közül</td>
<td>között</td>
</tr>
</tbody>
</table>

Finally, dressed postpositions (and case markers) can also be inflected for person as in the example alattam (under me).

For the sake of completeness, it should be mentioned that there has been considerable discussion in the linguistics literature regarding the relationship between postpositions and case markers, both synchronically and diachronically. Diachronically, it seems clear that the locative case markers were once postpositions that have been cliticized (e.g., Benkő, 1967). Synchronically, there has been a good deal of discussion regarding whether case markers and postpositions should be considered members of a single category P or multiple categories separating postpositions from cases (e.g., Asbury, 2005, 2008; Kiss, 2002). Despite its linguistic significance, this debate does not affect the present discussion in that our focus is on the basic locative case markers only.
3.2.3 Acquiring locative marking in Hungarian

In terms of acquisition, quite a bit is known about the development of locative marking systems in concrete contexts. In terms of the basic course of development, it is clear that mono-referential markers, that is, markers which place a target object in relation to a single reference point (e.g., in, on), are acquired earlier than bi-referential markers such as between (Weist, et al., 1997). Cross-linguistic research has also found CONTAINMENT and SUPPORT markers to be acquired earlier than markers for PROXIMITY (see Johnston, 1988, for a review). Finally, experimental research has demonstrated that children preferentially encode (non-linguistic) GOAL over SOURCE paths (e.g., Lakusta & Landau, 2005), accounting for the cross-linguistically early acquisition of GOAL markers when compared to SOURCE ones.

In Hungarian, these basic cross-linguistic findings have been preserved (Király, Pléh, & Racsmány, 2001; MacWhinney, 1974, 1976; Pléh, et al., 1997). Looking at this research into the acquisition of the Hungarian concrete locative markers in more detail, the foundation for the series of studies to be described here is MacWhinney (1974, 1976). This detailed longitudinal investigation into the initial stages of language development included recordings from five children: Zoli (1;5 – 2;2, 6 recordings), Gyuri (2;3, 9 recordings), Andi (2;1 – 2;8, 4 recordings), Moni (1;11 – 2;5, 4 recordings) and Eva (2;7 – 2;10, 15 recordings) and has provided the raw material for much subsequent research into Hungarian language development. In this study, MacWhinney (1974, 1976) included several observations about the developing nominal inflection system. First, it was found that these children had a strong preference for CONTAINER type relations over SUPPORT and PROXIMITY, which was the least frequent. Also, another observation was that in all three relation types the GOAL path was the most frequent, followed by STATE, and that the SOURCE path was much less frequent than either of
the other two. This fits with the cross-linguistic order of acquisition described by Johnston (1988).

More recently, Pléh and colleagues (1997) conducted a corpus study using MacWhinney’s (1974) data, which is now available on the CHILDES database (MacWhinney, 2000). In order to further investigate MacWhinney’s (1976) claims regarding the predominance of CONTAINER-type relations over SUPPORT and PROXIMITY, and strong preference for GOAL paths over STATE and SOURCE ones, Pléh and colleagues looked at data from the five children discussed above between the ages of 1;5 and 2;9 (12,609 utterances total). The focus of this analysis was the relative distribution of the various spatial expressions as opposed to the order in which they were acquired. The following distribution was found (p. 252):

Table 6: Distribution of Case Marking, from Pléh et al. (1997, p. 252)

<table>
<thead>
<tr>
<th></th>
<th>CONTAINER</th>
<th>SUPPORT</th>
<th>PROXIMITY</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE</td>
<td>29 (7%)</td>
<td>27 (23%)</td>
<td>11 (14%)</td>
<td>67 (13%)</td>
</tr>
<tr>
<td>GOAL</td>
<td>355 (88%)</td>
<td>86 (72%)</td>
<td>48 (60%)</td>
<td>489 (80%)</td>
</tr>
<tr>
<td>SOURCE</td>
<td>19 (5%)</td>
<td>6 (5%)</td>
<td>21 (26%)</td>
<td>46 (7%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>403 (67%)</td>
<td>119 (20%)</td>
<td>80 (13%)</td>
<td>602</td>
</tr>
</tbody>
</table>

From this table, it is clear that there is truly a strong advantage for CONTAINER relations over SUPPORT and PROXIMITY and that GOAL paths are greatly preferred over STATE and SOURCE paths. In attempting to account for the generally unexpected advantage for GOAL over STATE paths (despite the fact that STATE paths are claimed to be more frequent in the adult language), Pléh and colleagues argue that this may be attributable to an innate perceptual bias.
towards goals. This fits with empirical findings regarding the goal-directedness of infant behavior (e.g., Gergely, et al., 1995) and the preferential encoding of goals over sources (Lakusta & Landau, 2005). The advantage of CONTAINMENT is thought to result from the saliency of CONTAINER relations over other types, a position that goes back to Piaget & Inhelder (1956). Within CONTAINER relations, the comparatively strong advantage for the GOAL path might be the result of a general trend in adult Hungarian to reduce the inessive (-ban/ben) to the illative (-ba/be) (Pléh, 1995).

The findings of this corpus research have also been augmented by more recent experimental studies. Király and colleagues (2001), to start, elicited nonce case markers and postpositions from Hungarian children aged 3 to 6, with a view to further investigating the hypothesis that human cognition is goal-directed (p. 183). They reasoned that if children still exhibit a preference for GOAL over SOURCE paths when learning nonce locative markers, then this provides evidence for the position that children are biased towards goals. In one of the experiments they report, three novel sets of case markers and postpositions were created following the Hungarian morphophonological pattern described in the previous section. Children saw GOAL and SOURCE spatial relationships labeled with either the case markers or postpositions. UNDER was encoded by the nonce case markers -ga/-ge (to under) or -göl/-göl (from under) or the postpositions gána (to under) gánol (from under). DIAGONAL was encoded using the nonce case markers -csú/csé (to a diagonal position) or csól/csöl (from a diagonal position) or the postpositions révé (to diagonal) revül (from diagonal). Finally, VERTICAL was encoded by the case markers -va/ve (to a vertical position) or -völ/völ (from a vertical position) or the postpositions bagá (to vertical) or bábol (from vertical). After 3 demonstrations, a forced-choice comprehension test was administered to see whether the target relation had been learned.
Two relationships were modeled with novel objects and the participants were asked which represented the case marker/postposition. A significant effect of path type was found, but neither the effects of age nor case type were significant. This is taken to be evidence for a (possibly innate) GOAL preference in this age group.

The advantage for the GOAL markers seems to decrease with age, at least when compared to STATE markers. In an elicitation task involving locative case markers and postpositions, Pléh and colleagues (2002) found that 5-8 year olds produced an equal proportion of STATE and GOAL expressions, which is argued to be the effect of the more complex relationships encoded by postpositions. It is possible that the increased complexity of the relations expressed by postpositions is also the source the advantage for STATE markers in the adult language.

Finally, Lukács, Pléh, & Racsmány (2007) investigated the use of locative cases (CONTAINER and SUPPORT types) and postpositions by children with Williams Syndrome and by vocabulary-matched controls between 3;5 and 10;7 (mean 7;2). The control data is informative here. Experiment 1 was a comprehension and elicitation task developed by Pléh and colleagues (2002). Children were asked where/to where/from where a small object (e.g. a plastic circle) was located or moved. The controls were at ceiling in the comprehension portion of this study. Their production, too, neared 100% accuracy in all but the SOURCE path, where accuracy with postpositions was about 75%, a statistically significant difference. Experiment 2 is more interesting for our purposes in that it included conceptual abstraction (in a “non-spatial” condition) as a variable. This was a sentence completion task which required the children to supply one of the 9 locative case markers to the last noun in a sentence that was read aloud to them. Ninety sentences (5 with each relation type) were tested in all. The normally developing
controls (who were between the ages of 4 and 10;7, mean 7;10) were nearly at ceiling in their production of case markers in spatial (concrete) contexts. However, in the non-spatial (conceptually abstract) context, the controls were significantly less accurate in producing the SOURCE-path case markers. Also, production was significantly less accurate in the non-spatial condition overall. Thus, there is already some evidence that abstract contexts lead to less accurate production, even in a low-demand task with older children.

Thus, the following conclusions can be drawn from the existing research into locative case marking in Hungarian. First, the baseline frequency of path types in child language is as follows: GOAL > STATE > SOURCE. This is despite the higher frequency of STATE paths in the adult language. Also as predicted by cross-linguistic research, the following relative frequency of case types has been found: CONTAINER > SUPPORT > PROXIMITY. Finally, in the one experiment which has specifically treated conceptual abstraction as a variable, it was found that children between 7 and 10 are still significantly less accurate in producing case markers in abstract contexts, and that the SOURCE path in abstract contexts was significantly less accurate than the other two path types.
4 The Present Study

The goal of the present study, then, is to investigate how Hungarian-speaking preschoolers use and understand abstract locative expressions. Specifically, we asked whether there is evidence from either production or comprehension that children employ what they know about concrete locatives in their early forays into abstract language. Part 1 has presented two ways to approach the development of abstract locative expressions, from the perspective of usage-based conceptual metaphor theory, a theory of abstract language in adults, and from the perspective of language development, an approach to general language acquisition in children. Under a conceptual metaphor view, we should expect to see the impact of embodiment and conceptual metaphors on the early production and comprehension of abstract language. For our purposes, this expectation translates into the predictions that children who are using conceptual metaphors to process their early abstract language will (1) use locative markers in the same way in both concrete and abstract contexts, (2) exhibit the same systematicity in their use of abstract locatives as they do in their concrete locative systems and (3) show lexical and conceptual priming from the concrete to the abstract. From previous research into language development, on the other hand, it would not be surprising to find the effects of memorization and lexical learning in children, such that the way children and adults produce and comprehend abstract locative expressions differs.

Before presenting the experiments, additional detail should be provided about the relationship between conceptual metaphor theory and usage-based language development. Specifically, it should be pointed out that researchers working on conceptual metaphor theory and usage-based grammatical development all typically subscribe to the broader cognitive
linguistic approach to linguistic psychology. That is, all of these researchers are interested in understanding linguistic cognition, and they often work together to that end. Michael Tomasello (1998), for example, edited a book exploring cognitive linguistic approaches to language, and other researchers in this area often contribute to cognitive linguistic books and journals. Cognitive linguists, for their part, strongly support the usage-based program in language development, which they consider their standard approach (e.g., Evans & Green, 2006).

This seems strange in the context of the literature that has been discussed in this section in that these approaches make contradictory predictions for development, a fact which is pointed out by Rice (2003). It seems likely that the reason this contradiction has gone largely unremarked upon is that the two groups have different focuses, which lead them to think about the other’s approach in rather general terms. Researchers working on usage-based development, for example, typically believe that embodiment is an important piece of our cognitive make-up without seeing it as a crucial foundation for all of language. Researchers in conceptual metaphor theory, for their part, typically focus on adults and so tend not to think about this issue developmentally. They may assume that mechanisms such as statistical learning have a role to play without carefully considering the implications for their own adult-based theories. In any case, our premise here is that there is an important contradiction between the predictions of conceptual metaphor theory and the research in language development which needs to be addressed in order for work in this area to move forward. This issue will be a central focus of Part 3.

Thus, in order to examine the question of how preschool-aged children produce and comprehend abstract locative expressions, five experiments were conducted. Experiment 1 was a narrative elicitation task which asked whether there would be a difference in accuracy or error
patterns in the use of locative markers in concrete as compared with abstract contexts. Experiment 2 followed up on this experiment by investigating the source of an error involving the overuse of the time marker -kor (at (a time)). Experiments 3 and 4 asked whether children would systematically extend their knowledge about locative markers into novel and unusual contexts; for example, would into be used productively as the opposite of out of in a novel abstract context. Finally, Experiments 5a and 5b looked into the lexical and conceptual relationships between abstract and concrete locative expressions using a priming task.
Part 2: Empirical Study

The question asked by the present study, as stated above, is whether there is evidence from either production or comprehension that children employ what they know about concrete locatives in their early abstract language. More specifically, the experiments to be described here ask, based on the predictions of conceptual metaphor theory, whether the development of abstract spatial expressions draws on either (1) the conceptual system of spatial relationships, and/or (2) the linguistic system used to describe concrete spatial relationships, where, for example into is the opposite of out of and right is the opposite of left. In what follows, the five experiments conducted for this study will be presented, grouped by methodology. Section 5 will present the baseline production tasks, Experiments 1 and 2. Section 6 will present Experiments 3 and 4, which were comprehension tasks, and Section 7 will present the results of two priming tasks, Experiments 5 a and b. Taken together, these experiments provide some evidence that there are important effects of lexical learning in the early production and comprehension of abstract locative expressions. Children’s knowledge of concrete space and spatial language seems to have only a limited effect on how they use abstract locatives between 3 and 7 years of age.
5 Baseline Production Tasks: Experiments 1 and 2

The goal of the first two experiments to be described here was to obtain a baseline of how children use abstract locative markers. In Experiment 1, we asked whether preschool-aged children would be less accurate with locative marking in abstract contexts when compared with concrete contexts. Additionally, we were interested in the time course of development, specifically, when performance would become adult-like. Experiment 2 was conducted to follow up on a pattern of errors found in Experiment 1, namely a large number of errors in time contexts involving the time marker -kor. We asked whether these errors seemed to be driven by a conceptual or morphological overgeneralization.

5.1 Experiment 1

First, a narrative elicitation task was used to ask whether Hungarian-speaking preschoolers would be less accurate in their production of locative markers in abstract contexts as opposed to concrete ones, and when their performance with abstract locatives would reach adult levels of accuracy. From the perspective of conceptual metaphor theory, as we have seen, researchers typically assume that the abstract and concrete senses of the locative markers are conceptually related to one another and that abstract uses are metaphorical extensions of concrete ones (e.g., M. Johnson, 2007; Rice, 2003). Assuming this, we should not necessarily expect to see a difference in how abstract and concrete locative markers are produced by children. Hearing an expression such as in trouble should activate the child’s CONTAINMENT image schema and cue the child that trouble is a metaphorical container. Based on the previous literature in lexical development described above, on the other hand, we anticipated that at least the children in the youngest age group (3 year olds) might exhibit accuracy problems in abstract contexts in that
productive use of abstract vocabulary and metaphoric expressions seems to begin with 4 year olds and improve with age (C. Johnson & Maratsos, 1977; Ozcaliskan, 2005).

5.1.1 Method

5.1.1.1 Participants

Participants were 50 children and adult controls, 24 males and 26 females. All of the children were middle- to upper-middle-class monolingual speakers of Hungarian attending two nursery schools in Budapest. They ranged in age from 3;4 to 7;2. It is important to note that children up to the age of 7 in Hungary typically attend preschool and only learn to read and write once they enter grammar school between 7 and 7;5 years of age. This makes it more possible to compare the development of children across a wider age range. The adults were native speakers of Hungarian who worked at the Budapest University of Technology and Economics. They were all at least 20 years of age, and none of them were familiar with the experiment prior to their participation. As the 7 year olds (n = 4) performed identically to the adult controls (n =6), with nearly 100% accuracy, these groups were collapsed into a single control group. Table 7 shows the five groups of participants that resulted:

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Male</th>
<th>Mean Age</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 yr</td>
<td>10</td>
<td>6</td>
<td>3;7</td>
<td>0;3</td>
</tr>
<tr>
<td>4 yr</td>
<td>10</td>
<td>4</td>
<td>4;5</td>
<td>0;3</td>
</tr>
<tr>
<td>5 yr</td>
<td>10</td>
<td>4</td>
<td>5;5</td>
<td>0;4</td>
</tr>
<tr>
<td>6 yr</td>
<td>10</td>
<td>4</td>
<td>6;5</td>
<td>0;3</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.1.1.2 Materials

The stimulus for this experiment was a picture story consisting of eleven cartoon pictures drawn for this purpose. The story was about a little boy who wanted, and eventually received, a birdhouse for his birthday. Some of the pictures included representations of the little boy’s thought states and memories to serve as some of the non-spatial contexts. Figure 1 provides an example:

![Figure 1: Sample Picture for Experiment 1](image)

A basic script of prompts was used by the experimenters to elicit relevant case marked expressions. Although the course of the interview varied slightly from child to child, there were generally 12 prompts given in each condition. Examples of these prompts and their typical responses are given in Table 8. (The complete stimuli with morpheme-by-morpheme glosses of the Hungarian can be found in Appendix A):

<table>
<thead>
<tr>
<th>Concrete</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hol ül János?</em></td>
<td><em>Mire vár János?</em></td>
</tr>
<tr>
<td>Where is János sitting?</td>
<td>What is he waiting for?</td>
</tr>
<tr>
<td><em>A faágon.</em></td>
<td><em>A bulira.</em></td>
</tr>
<tr>
<td>On the tree branch.</td>
<td>For his party.</td>
</tr>
<tr>
<td><strong>Hol van a tojások?</strong></td>
<td><strong>Mire gondol?</strong></td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Where are the eggs?</td>
<td>What’s he thinking about?</td>
</tr>
<tr>
<td><strong>A fészekben.</strong></td>
<td><strong>Az ajándékra.</strong></td>
</tr>
<tr>
<td>In the nest.</td>
<td>About the gift</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Hol van János?</strong></th>
<th><strong>Mire emlékezik is János?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Where is János?</td>
<td>What does János remember?</td>
</tr>
<tr>
<td><strong>A létrán.</strong></td>
<td><strong>A nyárra.</strong></td>
</tr>
<tr>
<td>On the ladder.</td>
<td>The summer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Honnan mászik le?</strong></th>
<th><strong>Melyik napon lesz buli?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>From where is he climbing?</td>
<td>On what day will his party be?</td>
</tr>
<tr>
<td><strong>A fáról.</strong></td>
<td><strong>Szombaton.</strong></td>
</tr>
<tr>
<td>From the tree.</td>
<td>On Saturday.</td>
</tr>
</tbody>
</table>

5.1.1.3 **Design and procedure**

Testing took place at two nursery schools in Budapest, Hungary, and all children were tested in a quiet room at the nursery school they attended. The child was seated next to Experimenter 1, who conducted the experiment, in front of a Dell Latitude D600 laptop with a 14 inch screen. Experimenter 2 sat on the other side of the table and took notes. Sessions were video- and audio- recorded. The camera was positioned behind the child so that it recorded the screen and the child’s gestures, and the microphone was attached to a stuffed owl toy which sat on the table next to the child.

The task overall took between 10 and 20 minutes, and included a brief warm-up introducing the topic, followed by the presentation of the story. During the trial, children were shown the pictures one at a time using a PowerPoint presentation and asked a series of basically scripted questions associated with each picture, as illustrated above in Table 8. Since the children were allowed to freely respond to each question and make additional contributions to
the story telling as they wished, the course of the interview differed slightly across trials. The children received stickers for their participation.

In order to control for the child’s lexical knowledge, labels were typically provided before the question was asked (e.g., “This is a birdhouse, isn’t it? Can you tell me what John is thinking about?” The correct response would be “About the birdhouse”). If the question needed to be repeated, relevant vocabulary labels were always provided in both the abstract and concrete contexts. Thus, there were very few instances where children failed to respond to a question.

An additional control for the child’s lexical knowledge resulted from the morphologically distinct question forms that were necessarily used in each condition. In the concrete contexts, basic locative question words were used which specified the path but not the required locative type, i.e., hova (to where) hol (where) and honnan (from where). In the abstract condition, on the other hand, the nature of the concepts under discussion made the use of locative question words pragmatically inappropriate. Thus, abstract questions were asked using case-specific forms of the question words, which meant that the correct case marker was supplied as part of the question, e.g., miröl gondolkodik? (what is he thinking about?), a házikóról (about the little house). As it is obligatory in Hungarian to answer a case-specific question with a response marked by the same case, the child’s task in the abstract condition was essentially to concatenate the target noun with the case marker, both of which were provided by the experimenter.

The audio tapes of all sessions were coded by a native speaker of Hungarian who was not familiar with the research project and checked by the primary investigator. The number of correct responses was recorded for each condition, case, and path type. Only responses containing case marked NPs or pronouns were counted. Clausal responses (e.g., Q: miröl gondolkodik? – what is he thinking about? A: Hogy madár ház – that (there’s a) birdhouse) were
excluded. Any case marking errors were transcribed along with the question that elicited the error and what the correct response should have been.

In order to control for the degree to which the child understood the story, especially the abstract elements, errors were only counted if the child produced a semantically appropriate noun phrase as a response with an omitted or incorrect case marker. For example, if the question was Mikor lesz a bulija? (when will his party be?), the response should have been szombaton (on Saturday). If the child instead responded as though he had misunderstood the question, for example, a szülinapom van (it’s my birthday), the response was excluded. Every coding sheet was also checked against the audio by the primary investigator to confirm the accuracy of the counts for each category.

5.1.2 Results

In order to determine whether the introduction of abstract lexical items affected locative marking accuracy in preschool aged Hungarian speakers, a two-way multivariate analysis of variance (MANOVA) was conducted with abstraction (concrete, abstract) as the within-subjects variable and age (3, 4, 5, 6, control) as the between-subjects variable. The outcome measure was percent accuracy of locative marking. The results are presented in Figure 2 below:
This analysis revealed a main effect of age, $F(4,45) = 2.70$, $p = 0.04$, a main effect of abstraction, $F(1,45) = 14.34$, $p < 0.001$, and an interaction between age and abstraction, $F(4,45) = 3.40$, $p = 0.02$. Participants were less accurate in the abstract condition overall, and a Student-Newman-Keuls post-hoc revealed that the 3-year-old children were less accurate than the controls in the abstract condition. The other age groups did not differ from one another in accuracy. The interaction suggests, as predicted, that abstraction caused more problems for younger children than older ones. Thus, it seems that the introduction of abstract lexical items does disrupt children’s accuracy with spatial case marking and that this effect disappears by the end of preschool.

Looking in more detail at the patterns of errors, we were also interested to see whether the errors the children made with their case marking differed by condition. Did the children make the same proportion of substitution errors (using one case in place of another) as omission errors?
(omitting the case marker from the noun entirely) across the two conditions? For a break-down of the errors made in the abstract condition, see Figure 3 below:\(^\text{11}\):

\[\text{Figure 3: Errors by Type, Abstract Condition, Experiment 1}\]

From this chart it is clear that the majority of the 28 errors in abstract conditions (of 361 total case-marked nouns) were made in time contexts. Thirteen errors were omissions in time contexts as in (6) below, and seven errors involved the use of the time marker -kor (at (a time)) in date contexts as in (7). The expected responses are given in parentheses for comparison:

\[
\begin{align*}
\text{(6) Q: } & \quad \text{Mikor van a születésnap-ja?} \\
& \quad \text{When be.3SG the birthday-3SG.POSS} \\
& \quad \text{“When is his birthday?”}
\\
\text{A: } & \quad \text{Húsz (cf. húsz-adik-án)} \\
& \quad \text{Twenty (cf. twenty-ORD-ON)} \\
& \quad \text{“Twenty” (cf. “on the twentieth”)}
\end{align*}
\]

\(^{11}\) In the diagram, omit is short for omission and sub is short for substitution. Goal for Source and Source for Goal indicate that a goal path marker was substituted for a source marker within the same case type (e.g., into for out of or vice versa).
(7) Q: Mikor van a születésnap-ja?
When be.3SG the birthday-3SG.POSS
“When is his birthday?”

A: Húszkor (cf. húsz-adik-án)
Twenty-AT.TIME (cf. twenty-ORD-ON)
“At twenty” (cf. “on the twentieth”)

The remaining eight errors were other omissions, or substitutions of either a source for a goal case as in (8) or a goal for a source as in (9):

(8) Q: Mi-re vár?
What-ONTO wait.3SG
“What is he waiting for?”

A: Az ajándék-ról (cf. the ajándék-ra)
The present-OFF.OF (cf. the present-ONTO)
“About the present” (cf. “for the present”)

(9) Q: Mi-ról gondolkodik?
What-OFF.OF consider.3SG?
“What is he thinking about?”

A: A szülinap -ja -ra (cf. A szülinap -ja- ról)
The birthday-3SG.POSS-ONTO (cf. the birthday-3SG.POSS-OFF.OF)
“For his birthday” (cf. “about his birthday”)

In the concrete contexts, by contrast, no such pattern of errors is readily apparent:

12 In this diagram, the additional error labels: type in state, and type in goal refer to a substitution of one case type for another within a single path (e.g., -ra (onto) for -ba (into).
Of the 23 errors (from 744 total case marked nouns), most were substitutions, but there was a range of types made. The examples below illustrate a state for goal substitution (10), a case substitution in a state path (11), and an omission (12).

(10) Q: Where. SOURCE climb.3SG down
     “Where is he climbing down from?”

     A: The tree top-3SG.POSS-ON (cf. the tree top-3SG.POSS-OFF.ÔF)
     “On the top of the tree” (cf. “from the top of the tree”)

(11) Q: Where.STATE sit.3SG John
     “Where is János sitting?”

     A: The table-ON (cf. the table-AT)
     “On the table” (cf. “at the table”)

(12) Q: Where.GOAL draw.3SG John
     “Where is János drawing?”

Figure 4: Errors by Type, Concrete Condition, Experiment 1
The error patterns in these two contexts seemed to suggest that omissions were more common in abstract contexts, while substitution errors were more prevalent in concrete contexts. To examine this pattern in more detail, a two-way MANOVA was conducted with abstraction (concrete, abstract) and error type (omission, substitution) as the independent variables and percentage of each error type as the dependent variable. Due to power concerns, the age groups were collapsed for this analysis. The results are displayed in Figure 5 below:

The analysis revealed no main effect of either abstraction or error type, as expected. There was, however, an interaction between error type and abstraction, F(1,49) = 11.73, p = .001, indicating that more omission errors were made in the abstract condition and that, conversely, more substitution errors were made in the concrete condition.
5.1.3 Discussion

To summarize, this experiment found that 3-year-old Hungarian speakers used the locative markers less accurately than the control group in abstract contexts. By 4 years of age, there were no differences between preschool children and the control group, though children did not reach ceiling levels on this task until between 6 and 7 years of age. Children at all ages were quite accurate with their use of locative marking in both abstract and concrete contexts overall. Looking in more detail at the errors that were produced, however, errors in abstract contexts tended to be omissions, while errors in concrete contexts were more typically substitutions. Time contexts, additionally, were an especially rich source of errors.

Overall, this experiment fits with the findings of previous research in abstract lexical development, which suggests that children begin to productively use abstract language around 4 years of age. From these basic production data, it is difficult to draw any conclusions regarding the predictions of conceptual metaphor theory, however. On the one hand, there are clearly differences in how children use locative marking in abstract and concrete contexts, which would not necessarily be expected from a conceptual metaphor perspective. This is because once the child learns the locative marking system, it should be naturally extended into abstract locative contexts in that abstract concepts are processed as concrete ones.

However, there are also other ways these data might be explained. First, the abstract vocabulary is acquired later than concrete vocabulary overall (e.g., Gleitman, et al., 2005), which means abstract locative systems might be acquired later as well, even if they are rooted in the concrete systems. We saw from the data above that children make substitution errors, even in the concrete contexts. It has also been known for years that children go through an initial stage of locative omission in concrete contexts that looks similar to what we see in the abstract condition.
above (e.g., Brown, 1973). Thus, it is possible that the general developmental trajectory for locatives in both abstract and concrete contexts might be omission errors > substitution errors > correct production. On the other hand, if these abstract occurrences are really conceptual extensions from the concrete, then that should convey some advantage to the child in terms of speeding them along this developmental path. If they’ve already learned how to use concrete locatives correctly, there is no particular reason why they should have to learn the same markers from scratch in a new context. This differs from what would be expected from a lexical acquisition or usage-based perspective in that if the child is learning abstract expressions as lexical collocations, their knowledge of concrete locative marking would not be expected to relevant for acquisition. Thus, the root cause of accuracy problems in abstract contexts remains unclear. This will be further discussed in Part 3.

Two additional issues might affect our interpretation of these results. First, this task did not control for frequency and the number of items in each case and path type because of the need to create a natural narrative sequence. Specifically, the prompts included more concrete contexts than abstract ones, and the abstract contexts included more source target markers (because these are more often lexically required by abstract verbs), which, in concrete contexts at least, have been found to be less accurate than goal and state markers. Thus, this might have been a confounding factor in this experiment; it was controlled for in later tasks. Secondly, this task did not bear directly on the relationship between the abstract and concrete senses of the locative markers. It did not try to directly investigate whether children are transferring their knowledge of concrete space or concrete locative marking to abstract contexts, which would be the real test of whether children are using what they know about concrete locatives in abstract contexts. This more direct type of evidence was addressed especially by Experiments 3 and 5.
5.2 Experiment 2

Experiment 2 looked at the distinction between the conceptual and linguistic drivers of abstract locative marking by investigating whether the -kor errors found in Experiment 1 were driven by a conceptual or linguistic overgeneralization. While conceptual metaphor theory would not make any specific predictions regarding the role of conceptual overgeneralization in this case (since it is a purely abstract marker dealing with time with no synchronic connection to the spatial system), it is interesting to examine whether errors of this type are driven from within the linguistic system or whether they might have some conceptual basis.

Generally speaking, there are two reasons that overgeneralization of -kor might occur. First, the children might have made a conceptual error in which they overgeneralized a legitimate time marker into additional time contexts. Alternatively, it is also possible that these errors were due to morphological overgeneralization. It is not uncommon for children to overgeneralize grammatical rules after first learning them (e.g., Marcus, et al., 1992). In the acquisition of the regular past tense and other morphemes, for example, we see a so-called U-shaped learning curve, whereby children initially produce high frequency inflected forms correctly, but omit marking in other contexts. For example, a child might correctly produce broke, a highly frequent irregular form, but omit past tense marking in regular contexts. Following this early correct production, children will go through a period where accuracy on frequent items decreases as the regular inflection begins to be produced; for example, a child might start to produce incorrect forms such as *breaked. Finally, high levels of accuracy in both frequent and infrequent contexts return.

Looking at Hungarian, specifically, it is possible that rather than making a conceptual error, children might be overgeneralizing the case-marking rule for question and answer pairs
described in Part 1. Specifically, as introduced above, questions marked with locative markers (e.g., *miben* – in what) require responses marked with the same marker (e.g., *a dobozban* – in the box). In abstract contexts as well, if the question *melyik napon van a szülinapja* (on which day is his birthday) is asked, an appropriate response must also include the superessive case: *szombat* (on Saturday). This is relevant in that the basic Hungarian interrogative *when* is *mikor*, which, superficially, is composed of *mi* (what) + *-kor*. In the modern language, this is a fixed form, but, given the highly agglutinating nature of Hungarian, it is not unreasonable to imagine that a child might erroneously decompose this marker into its apparent constituents. If this were the case, then *mikor* questions would also require *-kor* marked responses, giving rise to the errors observed in Experiment 1.

In order to investigate these possibilities, the present experiment presented children (4- and 6- year olds) and adults with questions about time events in two formats: (1) using *mikor* (when) (e.g., *when is his birthday*) and (2) using locative-marked questions (e.g., *on which day is his birthday*). We reasoned that if children are driven by morphological constraints in their use of *-kor*, then there should be more errors with *-kor* after *mikor* questions. Thus, the hypothesis for this experiment is as follows: if the errors in Experiment 1 were caused by a morphosyntactic error, then we would expect to see a higher percentage of responses marked with *-kor* after *mikor* questions. If, on the other hand, the source of the *-kor* errors was conceptual, there should be no difference depending on which type of question was asked.
5.2.1 Method

5.2.1.1 Participants

Participants were 42 children and adults residing in Budapest, Hungary, as described below in Table 9:

Table 9: Participants for Experiment 2

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Male</th>
<th>Mean Age</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 yr</td>
<td>14</td>
<td>7</td>
<td>4;5</td>
<td>0;5</td>
</tr>
<tr>
<td>6 yr</td>
<td>14</td>
<td>7</td>
<td>5;11</td>
<td>0;4</td>
</tr>
<tr>
<td>adult</td>
<td>14</td>
<td>6</td>
<td>30</td>
<td>6;11</td>
</tr>
</tbody>
</table>

The children were middle- and upper-middle class native speakers of Hungarian who were attending nursery schools in Budapest. The adults were native-speaking Hungarian professionals working in Budapest. No participants had prior knowledge of the goals of the experiment. Three child participants from the youngest group were excluded for not understanding clocks and calendars.

5.2.1.2 Design and Procedure

This experiment involved answering questions about the time (hour, day, or month) that a given event occurred. The task included three practice items testing children’s understanding of clocks and calendars and six test items presented on PowerPoint slides. Each test item included (1) a pictorial depiction of an event, e.g., a child playing on the beach, (2) a time marker, e.g., a calendar showing the month of August, and (3) a recorded question regarding the time the event

---

13 A note on the participants for Experiments 2-5a: All of the adult controls and many of the children participated in all four experiments. When this occurred, the order of the tasks was counterbalanced to avoid ordering effects. Some children did not participate in all the tasks because they were absent on some of the testing days, or because they did not choose to participate in additional tasks. Preliminary analyses were conducted for all experiments to ensure that ordering did not influence the results.
occurred, e.g., “when does the boy play on the beach?” or “in which month does the boy play on
the beach?” The auditory stimuli were recorded by a native-speaking Hungarian female in a
child-friendly register. A depiction of the screen for one trial is below in Figure 6:

![Figure 6: Test Item for Experiment 1](image)

The six test items included two events depicting each of the following: clock time (7:00, 8:00),
months (August, September), and dates (Tuesday, Wednesday). For each participant, one
stimulus of each type was accompanied by a mikor (when) question (e.g., when does the little
boy play on the beach?) and the other was associated with a case-marked question (e.g., in which
month does the little boy go back to school). This was counter-balanced such that half the
participants saw each item with each type of question. All of the stimuli with morpheme-by-
morpheme glosses can be found in Appendix B.

Testing took place at nursery schools and offices around Budapest. All children were
tested in a quiet room at the nursery school they attended. Adult participants were tested at their
workplaces. Participants were seated next to the Experimenter in front of a Dell Latitude D600 laptop with a 14 inch screen. Sessions were video- and audio- recorded. The camera was positioned behind the child so that it recorded the screen and the child’s gestures, and the microphone was attached to a stuffed owl toy which sat on the table next to the child.

The task proceeded as follows: First, participants were presented with three practice trials which served the dual purpose of familiarizing them with the task and ensuring that the children had a basic understanding of the meaning of clocks and calendars, meaning that they could talk about points in time when assisted. For example, for the clock stimulus, the researcher used the following series of prompts: (1) *Ez egy óra, ügye?* (this is a clock, right?) (2) *Igen! És ez itt melyik szám …* (Yes! And what number is this here…[wait for response]) (3a – if correct) *Jó! Ez egy hármas szám!* (Good! It’s the number three!) Or (3b – if incorrect) *Ez egy hármas szám, ügye?* (It’s the number three, right?). Following this introduction, the child was invited to press the button to hear the question: “*Mit mutat az óra?*” (what does the clock show?) and respond to it. If the child was unable to answer the practice questions, his or her data was excluded from analysis. Three participants were excluded for this reason, as described above.

After the warm-up, the six test pictures were presented in randomized order. For each item, the event picture appeared first and then participants were invited to press the button that made the time marker appear (using standard PowerPoint animation). As with the practice trials, the experimenter ensured that the unit of time was clear to the children before proceeding to the question. For example, the experimenter would say, “this calendar means that it is August, right?” Then participants would be invited to press the button to hear and respond to the question. Each question was repeated twice. Overall, there were three items on which a child failed to respond to the question.
5.2.1.3 Coding

Each session was transcribed from the audio recording and coded from the transcript. The following codes were used: “correct -kor” was used when the response required the use of the -kor marker, and it was supplied appropriately (e.g., hétőrákor (7 o’clock)). “Incorrect -kor” indicated that the -kor marker was supplied inappropriately (e.g., if the child said augusztuskor (August-kor), instead of augusztusban (in August)). Similarly, “correct spatial” was used for appropriate suppliance of a locative marker (e.g., augusztusban), and “incorrect spatial” was used when a spatial marker was used in an inappropriate context (e.g., heten = on 7 (cf. at 7)). Only one such error of the latter type occurred. The code “non-spatial” was used if the child produced a case marker that was neither -kor, nor one of the spatial markers (e.g., the accusative, dative, or instrumental). “Omission” indicated that the child provided the relevant time expression, but without a marker (e.g., augusztus, hét), and “no response” indicated that the child failed to respond to the question. Finally “semantically inappropriate” indicated that the child responded in a way that did not answer the question. Twenty-two files (50%) were double-coded for reliability, which was 89% (κ = 0.86) across all codes.

5.2.2 Results

First, a preliminary analysis was conducted to ensure there were no ordering effects based on which experiment the child saw first. For this analysis, a one-way analysis of variance (ANOVA) was conducted with percent responses including -kor (overall) as the dependent variable, and the order in which the participant saw this task (1-4) as the independent variable. The result of this analysis was not significant F(3,41) = 0.63, n.s.

The main analysis included two independent variables: question type (mikor vs. locative-marked) as a within-subjects variable and age (4-years, 6-years, and adult) as a between-subjects
variable. The outcome measure was the percent of responses that included a -kor marker following each question type. As two of the questions were about clock time, which requires the -kor marker, ceiling performance was 33% for each condition. Figure 7 shows the means for each group:

![Figure 7: Percent of -kor Marked Responses by Age and Question Type, Experiment 2](image)

The data were analyzed using a two-way ANOVA. There was a main effect of question type, F(1,39) = 16.53, p < 0.001, as well as an interaction between age and question type, F(2, 39) = 4.63, p = 0.02. Younger children were more likely to respond using -kor after -kor marked questions. There was no main effect of age, suggesting that this difference was based on how the questions were asked and not on an inherent difference in how these time expressions are used across development.
5.2.3 Discussion

To summarize, the result of this experiment was that 4-year-old children produced more responses marked with -kor when responding to mikor (when) questions than when responding to locative-marked questions; this result seems to be due to morphological overgeneralization. When children heard questions including -kor, they responded with -kor, as would be required with other Hungarian case markers. It is possible that the presence of a locative marker in the question cued children into the relevant vocabulary domain, as discussed by (Shatz, et al., 2010), such that hearing a locative marker gave them a hint that the time expression they were being asked about required a locative, whereas the mikor context gave them no such clue. On the other hand, the questions were all about time, so the domain should have been clear. There were children (2 of the 28 children) who produced all -kor markers after mikor questions, suggesting that at least some children were following an erroneous morphological rule. Thus, it seems that generalizations within the linguistic system itself are likely to be important contributors to children’s production in addition to or instead of any conceptual influences. This finding is consistent with findings in usage-based grammatical development that suggest that lexical learning combined with extraction of grammatical patterns from the input are the primary drivers of children’s morphosyntactic production.

5.3 Conclusion

Taken together, Experiments 1 and 2 give a basic picture of the development of abstract locative marking in Hungarian. Three-year-old children were significantly less accurate than adults with abstract locative markers, but near ceiling in their ability to use concrete locatives accurately. The error patterns differed between abstract and concrete contexts, as well. Children made more omission errors in abstract contexts and more substitution errors in concrete contexts.
This suggests that there are differences in how children use locative markers in concrete and abstract contexts; although the source of this difference is as yet unclear. Experiment 2 further shows the importance of linguistic generalizations in constraining the early production of abstract locatives. Children produced more responses with the temporal marker -kor after questions involving mikor than they did after locative-marked questions. This pattern seems to be driven by a morphological overgeneralization of typical Hungarian question formation, rather than by a conceptual over-extension of -kor to additional time contexts. Thus, it seems that linguistic-system-internal generalization processes provide an important foundation for early production of abstract language.
Comprehension Tasks: Experiments 3 and 4

Experiments 3 and 4 had a shared goal – to determine if (and at what age) children apply their systematic knowledge of the spatial domain to abstract language. From the perspective of conceptual metaphor theory, we would expect to find evidence that when children process abstract language they are accessing the relevant image schemas, for example, CONTAINMENT or SOURCE-PATH-GOAL (M. Johnson, 2007). Whatever relationships hold between locative markers in concrete context should also be applicable to the abstract domain. In practical terms, this means that children should know that abstract locatives follow the same organizational system described above for concrete space (Newcombe & Huttenlocher, 2000). From a lexical learning perspective, on the other hand, we would not expect to see the same systematicity in children as in adults, since the density of adult semantic and lexical networks should allow for emergent properties not found in the child. In order to test these predictions, two comprehension tasks were designed to better assess children’s understanding of locative markers in abstract contexts. Comprehension tasks were used instead of production because children often comprehend a given component of language before they produce it themselves (e.g., Bates, 1993).\(^{14}\)

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\(^{14}\) This sense of *comprehension* can be distinguished from that discussed in the introduction (p. 2-3) in that here we are referring to the child’s ability to understand the communicative intent (or basic meaning) of an utterance, whereas the use of the term *comprehension* in the introduction refers to the child’s ability to break down and understand the morphosyntactic structure of an utterance. In the sense we are discussing here, understanding the basic communicative meaning of an utterance typically precedes one’s own production of that utterance type.
6.1 **Experiment 3**

Experiment 3 asked whether preschool-aged children are able to apply their knowledge of spatial relationships to a novel abstract locative context. Given a completely new abstract construction which described a mental state (thought) and incorporated a static locative marker \((\text{at or on})\), would participants use their understanding of spatial systematicity (e.g., the relationship between \(\text{on, onto, and off of}\)) to determine how to express, based on the nonce construction, a change of mental state (the thought occurring to someone)?

Specifically, we taught participants one of two nonce abstract nouns (\textit{tamap or lepec}), both of which were given the definition (in “Cat Language”) \textit{a thought about something you really want}. For each participant, the novel noun was taught in one of two static nonce constructions \((\text{the girl has a tamap/lepec on her, or the girl is at the tamap/lepec})\) accompanied by pictures of people thinking (using thought bubbles). In other words, we told participants that they were going to learn how to describe people thinking about things they really want in Cat Language. During the teaching phase, participants were exposed to seven examples of a single nonce abstract noun in a single static construction – a boy had a thought of really wanting an ice cream, a girl had a thought of really wanting a book, and so forth. Then, after confirming that participants had learned the construction and understood the basic ideas of thinking and their representation via thought bubbles, we gave them a forced-choice comprehension task to test how they would prefer to say, in Cat Language, that the given thought was occurring to someone. Participants could choose between two directional expressions based on the original static expression they learned. The two choices included either (1) a goal marker (e.g., \textit{the tamap is coming onto the person}) or (2) a source marker (e.g. \textit{the tamap is going off of the person}). The outcome variable for this experiment was which choice the participant made (goal or source).
An example of two possible expressions in both their static (13a and 14a) and directional (13b and c, 14b and c) variants are given below. For ease of reference in the analysis, we referred to the construction illustrated in (13) as thinker moving because in the directional variants the thinker is described as going to the thought. By the same token, the construction in (14) was labeled as thought moving because the thought is described as going onto the thinker.

(13) a. \[ \text{a lány/fiú a [tárgy] tamapjánál van} \]
the girl/boy the [object] tamap-3SG.POSS-AT be.3SG
“the girl/boy is at the tamap of [object]”

b. \[ \text{a lány/fiú a [tárgy] tamapjához megy} \]
the girl/boy the [object] tamap-3SG.POSS-TOWARD go.3SG
“the girl/boy is going to the tamap of [object]”

c. \[ \text{a lány/fiú a [tárgy] tamapjától megy} \]
the girl/boy the [object] tamap-3SG.POSS-AWAY.FROM go.3SG
“the girl/boy is going away from the tamap of [object]”

(14) a. \[ \text{a[tárgy] tamapja a lányon/fiún van} \]
the [object] tamap-3SG.POSS the girl-ON/boy-ON be.3SG
“the [object] tamap is on the girl/boy”

b. \[ \text{a[tárgy] tamapja a lányra/fiúra megy} \]
the [object] tamap-3SG.POSS the girl-/boy-ONTO go.3SG
“the [object] tamap goes onto the girl/boy”

c. \[ \text{a[tárgy] tamapja a lányról/fiúról megy} \]
the [object] tamap-3SG.POSS the girl-/boy-OFF.OF go.3SG
“the [object] tamap goes off of the girl/boy”

In terms of predictions, from a conceptual metaphor perspective, we would expect both children and adults to choose the goal-directed locative expressions (13b and 14b), both because of the bias towards goals over sources in spatial cognition (Lakusta & Landau, 2005), as well as...
because of conceptual metaphors which structure the mind in terms of containment (Kővecses, 2002, cf. *a thought occurred to me, an idea popped into my head*, etc.). From the perspective of lexical and grammatical development, on the other hand, we should expect changes across development, with adults exhibiting connections between the concrete and abstract domains not yet available to children.

The nonce word teaching paradigm employed here derives from work in usage-based language development research (e.g., Dodson & Tomasello, 1998), which ultimately originated with the *wug* test of Berko (1958). The goal of using nonce lexical and grammatical items is to test productivity, in other words, to ask whether the child can actively use a given aspect of language in a new context, beyond any specific expressions she may have learned. The ability to use a given construction in a novel context has been taken as the most conclusive evidence that it has been acquired and internalized by the child (e.g., Dabrowska, 2005). Here, the type of productivity being examined is semantic rather than grammatical. We are interested to see if participants are actively able to extend what they know about the systematicity of locative space into the abstract realm. For example, if the child knows that a person can be *in trouble*, can she apply that knowledge to the context of getting *into* and *out of* trouble.

### 6.1.1 Method

#### 6.1.1.1 Participants

The participants for this experiment were 81 children and adults from the same population described for Experiment 2. The demographics of this sample are described in Table 10 below:
Table 10: Participant for Experiment 3

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Male</th>
<th>Mean Age</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 yr</td>
<td>24</td>
<td>11</td>
<td>4;5</td>
<td>0;7</td>
</tr>
<tr>
<td>6 yr</td>
<td>28</td>
<td>14</td>
<td>6;0</td>
<td>0;6</td>
</tr>
<tr>
<td>adult</td>
<td>29</td>
<td>11</td>
<td>31;0</td>
<td>5;10</td>
</tr>
</tbody>
</table>

Fourteen participants were excluded from the sample for: not completing the task (n = 8) and missing two or more practice items (n = 6). As with Experiment 2, participants were recruited through their schools or workplaces. The children were provided with stickers for their participation.

6.1.1.2 Materials

Trials were presented using PowerPoint on a Dell Latitude D600 laptop with a 14 inch screen. Each trial depicted a young male or female looking up at a thought bubble containing a simple drawing of a familiar object (e.g., ice cream cone, car, sailboat, etc.). Pictures were accompanied by audio stimuli, which were recorded by a female native speaker of Hungarian in a child-friendly register and presented through the laptop’s standard speakers. Additionally, children were provided with green and red markers to indicate their choices during the test items (see Figure 11). Finally, a cat puppet was used to guide the children through the task.

6.1.1.3 Design and procedure

Participants were tested in a quiet room at their nursery school or workplace. Sessions were audio recorded and filmed so that the computer screen was visible and the child’s pointing could be clearly seen. Adult sessions were only audio-recorded and adults indicated their answers.

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15 Of the children who didn’t finish the task, 5 were from the 4 year old group and 3 were 6 year olds. Three children from each of the 4 and 6 year old groups missed practice items. Overall, 3 of the excluded children came from the TAMAP-nál group, 6 came from the TAMAP-on group and 5 came from the LEPEC-on group.
selection by saying \textit{bal} (left) or \textit{jobb} (right). The task was divided into two blocks, which, for most of the children, were presented on two consecutive days\textsuperscript{16}.

This task employed a between-subjects design with age group (4, 6, and adult) and construction type (thinker moving, thought moving) as independent variables. Additionally, to control for phonological factors, two different nonce words were used (\textit{tamap} and \textit{lepec}), both had the same meaning, \textit{a thought about something you really want}, and were used in the same way. Figure 8 below illustrates the design of this experiment, which will be described in what follows.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
\textbf{Warm up} & \textbf{Training} & \textbf{Test 1} & \textbf{Test 2} \\
\hline
\includegraphics[width=0.2\textwidth]{cat_language.png} & \includegraphics[width=0.2\textwidth]{learning.png} & \includegraphics[width=0.2\textwidth]{test_of_learning.png} & \includegraphics[width=0.2\textwidth]{extension.png} \\
\hline
\end{tabular}
\caption{Design of Experiment 3}
\end{table}

\textsuperscript{16} Because of scheduling constraints at the nursery schools, 75\% of the younger preschools and 46\% of the older preschoolers were tested on two days. The rest of the children were tested on a single day. This unanticipated group division and its effect on performance will be addressed in the Results section.
Warm-up phase: First, children were introduced to Cat Language using a cat puppet which looked similar to the brown cat in the Warm up panel above. They were told that they were going to learn a new word in Cat Language (either tamap or lepec). They were then presented with a sample training picture (similar to the one shown in the Training panel) to introduce the meaning of the nonce word and how to use it. This item also served to ensure that each child understood what thought bubbles represent. For the children who completed the task over two days, the warm up phase was repeated to refresh the child’s memory.

Training phase: The warm-up phase was followed by five training items presented in random order. All training items were of the type shown in the Training panel of Figure 8 above: a young male or female looking up at a thought bubble containing a clear, cartoon-style drawing of an object (e.g., a car, ice cream, book, sailboat, etc.). For each item, the children were invited to press the mouse button that activated the audio stimulus. Each sentence was repeated twice. The sentences each child heard were determined by condition. Each participant was randomly assigned to one of two construction types, which determined which frame he would be taught. Within each frame, participants were further randomly assigned to learn one of two abstract nouns. In the training phase, these were always presented in a static construction. The four resulting expressions are shown in (15) and (16) below:

(15) a. \( a \) lány/fiú a [tárgy] tamapjánál van
the girl/boy the [object] tamap-3SG.POSS-AT be.3SG
“the girl/boy is at the tamap of [object]”

b. \( a \) lány/fiú a [tárgy] lepecjénél van
the girl/boy the [object] lepec-3SG.POSS-AT be.3SG
“the girl/boy is at the lepec of [object]”
(16) a.  a [tárgy] tamapja a lányon/fiún van
the [object] tamap-3SG.POSS the girl-ON/boy-ON be.3SG
“the [object] tamap is on the girl/boy”

b.  a [tárgy] lepece a lányon/fiún van
the [object] lepec-3SG.POSS the girl-ON/boy-ON be.3SG
“the [object] lepec is on the girl/boy”

Block 2 repeated the introduction and two of the training items from Block 1, in order to refresh the memories of participants who did the task over two days. If both blocks were seen consecutively on the same day, the two introductory slides were not repeated, but in all cases, participants were shown two additional training items before the test items began.

As introduced above, the two constructions, which do not exist in adult Hungarian, were chosen to test two different semantic configurations (in the directional extension trial): thinker moving (the actor going to the thought), and thought moving (the thought going to the actor). This distinction is similar to the English contrast She arrived at the conclusion (thinker moving) vs. the idea came to her (thought moving). In Hungarian, however, the construction in (16) may be considered intuitively more similar to existing Hungarian thought-moving structures, as illustrated in (17) below:

(17) a.  eszébe jut
mind-3SG.POSS-INTO fall/come
“it occurs to him”

b.  észre vett
mind-ONTO take.3SG.PAST
“he realized”
For this reason, two different types of constructions were chosen to ensure that responses were
not based on straight analogy to expressions the child had already learned in Hungarian. This
will be discussed in the description of the Test 2 phase below.

In all cases, the pictures accompanying the utterances and the explanations of their
meanings were the same – the individual portrayed is having a thought about something he or
she really wants. Figure 9 gives an example of one of the pictures with its associated possible
descriptions (the full set of stimuli can be found in Appendix C):

![Figure 9: Sample picture for Experiment 3](image)

For this particular picture, a participant would hear one of four possible sentences, depending on
the condition he had been assigned to: (1) the girl is at the TAMAP of the car, (2) the girl is at
the LEPEC of the car, (3) the car TAMAP is on the girl, (4) The car LEPEC is on the girl.

*Test Phase 1:* Next, five test items were presented. The first four items (Test Phase 1)
provided a basic test of how well the children learned the new expression and whether they
understood the task. The fifth item (Test Phase 2) was the outcome measure for the experiment –
the test of whether participants were willing to make a directional extension based on the novel
static abstract expression they had learned. The screen for all five test items was set up as follows
(Figure 10):
Participants were asked to make a forced choice between two pre-recorded verbal descriptions of the picture, associated with speaker icons on opposite sides of the screen. Pressing the speaker icon on the left would trigger one of the sentences the speaker button on the right would trigger the other.

Children were given two large smiley-face markers to indicate which sentence was “good” and which sounded “strange,” modeled on those used by (Ambridge, Pine, Rowland, & Young, 2008). They were trained in advance to place the faces onto the keyboard on the side corresponding to the good/strange audio stimuli (i.e., if the strange sentence was on the left, the sad face would go on the left). Examples of what the faces looked like can be found below in Figure 11:

The test items for Test Phase 1 were divided into two pairs. The pairs were separated by a blank slide with a blue background. While the blue screen was showing, the experimenter introduced the next set of test items to the child.
The first pair of test items assessed the child’s ability to choose the picture depicted (in competition with another object) and the construction they were taught (in competition with the other construction that they didn’t learn). For example, paired with the picture in Figure 8, a participant might hear the following utterances for test item 1: (1) the girl was at the thought of the car, versus (2) the girl was at the thought of the ice cream. For item 2, he might hear: (1) the girl was at the thought of the car vs. (2) the thought of the car was on the girl.

The second pair of items used normal Hungarian sentences to introduce the notion of thoughts occurring to people and to ascertain whether the children understood this concept and that it could be represented by an appearing thought bubble. Children were told that they were going to hear some sentences in normal Hungarian (not Cat Language) and choose which one was “good” and which one was “strange”\(^\text{17}\). Following the explanation, the first item in this pair, for example, might show a picture with a bunny depicted in the thought bubble, paired with the following sentences: (1) “the thought of the sail boat is occurring to the girl” and (2) “the thought of the bunny rabbit is occurring to the girl.” This item again tested whether the children could reliably choose the depicted picture when confronted with two conflicting audio stimuli. The second item, for example, might depict a book in the thought bubble, paired with these sentences: (1) “the thought of the book is occurring to the boy,” versus (2) “the boy has a real book.” This item tested whether the children understood the difference between thinking and reality, as depicted by a thought bubble. Children who answered at least 3 of the 4 items in the test pairs correctly were included in the final sample.

\(^{17}\) The inclusion of this directional Hungarian expression might have provided a prime which could have biased the results in favor of goal-directed responses, especially in the object-moving condition. However, given that the 4 year old group performed randomly despite this potential prime (see below), the results of this experiment are not affected.
Test Phase 2: Finally, during Test Phase 2 specifically, the child was told that we were now going to decide how to say “eszébe jut” (the thought is occurring to him/her) in Cat Language. The last test item offered the choice between the goal and source sentences introduced above. Examples (13) and (14) from above are repeated below as (18) and (19):

(18) a.  
   a lány/fiú a [tárgy] tamapjánál van  
   the girl/boy the [object] tamap-3SG.POSS-AT be.3SG  
   “the girl/boy is at the tamap of [object]”

   b.  
   a lány/fiú a [tárgy] tamapjához megy  
   the girl/boy the [object] tamap-3SG.POSS-TOWARD go.3SG  
   “the girl/boy is going to the tamap of [object]”

   c.  
   a lány/fiú a [tárgy] tamapjától megy  
   the girl/boy the [object] tamap-3SG.POSS-AWAY.FROM go.3SG  
   “the girl/boy is going away from the tamap of [object]”

(19) a.  
   a[tárgy] tamapja a lányon/fiún van  
   the [object] tamap-3SG.POSS the girl-ON/boy-ON be.3SG  
   “the [object] tamap is on the girl/boy”

   b.  
   a[tárgy] tamapja a lányra/fiúnra megy  
   the [object] tamap-3SG.POSS the girl-/boy-ONTO go.3SG  
   “the [object] tamap goes onto the girl/boy”

   c.  
   a[tárgy] tamapja a lányról/fiúnról megy  
   the [object] tamap-3SG.POSS the girl-/boy-OFF.OF go.3SG  
   “the [object] tamap goes off of the girl/boy”

Participant response to this test item was the outcome variable for this task. Research in conceptual metaphor theory would predict more frequent GOAL responses (18b and 19b) than source responses (18c and 19c) as discussed above.
For the four static test trials, responses were coded according to the appropriateness of the child’s response to the picture shown. There were two items which juxtaposed a description of the presented image with a description that was not illustrated. For example, if a picture of a girl thinking about ice cream was paired with the following statements: “the girl is at the TAMAP of an ice cream” and “the girl is at the TAMAP of a car,” the correct response would be to choose the side with the description of the ice cream. A third item compared the construction the child learned with the one she did not learn (involving the same nonce noun). For example, if the same picture of the girl thinking about ice cream was presented combined with the statements: “the girl is at the TAMAP of the ice cream” compared with “the TAMAP of the ice cream is on the girl,” the child would be expected to choose the statement based on the construction she had learned. Finally, a fourth picture juxtaposed thought with reality. For example, if the same picture was paired with the statements: “the girl is thinking about an ice cream” and “the girl has a real ice cream,” the correct response would be the one involving thought. These four items were designed to provide a basic test of task comprehension and were unambiguous to the adults.

The final, directional trial was coded as being either “goal” (e.g., the girl is going onto the TAMAP of an ice cream) or “source” (e.g., the girl is coming from the thought of an ice cream), depending on which item the child chose. Reliability on 26% of the files (21/81) was 97% ($\kappa = .90$).
6.1.2 Results

6.1.2.1 Main analysis

First, a preliminary t-test was conducted to ensure that the phonological form of the verb (*tamap* vs. *lepec*) did not impact the results. The percent of goal-directed responses was the outcome variable. As expected, this analysis revealed no effect of verb $t(79) = -0.31, p = 0.76, n.s.$.

A preliminary univariate ANOVA was also conducted to ensure that there were no effects of the order in which participants completed this task. Also as expected, this analysis revealed no significant effect of task order $F(3, 77) = 0.16, p = 0.99, n.s.$.

Next, again using the percentage of goal-directed responses as the outcome variable, with age (4, 6, or adult) and construction (thinker moving, thought moving) as the grouping variables, a univariate ANOVA was conducted to ascertain the effect of these variables on the goal-directedness of the responses. The mean percentages of goal-directed responses by age group are presented in Figure 12 below:

![Figure 12: Percent of Goal Choices by Age, Experiment 3](image-url)
There were no main effect of construction, $F(1, 75) = 0.11, p = 0.74, n.s.$, but there was a main effect of age, $F(2, 75) = 5.46, p = 0.01$. The interaction between age and construction was not significant, $F(2, 75) = 0.86, p = 0.43, n.s.$ A Student-Newman-Keuls posthoc test revealed that the 4- and 6-year-olds did not differ from each other, but were significantly less likely to choose the goal response than the adults. Given that this task involved a binary forced choice, we confirmed these findings using a non-parametric Kruskal-Wallis test, with identical results.

There was a main effect of age on the goal-directedness of responses, $\chi^2 = 10.02, p = 0.01$. There was no effect of construction, $\chi^2 = 0.10, p = 0.75, n.s.$, or verb $\chi^2 = 0.10, p = 0.75, n.s.$ Thus, it seems that children initially choose between the goal- and source-directed options randomly, and performance becomes more goal-directed with age.

### 6.1.2.2 Effects of task design

We were also interested in whether the physical set up of the task had any effect on the results. The position of the correct responses and the order in which the stimuli were played were counter-balanced. Still, we suspected that there might have been a general bias towards choosing the side that was played first. To test this, we ran a second univariate ANOVA with the percent of right-side responses as the dependent variable and the side that was played first (left or right), the side the goal was on (left or right), and age (4, 6 or adult) as the independent variables. We found significant main effects of age, $F(2, 69) = 10.76, p < 0.001$, the side played first, $F(1, 69) = 10.76, p = 0.02$, and the side the goal was on, $F(1, 69) = 15.76, p < 0.001$. There was also a significant interaction between age and the side the goal was on, $F(2, 69) = 7.25, p < 0.001$. A Student-Newman-Keuls posthoc test revealed that 4 year olds were significantly less likely
overall to choose the response on the right side than older children and adults, indicated by the subscripts in the table below. The mean scores by age group are presented in Table 11 below:

Table 11: Percent of Right-Side Responses, Experiment 3

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Right Side played first</th>
<th>Goal on Right Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 year olds</td>
<td>0.16 (0.08)</td>
<td>0.31 (0.11)</td>
<td>0.14 (0.12)</td>
</tr>
<tr>
<td>6 year olds</td>
<td>0.69 (0.08)</td>
<td>0.79 (0.14)</td>
<td>0.85 (0.13)</td>
</tr>
<tr>
<td>adults</td>
<td>0.48 (0.08)</td>
<td>0.57 (0.12)</td>
<td>0.89 (0.11)</td>
</tr>
</tbody>
</table>

These results suggest that performance in the youngest children was being driven by factors other than whether the locative marker was goal- or source- oriented. This fits, of course, with the chance performance of this group on the task.

Finally, as discussed above, this task was initially designed to be conducted across two consecutive days for the child participants. This was to ensure that children had enough time to learn the new construction and to allow for any memory consolidation that might take place during sleep (e.g., Stickgold, 2005). In practice, however, the schedule at the nursery schools was such that many children were not able to be tested on consecutive days, and so had to be tested in a single session. Single-session testing occurred with 25% of the younger preschoolers and 54% of the older preschoolers. Because of this, we wanted to see what effect the additional time for learning and consolidation might have on the children. For this purpose we conducted a third univariate ANOVA with the original dependent variable (the percentage of time the goal option was chosen) and age and number of days tested (1 or 2) as the independent variables. The means are shown in Figure 13:
The results of this analysis were somewhat surprising in that there was a significant interaction between age and the number of days tested, $F(1, 76) = 5.41, p = 0.02$. From the graph, it is clear that, as would be expected, the 5 and 6 year olds who were tested on two days performed more like adults than those tested on a single day. For the 3 and 4 year olds, however, performance actually became less adult-like if they were tested on separate days. Possible reasons for this finding will be discussed below.

### 6.1.3 Discussion

Taken together, these results suggest that children are not initially transferring their locative knowledge from the concrete to the abstract domain when faced with a novel abstract context. The performance of the 4 year olds was at chance overall. Moreover, children at this age seemed to be driven primarily by factors of task design such as which stimulus was presented first. In the 6 year olds, there was the beginning of a clear tendency towards adult performance.
Children at this age were also strongly impacted by the division of testing across two days, such that their performance reached almost adult-like levels when they had additional time to learn.

This raises the question of why the younger children showed the opposite pattern of the older ones when tested across two days. A simple explanation might be that the children from the younger group who completed the task in a single day were linguistically more advanced, and so performed more similarly to adults. Another possibility might have to do with the degree to which the patterns/rules for using the spatial system in abstract language had been internalized by the child. It is possible that they younger children simply responded using straight analogy to the expressions they had learned about thought (e.g., *come into mind, take something onto one’s mind*). They might have chosen the option that was most similar to the expressions they already knew. In this case, very little learning *per se* would have taken place to consolidate. Children tested on the second day, then, would be drawing analogies as well, but this time from only two exemplars as opposed to the five exemplars presented during the first testing session. For the older children, true acquisition of the metaphorical correspondences between the locative system and abstract contexts would be underway, and so the additional time for memory consolidation produced a cumulative learning experience that allowed them to improve their performance with additional time. This type of explanation would have the same foundation as the U-shaped learning curve in morphological development discussed above (e.g., Marcus, et al., 1992).

Initially, children perform very accurately in their suppliance of irregular past tense forms, for example, because these forms have been memorized. As children learn the rules governing the regular past tense, however, performance on irregulars declines for a time, before the use of both the regular and irregular systems become adult-like.
In terms of limitations, when considering the results of this task, it should also be made explicit that this was a very complex task with a lot to learn – children had to acquire a new abstract verb in a new construction and then apply that knowledge to a comprehension. Thus, it is possible that children in the youngest group have more knowledge about the systematicity of abstract language than they were able to demonstrate in this context; it is possible that with an easier task, children would exhibit this understanding earlier. However, given that no study of abstract lexical knowledge or metaphor understanding has found this ability in 3 year olds, and that the general pattern in this admittedly limited literature is that 4 year olds have a weak understanding of metaphoric concepts which improves in 5 and 6 year olds, it seems that the results of this study fit with previous literature. It takes children time to learn how their language uses locative marking to organize abstract concepts; they do not seem to use the organization of spatial marking to bootstrap them into the abstract system.

6.2 Experiment 4

Experiment 4 took a somewhat different tack and looked at the strength of the connection between verbs and the locative markers they select. As discussed above, abstract verbs appear to lexically select a single case or adposition to mark their arguments. This seems to be a lexical and grammatical feature of abstract language as opposed to a conceptual one. On the other hand, from a conceptual metaphor perspective, even such lexical choices should be expected to draw on the concrete locative system and be rooted in conceptual metaphors. *Harry is in the Elks, not on* them or *at* them, for a reason – because groups are metaphorical containers (Lakoff & Johnson, 1980, p. 287).

To test the strength of children’s verb-based preferences, we gave participants a forced choice comprehension task where they had to choose a picture to associate with a normal
Hungarian sentence which used the opposite case marker from the one that would normally be expected (e.g., the sentence might be *the boy is out of love with the girl*) and the two pictures would be a boy giving a girl flowers (the verb-based interpretation) versus one where he was angrily snatching them away from her (the locative-based interpretation).

In terms of predictions for the outcome of this experiment, then, from the perspective of usage-based grammatical development, we would expect that adults would have strong verb-driven interpretative biases because of cognitive mechanisms such as entrenchment, which create preference for learned and familiar constructions. In children, this preference might be weaker than it is in adults. Akhtar (1999), for example, found that 2-year-old English-speaking children were willing to learn new verbs in Subject-Object-Verb order, despite very strong evidence that English uses Subject-Verb-Object order. This finding was attributed to children not yet having built a fully general transitive construction. By extension, it is possible that 4-year-old children might not yet be confident in their knowledge of the locative marker that a given verb lexically selects, and so might be willing to entertain alternatives. In this case, children should not exhibit a discernable pattern to their choice of marker. From a conceptual metaphor perspective, the predictions are less clear. If we assume that the locative content of these expressions should play a role in how they’re interpreted, we should expect participants, children and adults, to be influenced by the presence of an unconventional locative marker – they should choose the locative-driven interpretation.
6.2.1 Method

6.2.1.1 Participants

Participants for this study were 88 preschool students and adults drawn from the same population as those described for Experiments 2 and 3. Participant demographics can be found in Table 12 below:

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Male</th>
<th>Mean Age</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 yr</td>
<td>29</td>
<td>15</td>
<td>4;3</td>
<td>0;6</td>
</tr>
<tr>
<td>6 yr</td>
<td>30</td>
<td>15</td>
<td>5;10</td>
<td>0;7</td>
</tr>
<tr>
<td>adult</td>
<td>29</td>
<td>11</td>
<td>31</td>
<td>5;11</td>
</tr>
</tbody>
</table>

One child participant from the 4-year-old group was excluded because he did not understand the meaning of one of the verbs and he missed the practice question.

6.2.1.2 Materials

Materials for this task were color cartoon pictures presented using PowerPoint on a Dell Latitude D600 laptop with a 14 inch screen. Audio stimuli were recorded by a female native speaker of Hungarian in a child-friendly register. Sessions were video- and audio- taped such that the computer screen was visible and pointing could be clearly seen. The full set of stimuli with morpheme-by-morpheme glosses can be found in Appendix D.

6.2.1.3 Design and procedure

The design of this experiment was between subjects, with the percentage of verb-based responses as the dependent measure and age as the independent variable. Additionally, in order to confirm that sentence order would not affect the choice, sentence order was varied such that half the participants heard a sentence with Subject-Object-Verb (e.g., “the child away from the
teacher is paying attention”) order and half heard a sentence with Subject-Verb-Object order ("the child is paying attention away from the teacher"). These are both possible word orders in Hungarian.

Testing was conducted in a quiet room at the participant’s school or workplace. Participants were told that they would hear “funny” sentences that were not correct in Hungarian. We wanted to know what the participants thought they might mean. A concrete practice picture was then given to ascertain whether the children were able to choose a sentence that did not match the way things are in the real world. This picture is in Figure 14 below:

Figure 14: Practice Item for Experiment 4

The stimulus sentence for this picture was “the dog is walking the man.” If a participant chose the incorrect picture on this item his or her data was excluded.

Next the four\textsuperscript{18} test items were presented in random order. Pictures were shown adjacent to one another on the screen as shown in Figure 15 below:

\textsuperscript{18} Only 3 of the 4 test items were included in the analysis because one of the items (the cat is afraid towards the fox) turned out to be ambiguous. Child participants were not willing to entertain the notion that a fox might be afraid of a cat (reasonably in retrospect) and the pictures were rather unclear (see Appendix D).
For each item, participants were invited to press the button that activated the audio stimulus and then point to their selection. For the example in Figure 15, the sentence was as follows:

(20)  a kisfiúnak kedve van a répától (or a kisfiúnak a répától van kedve)
The little-boy-DAT desire be.3SG the carrot-FROM
“the little boy likes away from the carrot”

After participants made their choice, the slide was advanced to the next item. The children received stickers for their participation.

6.2.1.4 Coding

Responses were coded as being either verb-based or locative-based. Reliability on 21 of the 88 transcripts (24%) was 98% (κ = 0.92).

6.2.2 Results

First, as a preliminary analysis, a univariate ANOVA was conducted with sentence order (OV vs. VO) as the independent variable and percent of verb-based responses as the outcome measure. As expected, this analysis was not significant, F(1, 86) = 0.63, p = 0.43, n.s.. A second preliminary analysis was also conducted to ensure that there were no task-ordering effects. Similarly, this analysis did not reveal any significant effect, F(3,84) = 0.46, p = 0.71, n.s.
Next, the affect of age (4 years, 6 years, or adult) on the percent of verb-based responses was tested using a second univariate ANOVA. This analysis revealed a significant effect of age, $F(2, 85) = 3.20, p = 0.05$. The means for each group can be found in Table 13 below:

<table>
<thead>
<tr>
<th>Age Level</th>
<th>Percent Verb Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 year olds</td>
<td>0.77 (0.04)</td>
</tr>
<tr>
<td>6 year olds</td>
<td>0.88 (0.04)</td>
</tr>
<tr>
<td>adults</td>
<td>0.91 (0.04)</td>
</tr>
</tbody>
</table>

A Student-Newman-Keuls post-hoc test indicated that 4 year olds were less likely than adults to choose the verb-based option, as indicated by the subscripts in Table 13 above.

6.2.3 Discussion

This task found a very strong verb bias in adults, as would be predicted by research in usage-based development which would expect strong entrenchment in adults. As one adult put it, if she heard someone say a sentence with an opposite locative marker, she would just assume the speaker had made a mistake. For the children, as well, the verb bias was strong and increased with age. The youngest children, 4 year olds, chose the verb-based response more than 75% of the time and the older children, preferred the verb-based response almost as often as adults. This suggests that the lexical selection of the verb is a much more important driver of locative marking than the underlying systematicity of the locative system. However, the fact that the youngest children were less verb-driven raises the possibility that they are more open to transferring what they know about the locative system into these abstract contexts. There is one
main reason to think this is not the case. Specifically, when children did select the interpretation based on the locative marker, they apparently did so randomly in all but one instance. Children would typically choose one locative-based response and the others verb-based. The item on which the locative was preferred varied across children. Only one child categorically preferred the locative-based responses over the verb-based ones.

This result suggests that the verb is a much stronger driver for interpreting a sentence than the case marker and that even a salient change in locative-marking can not deter individuals from a verb-based interpretation. It also suggests that children are less secure in their verb-based interpretations than adults. Since there was only one child who systematically chose the case-based interpretations, whereas other children most typically chose one picture from the locative-based groups and the other two from the verb-based group, this suggests that the children were behaving randomly when they chose the case-based interpretations, as opposed to demonstrating a systematic preference for locative-based interpretations. This is also consistent with the random performance of 4 year olds in Experiment 3.

6.3 Conclusion

Taken together, Experiments 3 and 4 suggest that children are not driven by their knowledge of spatial systematicity in their comprehension of novel and unusual abstract locative expressions. In Experiment 3, 4-year-old children selected randomly between goal- and source-directed options, in a context where adult language, and conceptual metaphor theory, clearly prefer a goal-directed choice. In Experiment 4, adults categorically preferred a verb-based response in unusual abstract contexts, whereas children were less secure in their preferences. Rather than systematically choosing locative-based responses, however, the children seemed to be unsystematic in their choices of verb- versus locative-based responses. In sum, these
experiments suggest an important role for lexical and grammatical learning in the development of adult-like interpretative patterns. There is no evidence that children are using what they know about the systematicity of spatial language to bootstrap themselves into an understanding of relationships in the abstract domain.
7 Priming Tasks: Experiment 5

The goal of Experiment 5 was to investigate whether increased production of abstract locatives can be primed by exposure to concrete locative expressions (5a) or spatial scenes (5b). As we have seen in the adult literature, exposure to concrete language and visual scenes does impact how participants process abstract language (e.g., Boroditsky & Ramscar, 2002; Casasanto & Boroditsky, 2008). We were curious if the same would be true for children. In order to investigate this possibility, Experiment 5 used a modified structural priming methodology (e.g., Savage, Lieven, Theakston, & Tomasello, 2005). The task was based on a finding from Experiment 1 that preschool-aged children often produced clausal descriptions of abstract scenes that omitted the obligatory spatial markers as shown in (21b) below. The more acceptable adult variant is shown in (21a):

(21)  a. *arra emlékszik a fiú, hogy...
that-ONTO remember.3SG the boy that
“the boy remembers that…”

b. *a fiú emlékszik, hogy...
the boy remember.3SG that...
“the boy remembers that…”

We initially asked if participants could be primed to produce elevated rates of locative-marked descriptions of abstract scenes after exposure to either (1) descriptions of concrete scenes using the target case marker (e.g., She’s putting the book onto the shelf!) or (2) exposure to the same concrete scenes with presentation of the relevant NPs only (e.g., girl! book! shelf!).

Following the presentation of each prime, participants were asked to describe a picture of an abstract scene using a given verb requiring the primed locative marker (e.g., think + onto). If participants produced higher rates of locative-marked NPs after hearing full sentential
descriptions of concrete scenes (lexical prime condition), this would imply that there is at least a lexical/semantic connection between the concrete and abstract senses of these markers which would allow for priming. If participants were also primed to produce higher rates of locative-marked descriptions after just seeing the concrete relationship (conceptual prime condition), this would imply that there is also a conceptual connection between the concrete relationship (e.g., CONTAINMENT) and their abstract uses (e.g., trusting in someone), as would be predicted by research in conceptual metaphor theory.

Based on the results of Experiment 5a, Experiment 5b attempted to further isolate the conceptual relationship between abstract and concrete locative expressions, by accompanying the same prime pictures with sentences describing some other aspect of the picture rather than the spatial relationship (e.g., the boy really likes the picture of the cow). This was done in order to encourage participants to focus on the picture without specifically locative linguistic cues.

In terms of predictions, from a conceptual metaphor perspective, we should expect to see increased production of abstract locative markers both after exposure to descriptions of concrete locative expressions and visual spatial scenes. From the perspective of previous literature in language development, on the other hand, there should not necessarily be priming of any kind in the youngest children, but we might still expect to find priming in adults, in line with previous conceptual metaphor literature.

7.1 Experiment 5a

As described above, this was a priming task which asked whether participants could be primed to produce elevated levels of abstract locative expressions after hearing the target locative marker used in a concrete context as opposed to hearing a neutral sentence describing an
object. In other words, we asked whether a participant who had just heard the expression *the toys are in the box* would be more likely than participants who had just heard *there are a lot of toys* to produce an abstract expression like *he trusts in the girl*.

### 7.1.1 Method

#### 7.1.1.1 Participants

Eighty-one children and adults participated in this experiment. The demographics for this population are presented in Table 14 below:

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Male</th>
<th>Mean Age</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 yr</td>
<td>24</td>
<td>13</td>
<td>4;6</td>
<td>0;6</td>
</tr>
<tr>
<td>6 yr</td>
<td>28</td>
<td>17</td>
<td>5;11</td>
<td>0;6</td>
</tr>
<tr>
<td>Adult</td>
<td>29</td>
<td>11</td>
<td>31</td>
<td>5;11</td>
</tr>
</tbody>
</table>

Child participants were recruited from nursery schools in Budapest, Hungary, as described for previous experiments. Adult participants were the same group of professionals living in Budapest, as participated in Experiments 2-4. Twenty child participants, 17 from the 4-year-old group and 3 from the 6-year-old group, were excluded from analysis for: not finishing the task (n = 7), failing to produce any complete sentences (n = 7), failing to produce any abstract language (n = 5), and not being a native speaker (n = 1).

#### 7.1.1.2 Design and materials

This experiment employs a 3(age) x 2(prime type: object, relationship) x 2 (prime description: full sentence, vocabulary only) mixed design with repeated measures across prime type. That is, every participant was exposed to a single set of 8 test items (16 pictures altogether, divided into 8 prime-target pairs) representing four case markers (*-ról* = off of, *-tól* = from, *-ra* = into, *-be* = into).
= onto, and -ban = in). Four target pictures followed object prime pictures and 4 followed relational prime pictures. For each participant, one depiction of each case marker followed an object prime and one followed a relational prime. The verbs included in this task were adapted from the list of abstract verbs used by (Papafragou, et al., 2007). The pairing of primes with targets was counter-balanced across participants and the order of presentation was randomized. The pictures were further divided into two blocks presented on consecutive days, if necessary. Only two children elected to do the task over two sessions; the rest of the participants completed both blocks consecutively. Table 15 provides a complete example of one set of primes and target items (for the locative marker -ról (off of)) which will be described in more detail below. The complete stimuli for this Experiment with full morpheme-by-morpheme glosses can be found in Appendix E.

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Condition</th>
<th>Sentence Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pohár! Asztál !</td>
<td>Cup ! Table !</td>
<td>A pohár leesik az asztálról !</td>
</tr>
<tr>
<td>Almodik a fiú !</td>
<td>The boy is dreaming !</td>
<td>The boy is dreaming !</td>
</tr>
</tbody>
</table>

Table 15: Complete Example for the Locative Marker -ról, Experiment 5a
<table>
<thead>
<tr>
<th>Vocabulary Condition</th>
<th>Object Prime (-ról)</th>
<th>Target (-ról)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A lot of dishes !</td>
<td>Sok edény !</td>
<td>Mesél a fiú!</td>
</tr>
<tr>
<td>Milyen sok edény van ott !</td>
<td>There are a lot of dishes there!</td>
<td>The boy is talking!</td>
</tr>
</tbody>
</table>

As described above, each case marker used in this study was represented by two target pictures and two primes. The target pictures depicted abstract verbs requiring the given case marker (in this case álmodik = dream and mesél = tell a story), the relational prime picture illustrated the standard concrete meaning of the locative marker (in this case -ról = off of), and the object prime depicted a simple object or group of objects from a similar semantic category to the objects shown in the relational picture (in this case, dishes). The descriptions of the prime pictures varied by condition. In the first condition (vocabulary only), the nouns depicted in the prime picture were simply named (e.g., glass! table!). In the second condition (full sentence), the prime picture was described with a full sentence (e.g., the glass is falling off of the table). The full sentence condition served as a lexical prime, where the participants would be exposed to the locative markers in concrete contexts. The vocabulary condition was intended as a conceptual prime, whereby participants would be exposed to the relationship only, without hearing the relevant locative marker. In the example given above, half of the participants saw the target
álmódik paired with the object prime and half saw it with the relational prime. The same holds for the mesél target picture. After seeing the prime picture, participants were presented with the target verb and asked to use it in a sentence describing the picture. All stimuli were recorded in advance by a female native speaker of Hungarian in a child-directed register. The outcome measure for this task was the percentage of target items in each condition that was described using the target locative markers. As the object primes depicted simple objects only, performance on these items was considered to be a within-subjects baseline control.

7.1.1.3 Procedure

Each participant received two practice items before the testing session. These were depictions of concrete actions in either transitive (build) or ditransitive (give) frames. Practice items were used to illustrate the procedure and to ensure that the children were able to produce sentences using a verb provided by the computer. Following this warm-up, participants were presented with the eight pairs of items in random order on a Dell Latitude laptop computer with a 14 inch screen. All prompts were played from the internal speakers of the laptop. As described above, each participant was assigned randomly to a description condition (vocabulary or full sentence) which determined how the pictures they saw would be described. Each prime description was repeated twice. The presentation of the target pictures was always be accompanied by the abstract verb to be used (e.g., “Thinking! The boy is thinking!”) recorded by a female native speaker of Hungarian in a child-directed register.

The experimenter helped the children to transition between pictures and provided prompts where necessary. Given the structure of Hungarian it was not possible to ask direct questions to elicit picture descriptions because such questions necessarily contain the target locative markers (e.g., Mire gondol? = what is he thinking about. The question form mire
includes the target marker -re). Thus, if prompting was necessary, as it often was for the youngest children, the experimenter first asked “how can we continue the sentence?” If such a prompt was unsuccessful in eliciting a response, the experimenter began the sentence for the child by repeating the computer prompt with intonation suggesting that the sentence should be completed while simultaneously pointing to the object of the thinking, dreaming, etc. (e.g., the boy is thinking…). Responses were video and audio-recorded for later analysis. The video camera was positioned to show the computer screen in order to be sure what the child was pointing at when pointing occurred. The children received stickers for their participation.

7.1.1.4 Coding

The responses for each target item were transcribed, including any experimenter prompts. Reliability for 49 transcripts (39% of the 126 files for Experiment 5, overall) was 90% (κ = .86). The categories used in coding are described in what follows:

Expected locative marker: this code was used when the expected case marker (e.g., -ról on an item where this was the target marker) was produced. This code was used anytime the target marker was used, even if a full sentence was not produced (e.g., if the child simply said a focizásról = about football for the dream item shown above, this was counted as a correct use of the marker).

Other locative marker: This code was used if any of the other nine basic locative markers was produced. This code was applicable for case marking errors, as well as for when other verbs were produced. For example, the verb gondol (to think) takes the marker -ra (onto). Semantically, this verb is almost synonymous with the verb gondolkodik (to consider, think.
about) which takes the marker -ról (off of). If the child produced gondolkodik with -ról, instead of gondol with -ra, this was coded as the “other locative marker” category.

_Non-locative markers or omissions:_ This category was used for all abstract responses which did not include any case marking or which included only non-locative markers such as the accusative or dative. A response was considered to be abstract if it dealt with the mental content of the picture, but not if it simply described the actions represented. The response “the boy is dreaming that he’s playing football” was coded as abstract, for example, while the response “the boy is dreaming and playing football” was not. The majority of responses that received this code included subordinate clause that was not locative-marked such as, “the boy is dreaming that he will be a big football star one day.”

_Non-abstract:_ This category included all utterances that did not deal with the abstract content of the target picture. A common type of response in this category involved a child simply describing the actions depicted without making any connection with the mental content, for example, “the boy is sleeping and they’re playing football there.” Personal and unrelated utterances (e.g., “I like playing football”) were also included in this category.

_No-response:_ This category was used either when no response was produced, or when the child did not understand the meaning of a verb.

### 7.1.2 Results

#### 7.1.2.1 Main analysis

A preliminary repeated-measures ANOVA was conducted to ensure that task ordering did not influence the results of this task. As expected, there was no effect of task order, F(3,77) = 0.23, p = 0.87, n.s.
The outcome measure for this task was the percentage of responses including the expected locative marker following object primes as compared with relational primes. A two-way ANOVA was conducted with prime type (object or relational) as a within-subject variable and age group (4, 6, adult) and description type (vocabulary or sentence) as between subjects measures. This analysis yielded a main effect of age, $F(2, 75) = 32.50$, $p < 0.001$, and a main effect of prime type, $F(1,75) = 4.09$, $p = 0.047$. No other main effects or interactions resulted. The means and standard errors are presented in Table 16. A Student-Newman-Keuls post hoc test revealed that the 4 and 6 year olds produced significantly less expected locative marking than the adults, as indicated by the subscripts attached to the group titles in Table 16.

Table 16: Means by Prime Type and Condition, Experiment 5a

<table>
<thead>
<tr>
<th></th>
<th>4 year olds&lt;sub&gt;a&lt;/sub&gt;</th>
<th>6 year olds&lt;sub&gt;a&lt;/sub&gt;</th>
<th>Adults&lt;sub&gt;b&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Object</td>
<td>Relation</td>
<td>Object</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>.29 (.07)</td>
<td>.31 (.08)</td>
<td>.30 (.07)</td>
</tr>
<tr>
<td>Sentences</td>
<td>.17 (.07)</td>
<td>.21 (.08)</td>
<td>.30 (.07)</td>
</tr>
</tbody>
</table>

As there was no significant difference between the sentence and vocabulary-only conditions, they were collapsed in the graph below (Figure 16) in order to more clearly show the priming effect:
Thus, it is clear that priming was found in each age group overall, suggesting that there is a connection between the lexical entries of abstract and concrete locative markers, even in the youngest children tested here.

7.1.2.2 Item analysis

Because of the unavoidably different frequencies of the test items, the lexical selection of the case markers by the verbs, and the possibility that individuals would have different preferences regarding the use of locative marking, we also wanted to look at the individual and item variation in more detail.

First, it is clear that the frequencies of the verbs used differed substantially from one another. This was unavoidable in that the number of abstract verbs that can be depicted, require locative markers (as opposed to grammatical case), and might be expected to be familiar to preschoolers is limited. Table 17 shows the approximate frequencies of the verbs used in the sample. Present and past tense forms in all persons were collapsed together for this purpose.
Frequency numbers were taken from the Hungarian web corpus (Halácsy, et al., 2004; Kornai, et al., 2006):

Table 17: Verb Frequencies for Experiment 5

<table>
<thead>
<tr>
<th>Frequency Rank</th>
<th>Verb</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>fél (fear)(^{19})</td>
<td>251,264</td>
</tr>
<tr>
<td>2</td>
<td>gondol (think)</td>
<td>27,041</td>
</tr>
<tr>
<td>3</td>
<td>emlékszik (remember)</td>
<td>14,572</td>
</tr>
<tr>
<td>4</td>
<td>bízik (trust)</td>
<td>10,592</td>
</tr>
<tr>
<td>5</td>
<td>mesél (tell)</td>
<td>7,734</td>
</tr>
<tr>
<td>6</td>
<td>álmodik (dream)</td>
<td>4,095</td>
</tr>
<tr>
<td>7</td>
<td>reménykedik (hope)</td>
<td>2,583</td>
</tr>
<tr>
<td>8</td>
<td>elképed (be surprised)(^{20})</td>
<td>&lt; 1,000</td>
</tr>
</tbody>
</table>

Clearly, there were vast differences in frequency between these lexical items which might have affected the results. Specifically, children might be expected to better know which locative marker is associated with more frequent abstract markers and so produce more locative marking. Adults, as well, might be more inclined to produce locative marking with more frequent verbs in that locative marking is ostensibly required in abstract contexts. To investigate this possibility, we conducted a MANOVA with verb as a within-subjects variable and age as a between subjects variable. As in the main analysis, the outcome measure was the percent of responses using the expected locative marker. A graph of the mean rate of locative production by verb can be found in Figure 17. The verbs are ordered from left to right according to frequency:

---

\(^{19}\) It was somewhat problematic to count frequency for this verb because *fél* also means “half” in Hungarian. Every effort was made to separate these senses, but, given that the corpus is organized as a simple frequency list, this number is almost certainly still too high. In any case, *fél* was by far the most frequent verb in this sample, which would doubtless be the case even if these two lexical items could be reliably separated.

\(^{20}\) This verb did not appear in the top 100,000 most frequent words in the corpus, meaning that it appeared less than 1,000 times in the corpus as a whole.
This analysis revealed main effects of verb, $F(7, 546) = 9.59$, $p < 0.001$, and age, $F(2, 78) = 33.05$, $p < 0.001$. A Student-Newman-Keuls post-hoc confirmed that children of both age groups produce lower levels of locative marking than adults, as shown by the main analysis. There was also a significant interaction between age and verb, $F(14, 546) = 2.98$, $p < 0.001$. Thus, there are clear preferences for locative marking based on the lexical properties of the individual verbs in question. For older children and adults, this does not seem to be tied exclusively to the relative frequencies of the verbs in question. For the youngest children, however, it does seem that frequency is the primary driver of locative production, as would be expected under a lexical learning account. The more frequent the verb, the more likely it is that the child will know which locative marker it selects.
7.1.2.3 Error analysis

Altogether there were 14 locative substitution errors produced by the children in this sample (out of 528 total child utterances). The break-down of these errors by verb can be seen below in Figure 18:

The majority of these substitutions involved using -ról (off of) in place of the target marker (n = 11). The other three errors were: one substitution of -ra (onto) for -ban (in) with bízik (to trust), one use of -on (on) instead of -ban (in) with reménykedik (to hope), and one use of the accusative with reménykedik (to hope). Some examples of these errors can be seen below:

(22) Elképed a fiú. Elképed a fiú az elefántról.
    surprise.3SG the boy. surprise.3SG the boy the elefant-OFF.OF
    The boy is surprised by the elephant (used -ról instead of -tól)

(23) úgy hogy azon reménykedj, hogy valami jót kap.
    so that that-ON hope-SUBJ.3SG that something good-ACC receive
    “…that he hopes that he’ll get something good.”
The overwhelming predominance of errors in which -ról was substituted for other abstract locative markers raises the possibility of it being a default marker. This will be discussed in more detail in section 7.3.

7.1.3 Discussion

In sum, then, the result of this experiment was that participants were primed to produce elevated levels of abstract expressions involving locative markers after being exposed to concrete scenes depicting the relevant locative relationship with an accompanying verbal description. There was, however, no difference depending on whether the locative marker was produced in a full sentence or whether only the vocabulary associated with the locative scene was produced. That is, participants produced the same rates of abstract locative expressions after full sentence primes as after vocabulary-only primes. This is somewhat puzzling given that, if there is true conceptual priming here, we should expect to see higher levels of priming in the sentence condition (which adds a lexical prime to the mix) than in the vocabulary-only condition.

One possible explanation for this result is that participants were primed lexically in both cases. Take the following example (Figure 19):
Participants in the vocabulary-only condition saw this picture paired with the following prompt: “Boy! Picture! Wall!” It seems likely that this pairing encouraged participants to mentally produce the full description “the boy is hanging the picture on the wall,” thereby priming themselves lexically. In fact, several participants spontaneously produced descriptions to this effect. In response to this result, Experiment 5b was designed in an attempt to further isolate the conceptual relationship and avoid this possibility of covert lexical priming.

7.2 Experiment 5b

Experiment 5b was designed as a follow-up to Experiment 5a in order to further isolate the conceptual spatial relationship depicted in the prime pictures. The stimuli and coding for this experiment were identical to Experiment 5a. The only difference was the sentences that were presented to describe the prime pictures; specifically, in this condition, full-sentence primes were given that did not describe the spatial relationship shown. For example, for the picture above in Figure 19, the new prime was “the boy really likes the picture of the cow!” In this way, participants were exposed to the spatial relationship in an engaging way while blocking them from producing their own descriptions of the relationship in question.

7.2.1 Method

7.2.1.1 Participants

Participants in this experiment were 45 native Hungarian-speaking children and adults residing in Budapest, Hungary. In that there were no significant differences in locative marking between the 4- and 6- year old children in Experiment 5a, a single group of preschoolers was used for this experiment.
As in previous experiments, children were recruited through the preschools they attended. However, this group of children did not participate in any other tasks. The adults were undergraduate students at the Budapest University of Technology and Economics who participated for course credit. Similarly, they only participated in this task.

### 7.2.1.2 Design and procedure and coding

The design, procedure and data coding used in this experiment was identical to that of Experiment 5a.

### 7.2.2 Results

As with Experiment 5a, the outcome measure for this task was the percentage of responses including the expected locative marker following object primes as compared with the percentage of responses including expected locative markers following relational primes. A two-way ANOVA was conducted with prime type (object or relational) as a within-subject variable and age group (preschool or adult) as the between-subjects measure. This analysis yielded a main effect of age, $F(1, 43) = 16.99, p < 0.001$, but no main effect of prime type $F(1, 43) = 0.06, n.s.$ or interaction between prime type and age $F(1, 43) = 0.31, n.s.$ That is, adults produced more locative markers in abstract contexts overall than children, but being primed with the relevant concrete relationship did not affect the rate of locative production in any age group (Figure 20).
It is noteworthy that, unlike in Experiment 5a, the direction of the difference in accuracy between object and relational primes differs between children and adults, further suggesting a lack of a priming relationship in this task. In order to look into this result in more detail, we also looked at item and individual variation, as well as error rates.

7.2.2.1 Item analysis

We conducted the same item analysis as for Experiment 5a. Here again, two-way MANOVA with age (preschool, adult) as a between subjects variable and verb within subjects revealed a main effect of age, $F(1, 43) = 16.99$, $p < 0.001$, and verb, $F(7, 301) = 5.63$, $p < 0.001$. There was also a significant interaction between age and verb, $F(7, 301) = 3.55$, $p = 0.001$. 

Figure 20: Percent Expected Locative by Prime Type and Age
Here again, adults produced more locative marking overall, and there seems to be an important lexical component to locative marking. There are some verbs that seem to be more likely than others to be locative-marked, independent of their frequency in the language. However, here more so than in Experiment 5a, less frequent verbs seem to omit locative marking more than verbs of higher frequency.

### 7.2.2.2 Error analysis

We also conducted the same error analyses here as for Experiment 5a. Interestingly, there were considerably more substitution errors in this condition than in 5a, 31 substitution errors out of a total of 216 child utterances. In other words, 14.4% of child utterances in Experiment 5b contained a substitution error, whereas only 2.7% of child utterances in Experiment 5a did. The break-down of errors by verb can be seen in Figure 22 below:
There was also a much wider variety of types of substitution here, as compared with Experiment 5a. The target case markers for substitutions are shown below (Figure 23):
Clearly, -ról is the predominant target for substitution errors here, as well. However, the variety is much greater than what was seen in Experiment 5a. Some examples of errors can be found below:

(24) Elképed a fiú az elefántba. (age: 5;0)
Surprise.3SG the boy the elefant-INTO
“The boy is surprised by the elephant” (should be -tól)

(25) Reménykedik a fiú arról, hogy kap ajándékot. (age: 6;4)
Hope.3SG the boy that-OFF.OF, that receive.3SG present-ACC
“The boy hopes that he will receive a present” (should be -ban)

7.2.3 Discussion

To summarize, this task found no evidence of purely conceptual priming in either children or adults. It is possible that the use of unrelated verbal primes in this task might have drawn participant attention such that they did not even register the locative relationships. Alternatively, as will be discussed below, it is also possible that a stronger prime is needed. In any case, it is clear that the visual presentation of locative relationships had little or no effect on how subsequent abstract language was processed. This can be seen in both the lack of a priming effect as well as in the much wider variety of errors produced in Experiment 5b. In terms of errors, the predominance of errors which target the source marker -ról is interesting, in that in concrete contexts source markers are dispreferred. This suggests that different factors are driving productive locative marking in abstract ones as opposed to concrete ones. This will be discussed in Part 3.

7.3 Discussion of Experiment 5

Overall, the results of these experiments were mixed. We found lexical priming in all age groups, suggesting that the children do have a unified lexical entry, or at least two related entries,
for abstract and concrete senses of the locative markers. On the other hand, there was no conceptual priming in any age group and errors were in fact much more wide-ranging in this condition, suggesting exposure to a spatial configuration without cueing language is not sufficient to prime locative marking in abstract contexts. Hearing and processing concrete locative language seems to have tethered production to that locative marker, whereas without this anchor, a wider range of possibilities became available, especially to the children. There were also apparent lexical frequency effects in the youngest group of children in 5a, whereas in older children and adults verb-based preferences seemed to predominate.

Most errors targeted the source marker -ről as compared with other markers. Intuitively, this result seems to be due to the comparatively broad application of -ről in abstract contexts. While it is not possible to check the frequency of -ről by context (abstract vs. concrete) because of the way available corpora of Hungarian are structured, it intuitively seems that -ről is more frequent in abstract contexts than in concrete ones. From a morphological point of view a marker of this kind might be considered a candidate for a default in abstract contexts (e.g., Marcus, Brinkman, Clahsen, Wiese, & Pinker, 1995). Alternatively, from a usage-based view, a single marker that can be used with a wide variety of nouns is likely to trigger the formation of a generalization (Dabrowska, 2001).

From the perspective of conceptual metaphor theory, however, it is somewhat puzzling that children are so willing to over-use this source marker, even in abstract contexts, given the general goal bias found in concrete language (Johnston, 1988; Pléh, et al., 1997). If abstract locatives are really built on the foundation of concrete ones, then there is no reason to expect that children would prefer to use -ről in abstract contexts when they avoid it in concrete ones. The finding that children in Experiment 5a used locative marking less accurately with less frequent
verbs is another apparent effect of lexical learning that does not fit easily into a view that accepts embodiment and conceptual metaphor as the foundation of abstract language.

Going back to the lack of priming in Experiment 5b, it is of course possible that the visual/picture prime used here was not strong enough. Thinking about this result in retrospect, it seems that in most of the successful conceptual/spatial priming experiments with adults, physical motion of some kind was required to induce priming. If only very strong primes are effective, this suggests that access to spatial schemas is optional and context dependent, as would be suggested by research by Glucksberg, McGlone, and others (e.g., Bortsfield & McGlone, 2001). It would be interesting to attempt other types of priming, for example, placing children in specific locations while they engage in a picture description or elicitation task (e.g., on top of a table, inside a play house) to see if a physical priming effect might be obtained. A task of this type might also be less demanding than the one reported here (where children were required to alternate between comprehension and production).

Taken together, Experiment 5 suggests that both children and adults can be primed by hearing concrete locative descriptions, whether they explicitly include a locative marker or simply object labels suggesting a spatial relationship, to produce elevated levels of abstract locative marking. This appears to be lexical and not conceptual priming in that elevated rates of abstract locatives were not produced following pure conceptual primes. However, this data also makes it clear that there are important differences in lexical selection across the verbs used in this sample.
Part 3: Discussion

Part 3 will make the case that the adult ability to frame and discuss abstract concepts in terms of concrete ones is emergent. That is, we will argue that spatial language and physical concepts have an important role to play in how adults think about abstract domains. However, the ability to use these concrete tools to manipulate abstract ideas develops only over time. It is an emergent property of dense lexical and grammatical networks and of expertise with language. Adults are able to marshal what they know of concrete language and of the world around them to deepen their understanding of abstract concepts and even create new metaphorical ways of thinking. This ability, however, takes time to develop. Children do not have access to the same dense networks nor the same real-world knowledge. They have to gather this information from their environment and slowly find its structure. They extract categories and patterns and learn to manipulate them. Over time and continued restructuring of mental representations, children develop adult capacities for abstract thought and language. Even in adults, however, this developmental process means that there are multiple routes to abstract language processing. The role of conceptual metaphors and embodiment in the production and comprehension of abstract language is limited.

This discussion will be organized into four parts. First, Section 8 will recap the evidence supporting a developmental approach to abstract language in children, both from the present study and previous literature, and describe the way such a developmental process might work cognitively. Section 9 will turn to abstract language in adults, where we see a juxtaposition between research which suggests an important role for embodiment and conceptual metaphors in
linguistic cognition with experiments indicating that this role is perhaps more limited and context-dependent than is often suggested by literature in conceptual metaphor theory. Section 10 will turn to the implications of a developmental account for conceptual metaphor theory. Specifically, we will argue that the role of embodiment and conceptual metaphors in abstract language cognition is limited and that conceptual metaphor theory may be difficult to distinguish empirically from analogically-based alternatives. Finally, Section 11 will summarize the approach proposed here by presenting a picture of abstract language through development and lay out the limitations of the present study and possible directions for future research.
8 A Developmental Approach for Children

This section will argue that the present study in the context of previous literature offers compelling reasons to prefer a developmental, usage-based, approach to abstract language over one based on a consistent role for embodied cognition and conceptual metaphor throughout life. Adults apparently have a more sophisticated ability to bring to bear what they know of the concrete world to their understanding of and communication about abstract domains. This suggests that knowledge of the concrete world is not the primary driver of the acquisition of abstract expressions in children. We will first present the arguments for developmental change and then provide evidence bearing on how this might work cognitively.

8.1 Arguments for a developmental approach

8.1.1 The present study

There are reasons, both from the experiments conducted for the present study and from previous developmental literature, to believe that the way children produce and comprehend abstract language changes as they mature. Children do not seem to be drawing on their understanding of the concrete world in their early use of abstract locative marking, as would be expected by a view of development based on conceptual metaphor theory. From the present study, we saw in Experiment 5a that 4 and 6 year old children do exhibit lexical priming from the concrete to the abstract, which suggests that by 4 years of age lexical entries for concrete and abstract senses of the locative markers are connected in some way. However, there are other types of evidence (discussed in the next section) suggesting that important points of connection between the abstract and concrete are lacking in young children. Not every aspect of locative lexical and conceptual structures is shared across concrete and abstract contexts.
First, Experiment 3 found that 4 year olds did not exhibit the same locative systematicity in abstract domains as they apparently do in concrete ones. This nonce word task found that adults exhibited a goal bias in a nonce abstract context, as would be expected by relevant conceptual metaphors (e.g., THE MIND IS A CONTAINER) and existing Hungarian expressions (észre vett – to take something onto one’s mind; eszébe jut – to have something come into one’s mind). Four-year-old children, however, did not display this same goal-bias; they chose randomly between goal and source-directed options. In fact, looking in more detail at what drove picture selection in the younger children, it seems like task-design factors, such as which stimulus was played first, were more important to children at this age than the linguistic choice itself. This is despite the fact that these children understood the relevant Hungarian expressions (e.g., eszébe jut – to have something come into one’s mind) and demonstrated that they had learned the meaning of the new expression they were taught. As 6 year olds performed similarly to adults on this task, there is reason to believe that the way a given natural language maps locative expressions onto abstract domains has to be learned – abstract senses of locative markers do not seem to be extended from concrete ones in child development.

This fits with the finding from Experiment 1 that children don’t seem to be using their knowledge of concrete locatives to bootstrap them into the abstract locative system. This task found that 3 year olds were less accurate than adults in their use of abstract locative marking, and that they were less accurate with locative marking in abstract as opposed to concrete contexts. In terms of errors, as well, children across preschool made more omission errors in abstract contexts and more substitution errors in concrete contexts. This is an interesting finding in that it seems
that the concrete and abstract locative systems independently undergo the same developmental progression of errors from omission to substitution to accurate production.

From the literature on concrete locative marking, it is clear that early in development, children often omit locative markers (e.g., Brown, 1973; MacWhinney, 1974). From this previous literature and from the data presented in Experiment 1, it also seems that a stage in which concrete locative markers are substituted for one another is not uncommon. The combination of the error data from Experiments 1 and 5b further suggest that this same trajectory can also be found in the abstract domain. Young children often omit locative markers in these contexts, while slightly older children more typically substitute one locative for another in abstract contexts. This replicated developmental pattern in both concrete and abstract contexts suggests that children are not extending what they know about the concrete system of locatives into their developing understanding of the abstract domain.

8.1.1.2 Abstract locative production is driven from within the linguistic system

Another suggestive finding related to child errors comes from Experiment 5, specifically, the predominance of errors targeting the source marker -ról (off of). In this experiment overall, 25 of the 45 substitution errors produced (56%) targeted -ról. This preference for a source marker when, in concrete contexts, children most often prefer goal markers suggests that locative marking in abstract contexts is not drawing on the conceptual content of concrete locative relationships. Instead, this type of error seems to be driven from within the linguistic system, as -ról commonly marks the arguments of abstract verbs. From the perspective of usage-based language development, the wide variety of abstract verbs appearing with -ról makes it a good candidate for the formation of a schema where abstract nouns would generally be associated with
the marker -ról (along the lines of: Nt[+abstract] + -ról) (e.g., Dabrowska, 2001; Matthews & Bannard, 2010). This might account for why it is a common target for overgeneralization.

There are several other apparently linguistic-system-internal findings from these experiments which are informative. From Experiment 2 it seems that morphological factors are important to determining how children use case marking in abstract contexts. This task found that children were more likely to produce the temporal marker -kor when responding to a question involving mikor (when) than when responding to an equivalent locative-marked question. This suggests that the overgeneralization of -kor is morphological rather than conceptual.

In Experiment 5a, as well, the use of locative marking by 4 year olds seems to have been determined by the frequency of the verb it accompanied; the more frequent the verb, the more likely children were to provide appropriate locative marking. This appears to be another effect of lexical learning, in that the more frequently a verb occurs, the more opportunities children have to learn which locative marker it requires.

From Experiment 4, lastly, it seems clear that, even in the youngest children, the meaning of an abstract verb is more important than the associated locative marker in determining how an incorrectly locative-marked sentence should be interpreted. Rather than entertain the possibility that a non-canonical case marking choice might alter the meaning of an abstract expression, children, like adults, seem to have been driven by the meaning of the verb. This was despite the fact that they were explicitly told that the sentences would be unusual and that we were curious what they thought such sentences might mean. Thus, it seems that the properties of the lexical

21 From a theoretical linguistic perspective, this could be thought of as a default rule (e.g. Marcus et al., 1995)
and grammatical systems have an important role to play in how children use locative marking in abstract contexts.

### 8.1.1.3 Conclusion

Looking at the experiments overall, it is clear that there were developmental changes in most of the tasks across the preschool years. Not surprisingly, children’s performance became more adult-like over time. This, again, is somewhat puzzling from a conceptual metaphor perspective in that if children are using their embodied understanding of locative marking as the foundation of their use of abstract locatives, we might not expect to see a lot of additional changes in how locative markers are used once the child has fully acquired the concrete locative system (which these children demonstrably have). Thus, in sum, there are reasons to believe that young children are not driven by what they know about concrete locative marking or spatial concepts in their use of the abstract locative systems. Instead, the picture painted by the experiments described here is one of lexical learning and gradual development of a linguistic system, as would be expected by research into usage-based grammatical development and the acquisition of the abstract lexicon.

### 8.1.2 Previous literature

Looking back to previous developmental literature, as well, there are additional reasons to be cautious about applying conceptual metaphor theory as an approach to development. Murphy (1996), for example, argues that some of the concrete domains claimed to be sources for abstract expressions are actually more complex and less likely to be understood by children than the abstract target domains. One example he gives, drawing on the work of Ortony (1988), is the conceptual metaphor ANGER IS A LIQUID IN A HEATED CONTAINER which can be seen in expressions such as *he exploded*, *he blew his top*, or *she flipped her lid*. Murphy argues that
emotions such as anger are likely to be much more salient to children than the physical phenomena these expressions apparently refer to. Moreover, children are likely to produce and comprehend expressions such as these before learning about the underlying physics. Evidence to support this claim comes from Ackerman (1982) who found that 6 and 8 year old children were often able to correctly respond to yes/no comprehension questions involving common idioms without being able to explain what the same idioms meant in follow-up interviews.

Similarly, Murphy, Asch & Nerlove (1960) demonstrated that children could not understand the psychological senses of adjectives such as hard and deep until 8 or 9 years of age. Thus, as was also suggested by the literature in abstract lexical development discussed in Part 1, it seems that children are likely to initially use direct mappings between form and meaning when they begin to acquire figurative language – for a child he blew his top is likely to just mean angry. Knowledge of the additional physical layer of meaning likely develops with increased linguistic development and real world knowledge.

8.2 Mechanisms of a developmental approach

Up to now, this discussion has presented evidence that a developmental approach to the acquisition of abstract language in children is called for. This section will incorporate research into the mechanisms of development and change in order to provide a better sense of how a developmental approach might work. We will summarize evidence suggesting that children and adults are able to restructure their mental representations over time and discuss research bearing on how they might do this. Sections 9 and 10 will turn to what this might mean for abstract language in adults.
8.2.1 Evidence for representation and processing change across development

8.2.1.1 Mental representations change across development

From research in cognitive development, there is quite a bit of suggestive evidence that mental representations change with increased experience. In lexical development, for example, we have seen that word knowledge develops slowly over time and that the lexicon apparently reorganizes itself with development. Several examples are described in what follows.

In lexical semantics, it has been argued that increasing vocabulary size can affect the categories present in the child’s lexicon (e.g., E. Clark, 1995), and that categories themselves can be reorganized as the child develops (e.g., Ameel, et al., 2006). In the development of abstract and figurative language, as well, children apparently follow a developmental trajectory in which they first build abstract semantic domains for, say, time, number or mental content. Even once these domains exist, however, children seem to spend a rather extended period of time learning the meanings of the words within a given domain and to uncover the relationships between them (Carey, 2009; C. Johnson & Maratsos, 1977; Shatz, 2005; Shatz, et al., 2010).

In phonological development, Walley (2005) has argued that the growth of the lexicon affects how children represent and process spoken words. Specifically, she reviews evidence suggesting that as children’s lexicons increase in size between about 5 and 7 years of age, the competition among larger numbers of words leads to a development of more detailed phonological representations, which allow words to be kept distinct from their neighbors and processed more readily. In other words, children initially have holistic phonological representations, which they are apparently able to deconstruct and re-form so that more detail of the phonological structure of words in dense neighborhoods can be represented.
In morphosyntactic development, also, there is evidence that representations change over time. The common U-shaped learning curve, for example, is likely to be the result of an organizational change of the morphological system. As we saw in previous sections, when a child initially learns a new morpheme, say the English past tense, he is typically very accurate with frequent forms, such as irregular past tense verbs, and less accurate with forms that are less frequent, such as regular verbs. As the child ultimately begins to learn the regular past tense, he will generally go through a period in which accuracy with frequent irregular verbs declines and over-regularization occurs. Finally, the child will end up accurately using the past tense in both regular and irregular contexts. This transition from accurate, to overgeneralized, and back to accurate is likely to be related to a restructuring of the child’s knowledge of past tense morphology. In grammatical development, we have also seen evidence from usage-based research that children’s linguistic behavior and abilities change substantially over time, suggesting that some restructuring of representations is taking place.

### 8.2.1.2 Learning mechanisms change across development

Another piece of suggestive evidence comes from proposals that the way lexical learning occurs in the lexicon changes over time. Hirsh-Pasek, Golinkoff, and colleagues (Hollich, Hirsh-Pasek, & Golinkoff, 2000; M. Maguire, Hirsh-Pasek, & Golinkoff, 2006), for example, have argued that the tools children use to learn vocabulary change as they acquire the ability to exploit more properties of the input. Initially, they argue, children are limited to perceptual cues to word meaning — what they can see and hear around them. Next, as their ability to engage in instances of joint attention increases, they begin to use what they can glean from the intentions of their caregivers in order to supplement their senses. Finally, as the amount of language they know grows, they begin to be able to use syntactic cues, like part of speech, to enhance their
vocabularies further. This trajectory is not explicitly argued to involve a progressive reorganization of the lexicon, though it’s not difficult to imagine that these shifts in reliance on different types of linguistic cues could be associated with corresponding changes in how the lexicon is structured, in that more and more lexical information is available to the child as she progresses developmentally.

8.2.1.3 Information processing changes with increased experience

In non-linguistic domains, it is known that expertise with a complex skill can affect the way that information related to that domain is processed. London taxi drivers, for example, have been found to have larger hippocampal regions associated with navigation than controls, and the size of this region is correlated with years on the job (E. Maguire, et al., 2000). Maguire and colleagues suggest that this result is likely related to an “overall internal reorganization of hippocampal circuitry in response to a need to store an increasingly detailed spatial representation” (p. 4402).

Behaviorally, as well, there is evidence that experts process information related to their domain of expertise differently than non-experts. In chess, for example, it has been found that the eye movements of masters around a chess board differ from the way novices look at the board, suggesting a difference in the way this information is being processed (e.g., de Groot, Gobet, & Jongman, 1996). Findings of this type, that experts in a given domain show differences in both processing and neural structure from less experienced individuals, suggest that reorganization of complex neural domains, language certainly can be counted among these, is common with development. Thus, it would not be surprising to find that adults, who can be considered expert users of their native languages, would have a more interconnected and efficient lexical network with which to process and interpret metaphors and other figurative language than children. In the
abstract domain, the semantic network is likely to be more densely interconnected and may even be processed in a completely different way than it is by the much less experienced child learners.

8.2.2 Possible mechanisms of representational change

Assuming that these observations are based on real underlying change in cognitive representation, the question then becomes how this might work. From the research we have discussed related to usage-based development it seems that children have a number of relevant abilities that could be brought to bear here. They are able to store multiword chunks (e.g., Bannard & Matthews, 2008) and extract patterns from such complex input (e.g., Gomez, 2002). They are able to group similar words and concepts into categories, both based on their semantic properties (e.g., Rosch, et al., 1976) and their distributional characteristics (e.g., Matthews & Bannard, 2010). They seem to also be able to compare grammatical schemas to create new constructions by analogy (e.g., Ambridge & Rowland, 2009).

Looking at research in non-linguistic psychology, as well, these types of mechanisms are rather commonly discussed in research into cognitive development (see, for example, the contributions to Demetriou & Raftopoulos, 2004). Raftopoulos & Constantinou (2004), for example, enumerate five ways that (computational) neural networks are able to change, which are argued to be representative of the types of changes that take place in child cognitive development. First, a “bridging combination” occurs when a new category is superimposed on two or more existing categories, grouping them together without changing the underlying organization. Such a change might occur, for example, when a network learns to pronounce a new sound combination – a new category is formed that leaves the old categories intact. A related process, “Interweaving,” occurs when the newly formed category or structure (i.e., an organized grouping of neurons) draws activation away from the old categories that it groups
“Conflation” occurs when existing categories or structures are blended together such that one category takes on the properties of another. A conceptual metaphor example of this might be if the spatial adverb *up* were to take on the properties of *increase* by metaphorical relationship, as, for example, in expressions such as *up the ante* or *up the dosage*.

“Restructuring,” by contrast, involves fundamentally changing the qualitative or quantitative properties of a set of connections because it encounters another incompatible structure or data which cannot be accommodated by the existing structure. Finally, a related process, “fusion” occurs when two or more structures are similar enough that a new grouping is formed which completely subsumes the old categories. These mechanisms are further supplemented by processes of differentiation and refinement which “tune” existing representations. These types of processes broadly fit with what we have seen in child language development and provide some additional basis for their plausibility.

### 8.3 Conclusion

Overall, if children’s mental representations do form and change along a similar line to what we have described here then incorporating a developmental perspective into accounts of abstract language in adults can have important explanatory benefits. Specifically, this type of developmental scenario in which representations change and become increasingly sophisticated over time could explain the differences between children and adults in terms of abstract language processing and use. Children have less sophisticated representations to work with. Additionally, the type of developmental transformation described by research in usage-based grammar, in which patterns are extracted, but frequent chunks remain in memory in order to make processing more efficient, also helps to account for the context-dependence suggested by research into conceptual metaphors with adults. This will be the topic of Section 9.
9  A Developmental Approach for Adults

The case of abstract language in adults is interesting in that there is both compelling evidence for the validity of aspects of conceptual metaphor theory (e.g., embodiment in general, the use of concrete systems to structure abstract domains) and also data suggesting that how abstract language is produced and comprehended is dependent on the exact language processing context (e.g., whether the sensorimotor system is engaged or not, whether the expression is novel or conventional). In short, adults seem to have multiple possible ways to deal with abstract language. This has noteworthy implications of this for conceptual metaphor theory, as will be discussed in Section 10.

9.1  Context dependence and development

9.1.1  Context dependence

If we accept a developmental approach in which abstract language processing changes over time, we should expect to see context dependence in the way adults produce and comprehend abstract expressions. This is because adults, in this view, maintain the memorized lexical entries they formed during their initial acquisition of abstract expressions, even if the expressions were subsequently reorganized into a denser and more efficient lexical network. When an adult is processing conventional abstract language under normal circumstances there may be no reason to access deeper semantic information about a given expression; whereas, if the expression in question is novel or ambiguous, it might be helpful to retrieve additional facets of the expression’s meaning.

In fact, looking both at the present study and the previous literature, context dependence is the norm. From previous literature as well as from our Experiment 5b, for example, it seems
that physical action may be necessary to induce sensorimotor processing of abstract language. Experiment 5b attempted to induce conceptual priming using pictures of locative relationships. This type of prime was not strong enough to induce an effect in either adults or children. The visually-presented locative scenes apparently had no impact on language processing. Similarly, previous literature also suggests that physical engagement of some kind seems to be necessary for conceptual priming from concrete to abstract. The study conducted by Boroditsky & Ramscar (2002) involved physical movement towards a goal. Casasanto & Boroditsky (2008) used line drawing as one outcome measure. Even Glenberg and colleagues (2008) specifically engaged the motor system during their TMS task. Thus, it is possible that without a physical component to the task, there is no role for sensorimotor representations in abstract language processing. This fits with neurological research from Kemmerer (1999), for example, who found that the mere processing of proximal and distal language did not engage the spatially relevant parts of the cortex, and with findings from Aziz-Zadeh and colleagues (2006), who found no activation of mirror neurons during exclusively linguistic processing of abstract expressions.

An additional reason why embodiment and conceptual metaphors may seem to impact participants in some contexts but not others has to do with conventionality. If an abstract expression is conventional, such as kick the habit, it might not be necessary to access the physical meaning of the word kick. The simple knowledge that this expression means give up may be enough. On the other hand, if someone says they punched the problem in the jaw, on the other hand, the physical meaning of punch might be more likely to be considered. This is similar to the findings of Mashal and colleagues (2007) that novel metaphors are processed in a different part of the brain than conventional ones.
Similarly, there may also be a difference in how action-based abstract expressions (e.g., *kick a habit*) and more grammatical locative expressions (e.g., *on time*) are processed. As we saw in Part 1, cases and adpositions are at least partially grammatical in nature. The preposition *of*, for example, arguably has no lexical meaning other that its ability to mark possessive noun complements. Locative markers, as well, exhibit many of the properties of grammatical morphemes; for example, they form a closed class (i.e., it is not possible to simply make up new ones), and they are highly polysemous, meaning that they can mark a variety of functions (e.g., Beard, 1995). Thus, it would not be surprising to find that abstract locative markers are never interpreted based on their concrete semantics because they may be simply processed as grammatical function markers. This would explain why the choice of locative marker in abstract contexts does not seem to matter. The difference between *in this view* and *on this view* is negligible (cf. Mandler, 2004: 258).

Finally, looking at more traditional psycholinguistic experiments, as well, it seems rather easy to disrupt effects apparently attributable to conceptual metaphors. As we described in Part 1, Nayak & Gibbs (1990) and Gibbs and colleagues (1997) found that processing expressions based on conceptual metaphors had a facilitatory effect on recognition of related words. This result, however, seems to only be replicable when the conceptual-metaphor-based expressions are presented in context (e.g., a whole paragraph). When the same figurative expressions (e.g., *he blew his top*) are processed in isolation, no facilitation occurs (Glucksberg, et al., 1993; Glucksberg, et al., 1997). Taken together, the processing relationship between abstract language and its purported concrete underpinnings is fragile.
9.1.2 Conclusion

As discussed in the introduction to this section, optionality in how concrete systems are applied to abstract language production and comprehension is what we would expect based on a developmental approach. If the initial acquisition of frequent abstract expressions was based on memorization, then these representations should be maintained even once new ways of dealing with abstract language emerge. This leads naturally to multiple options or paths for abstract language processing. This evidence brings to mind the argument made by Bortfield and McGlone (2001), as well as others, that availability does not equal obligatory access. In other words, just because adults are able to make use of their spatial representations and concrete lexical knowledge under certain circumstances does not mean that it is required for them to do so.

9.2 The attractions of conceptual metaphor theory

Even if the application of concrete systems to abstract domains is optional, there are still compelling reasons to consider a conceptual metaphor approach. The apparent universality of concrete expressions co-opted to describe abstract concepts is one of the main reasons a conceptual metaphor approach was originally developed. Recent research into mirror neurons also suggests an important role for embodiment in at least some concepts. While these are important aspects of linguistic cognition, we will argue (here and in Section 10) that their role in the synchronic production and comprehension of abstract language is limited.

9.2.1 Linguistic universality

One compelling piece of evidence for a conceptual metaphor approach is that the organization of abstract domains in terms of concrete ones is a cross-linguistic phenomenon; many (if not all) languages make use of this type of structure (e.g., Bybee, Perkins, & Pagliuca,
In the domain of time, for example, Haspelmath (1997) looked at temporal adverbials in 53 languages from different language families. He found that all the languages he surveyed have temporal expressions that are identical to spatial ones; although, not all temporal expressions are spatial in nature. He argues that this finding in combination with the asymmetry between temporal and spatial expressions (i.e., spatial expressions are often used in temporal contexts but not vice versa) provides support for the notion that humans conceptualize time in terms of space. This type of cross-linguistic research augments the basic finding of conceptual metaphor theory discussed in Part 1, namely, that most languages have a large number of abstract expressions which can be grouped together according to the concrete domains they draw upon (e.g., Kövecses, 2002). It is certainly tempting from such evidence to conclude that such a prevalent phenomenon must have cognitive underpinnings. If we don’t use concrete concepts and language to structure abstract domains, then why is this trend so widespread?

This cross-linguistic research is supplemented by historical evidence, as well; many abstract words seem to have concrete origins. This can be seen, for example, in words such as propose, which is derived from the Latin put forward (pro-pose), refuse, which originally meant pour back, comprehend, which derives from the Latin for grasp, or hypothesis, which originated as the Greek word for foundation (Sweetser, 1990). In the data described in this study, as well, the Hungarian temporal marker -kor derived originally from a Turkish word for line, which is exactly what would be expected if we understand and organize abstract domains in terms of concrete ones. From Sweetser’s point of view, these etymological relationships, together with other properties of the lexical domains she studies, point to a common cognitive basis for both the polysemy in the synchronic lexicon as well as historical changes in meaning.
9.2.2 Mirror neurons

A second body of research which is quite suggestive from the perspective of conceptual metaphor theory has to do with mirror neurons. Mirror neurons are neurons which engage when you perform an action, when you watch someone else performing an action, when you think about performing an action yourself, or when you process language describing an action. They are goal-specific, in that there are groups of mirror neurons that are only sensitive to grasping or kicking (see Aziz-Zadeh & Damasio, 2008, for a review). According to Aziz-Zadeh & Damasio, one way the mirror neuron system might work, is basically by collecting all the individual representations of grasping throughout the brain (i.e., grasping with different body parts, or in different ways) grouping them together into a more general representation of the overall action. Such a representation might then provide the basis for concept formation and ultimately for language.

This approach has been developed as a basis for embodied semantics by Gallese & Lakoff (2005), who attempt to provide a neurologically-based approach to conceptual metaphor theory founded on this system. The mirror neuron approach to embodied semantics has triggered a flurry of activity in this area in recent years. The original Gallese & Lakoff paper, for example, has been cited 172 times in the Web of Science database since it was published\textsuperscript{22}. Many of these authors, especially in the last couple of years, have investigated and found evidence for the involvement of sensorimotor representations in language processing, in both abstract and concrete contexts (e.g., Badets & Pesenti, 2010; Bergen & Wheeler, 2010; Ghio & Tettamanti, 2010; van Elk, van Schie, Zwaan, & Bekkering, 2010; Willems, Hagoort, & Casasanto, 2010).

\textsuperscript{22} Based on an ISI Web of Knowledge cited reference search; 4/18/2010.
9.2.3 From a developmental perspective

While these findings do offer compelling reasons to investigate the role of the physical body and physical language in abstract language and conceptual structure, they don’t require that conceptual metaphors be the foundation of our abstract conceptual structure. No direct line from the body to abstract concepts is necessary. As we have discussed, adults appear to have dense lexical and conceptual networks which allow them to make connections between disparate domains in a way children cannot. Thus, it is completely conceivable, even likely, that adults do use their knowledge of the physical world to help them understand intangible domains. If you want to understand how an unfamiliar system works, looking for similarities to systems you do understand can be quite helpful (see Feynmann & Robbins, 1999: 109 for an amusing anecdote to this effect). However, if there is no inherent connection between the abstract and the concrete – if it is emergent – then we are not conceptualizing the abstract in terms of the concrete, even when we do make this type of analogy.

We have seen that children are able to learn quite a bit about abstract language before developing the ability to connect domains such as time and location to one another. We have also seen research (e.g., Kemmerer, 2005) indicating that adults who lose the capacity to understand certain concrete domains can nevertheless use abstract language that is ostensibly based on them. From the critiques raised by Murphy (1996), as well, it seems clear that abstract concepts must have independent conceptual structure, rather than drawing their structure directly from conceptual metaphors, otherwise there would be no way to determine what aspects of a given concrete concept might serve as a relevant point of analogy to an abstract domain. Thus, although diachronically, it may be the case that abstract language derived from concrete
language and physical concepts, humans seem to be able to go beyond this constraint in their thought and speech about abstract domains.

Similarly, it is not difficult to believe that mirror neurons have an important role to play in human cognition and even that they may be important to our initial development of conceptual structure. However, given the apparently limited processing role for mirror neurons in conventional abstract contexts (e.g., Aziz-Zadeh & Damasio, 2008) and the neurological differences in the processing of conventional and novel abstract language (Mashal et al., 2007), it is not necessarily the case that they are fundamentally involved in the way our lexicons are structured. Linguistic systems seem to be automatic in a way that seems to render frequent reliance on mirror neuron systems superfluous. Our physical existence as entities moving through the world is certainly significant for understanding our cognitive make-up, but it may be less important to understanding the mechanics of abstract language production and comprehension.
10 Implications for Conceptual Metaphor Theory

What the research presented here centrally implies for conceptual metaphor theory is that its role in abstract language production and comprehension is likely to be more limited than the mainstream approach to conceptual metaphor theory typically suggests. What we call conceptual metaphors may essentially be a convenient way to group linguistic expressions together thematically. Similarly, embodiment is likely to be important to human cognition without necessarily being the foundation of abstract language specifically. There are three issues to be briefly raised here: (1) the relationship between conceptual metaphor theory and usage-based development, (2) the relationship between conceptual metaphor theory and analogically-based approaches to metaphor (e.g., Glucksberg, 2003), and (3) the role of conceptual metaphors and embodiment in abstract language cognition.

10.1 Conceptual metaphor theory and usage-based development

An important question that arises from this developmental perspective is whether conceptual metaphor theorists would really deny developmental change in abstract language production and comprehension (Section 8) and its consequences for adults (Section 9). As mentioned in the Part 1, advocates of conceptual metaphor theory and of usage-based developmental approaches tend to support one another and advocate for each other’s approaches. It is common to believe that these perspectives can happily co-exist, probably because conceptual metaphor theory tends to focus on adult cognition while usage-based development concentrates on children.

However, as we have seen, when focusing on child acquisition, conceptual metaphor theory and usage-based development actually have some important contradictory assumptions.
regarding embodiment. Specifically, conceptual metaphor theory expects embodied cognition to drive a child’s learning about the world. In order for conceptual metaphor theorists to subscribe to a usage-based approach to development, which many of them apparently do (e.g., Evans & Greene, 2006), it would be necessary to accept that the metaphorical mappings between abstract expressions and concepts and their physical, real-world underpinnings must be learned. Children in the earliest stages of abstract language development do not appear to have a sense of the concrete conceptual underpinnings of the language they use, which suggests that a concrete conceptual foundation cannot be of primary importance to early abstract language development.

10.2 Conceptual and attributive approaches to metaphor

Further, if conceptual metaphors do not provide the foundation for our abstract concepts, then they are not psychologically privileged in the way conceptual metaphor theory assumes. If they do not have a special psychological role, then there is essentially no difference between saying LOVE IS A JOURNEY and saying that some properties of journeys are useful to help us better understand the nature of love and relationships. If you can’t use conceptual metaphors to elucidate underlying conceptual structure, then saying we make analogies between domains amounts to the same claim.

From the perspective of Bortfield & McGlone (2001) and their colleagues, metaphor allows people delve deeper into the meaning of abstract expressions. Adults use the knowledge they have about relationships in the physical world to shed light on the intangible realm of thought. This conscious thought process gives rise to new framings and new expressions. Once a metaphorical relationship has been established and becomes conventional, it can later be learned by others without the need to go to the source, so to speak. The historical layers of our language can affect how we think, but they do not have to. Metaphors are tools, not foundations.
10.3 The role of conceptual metaphors

Thus, it seems that the role of conceptual metaphors and embodiment in abstract language is limited. On the one hand, conceptual metaphors are useful in that they provide a short-hand for grouping expressions that might imply the existence of a psychologically relevant frame (e.g., Lakoff, 2004). On the other hand, conceptual metaphors do not seem to be predictive. Extracting clusters of expressions does not tell us how people really understand a given concept. The conceptual metaphor HAPPINESS IS A CAPTIVE ANIMAL mentioned in Part 1, for example, derives from groupings of expressions surrounding other emotions (e.g., anger). Although it can be argued to exist for happiness too, it does not seem to be very informative regarding how people conceptualize HAPPINESS. Embodied cognition has a role to play in understanding human psychology, but the path from the body to the abstract conceptual realm is circuitous at best.
11 Summary, Limitations, and Future Directions

11.1 A picture of abstract language across development

To summarize, the following is a complete sketch of the proposal we have presented in Part 3. First, children in the early stages of abstract language development seem to memorize the abstract locative expressions they hear. Presented with expressions such as in trouble and on time, they determine from the linguistic context what these utterances are likely to mean and form a relevant lexical entry for the expression as a whole. This is basically the fast mapping process in lexical development described by Carey and Bartlett (1978). Next, as children begins to acquire more and more expressions, they begin to form different domains of abstract language in line with what has been described by Shatz and colleagues (Shatz, 2005; Shatz, et al., 2010). The creation of these lexical domains gives them a sense of how different words should be grouped together and allows them to begin to connect words in their mental lexicon. The increasing number of abstract locative expressions stored in this way is also likely to suggest the possibility for generalization in that it will become clear to the child that given locative markers can accompany a wide variety of abstract nouns and verbs (Matthews & Bannard, 2010). Representations develop, change and reorganize with experience (e.g., Demetriou & Raftopoulos, 2004; Ericsson & Kintsch, 1996).

Newly formed abstract schemas may also begin, either simultaneously or consecutively, to be further grouped by analogy with related schemas, such as those for concrete locatives. From research into embodied representations in concrete contexts, it seems likely that sensorimotor representations form part of (or are connected to) the lexical/semantic representations for action vocabulary like grasp (Aziz-Zadeh, et al., 2006; Gallese & Lakoff,
By extension, it does not seem unreasonable to suppose that the representations of the concrete locative markers include or are connected to spatial representations of, say, CONTAINMENT or SUPPORT. In this way, when the grammatical schemas for abstract and concrete locatives are joined, a second-order connection between abstract locatives and the underlying spatial representations are formed (perhaps along the lines of Carey’s (2009) account of the number concept). As the child continues to mature linguistically, these networks develop and increase in density until a whole range of interconnections is available to the adult that were not there in the beginning. In this way, the properties of the adult grammar emerge as the result of developmental processes.

This developmental scenario raises several additional questions vis-à-vis conceptual metaphor theory. First, how do adults and children acquire new metaphors? From this perspective, it seems that the synchronic process of the acquisition of new abstract expressions should differ for young children and adults. For adults, when they first learn a new metaphor or piece of figurative language, they are likely to process the concrete meaning and then work out the metaphorical implications, as suggested by research in conceptual metaphor theory. This is because adults have all the available semantic connections and real-world knowledge to process newly encountered expressions in this way. This procedure would also give rise to the effect found by Mashal and colleagues (2007) that adults process novel metaphors differently than conventional ones. Children, on the other hand, would be more likely to memorize new abstract expressions as vocabulary because denser semantic networks seem to process information differently than less dense ones and because the child’s knowledge of the world is more limited. Essentially, it seems plausible that children need to simply acquire pieces of vocabulary until they hit a critical mass and their lexical network for a given domain begins to reorganize. At that
point, what a child already knows about this domain will begin to shape how she learns. Once she has a certain amount of linguistic experience, that knowledge will be used to process new language she is exposed to.

Diachronically, on the other hand, it is probably the case that new figurative and metaphorical expressions were invented by adults by extension from, or on analogy to, concrete language. For adults, new metaphors may be processed in a way that is based on concrete language. Over time, however, as such metaphors become more frequent, grammaticalization occurs, and these expressions no longer need to be processed through the concrete, even though they can be when necessary. This fits with what is known about superficial processing in discourse and the use of chunks in language processing (Arnon & Snider, 2010; Pickering & Garrod, 2004b). It would also be predicted by research in processing efficiency and expertise (Ericsson & Kintsch, 1996; Walley, 2005).

11.2 Limitations and future directions

This being said, our data support only limited conclusions regarding how abstract language is represented, produced, and comprehended by children. The proposal presented here remains speculative and a great deal of additional research is needed.

Theoretically, a significant open question has to do with what the role of embodiment and conceptual metaphor actually is and how language and concepts are related to one another. Clearly, there is a relationship between language and conceptual structure. Language can evoke concepts. Conventional divisions of thought may actually affect our conceptual structures (e.g., Bowerman & Levinson, 2001). This thesis has, as times, discussed words and concepts
interchangeably. However, they are unlikely to be one and the same. How this relationship actually works and where morphosyntax fits in is an exciting area for future research.

Methodologically, an important limitation of the experiments presented here overall is that they all used pictorial stimuli which represented abstract concepts using symbolic devices such as thought bubbles, clocks and calendars. Even for children at this age, cartoon pictures such as the ones used here present a processing challenge which is augmented by the use of devices such as thought bubbles, whose meaning the child must also decipher. This leaves room for further experiments testing the differences in abstract language interpretation using different stimuli.

Similarly, the priming task presented here (Experiment 5) did not involve a physical prime such as those described, for example, by Boroditsky and colleagues (Boroditsky & Ramscar, 2002; Casasanto & Boroditsky, 2008). It would be interesting to replicate these more active tasks with children to see if the same results are obtained. Another possible variation of this approach might be to have children describe abstract scenes such as the ones in Experiment 5 while sitting physically in different salient locations, such as on a table or in a playhouse. Such a physical context might strengthen the conceptual prime and potentially change the results.

Another extension of the present line of inquiry would be to investigate the difference in processing of novel and common metaphors in children using a task similar to the one described by Mashal and colleagues (2007) to investigate whether novel and conventional metaphors are processed in different parts of the brain by children in the same way they are in adults. Overall, then, the present study has suggested that there are important differences in the way that adults and children represent and use abstract locative marking and that this has implications for our
understanding of abstract language in adults. The experiments described here have only taken one small step in the direction of ascertaining the magnitude of this difference and what its theoretical implications might be.
Conclusion

This dissertation has shown that there are reasons to question the conceptual metaphor approach to abstract language as a model of child development. Rather than exhibiting evidence that they interpret abstract language on the basis of conceptual metaphors or their knowledge of the concrete locative system, children seem to initially be memorizing abstract locative expressions and slowly working out how to apply their knowledge of space to these domains over time.

In order to bring together developmental findings with research in conceptual metaphor theory, we have argued that the apparent effects of embodiment and conceptual metaphors in adults processing of abstract language are likely to be emergent. In other words, as children deconstruct and reorganize their representations of memorized abstract locative expressions, these become integrated into a broader cognitive network. When this occurs, children gain access to second-order connections between expressions and domains that were not available to them during the initial stages of learning. This possibility suggests the need for a reconsideration of the role of conceptual metaphors and embodiment in abstract linguistic cognition. A unified approach which can account for both abstract language in both adults and children is needed.
Appendices

Appendix A: Stimuli for Experiment 1

<table>
<thead>
<tr>
<th>Prompts</th>
<th>Sample Common Responses</th>
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<tbody>
<tr>
<td><em>Hol ül János?</em></td>
<td><em>A fá-n, a fa-ág-on</em></td>
</tr>
<tr>
<td>where sit.3SG John</td>
<td>the tree-ON the tree-branch-ON</td>
</tr>
<tr>
<td>“Where is János sitting?”</td>
<td>“On the tree,” “On the tree branch” (C)</td>
</tr>
<tr>
<td><em>Hol van a madár anya és a kisbabái?</em></td>
<td><em>Az égen</em></td>
</tr>
<tr>
<td>where be the bird mother and the baby-POSS-PL</td>
<td>the sky-ON</td>
</tr>
<tr>
<td>“Where are the mother bird and her babies?”</td>
<td>“In the sky” (F)</td>
</tr>
<tr>
<td><em>Hol van-nak a tojás-ok?</em></td>
<td><em>A fészek-ben</em></td>
</tr>
<tr>
<td>where be-3.PL the egg-PL</td>
<td>the nest-IN</td>
</tr>
<tr>
<td>“Where are the eggs?”</td>
<td>“In the nest” (C)</td>
</tr>
<tr>
<td><em>Melyik évzakon történik ez a történet?</em></td>
<td><em>Nyár-on</em></td>
</tr>
<tr>
<td>which season-ON happen.3SG this the story</td>
<td>summer-ON</td>
</tr>
<tr>
<td>“In which season is this story happening?”</td>
<td>“In the summer” (A)</td>
</tr>
<tr>
<td><em>Mit csinál János?</em></td>
<td><em>Le-mászik a létrá-n</em></td>
</tr>
<tr>
<td>what do.3SG John</td>
<td>down-climb.3SG the ladder-ON</td>
</tr>
<tr>
<td>“What is János doing?”</td>
<td>“Climbing down on the ladder” (C)</td>
</tr>
<tr>
<td><strong>Honnan?</strong></td>
<td><strong>A fá-ról</strong></td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>From where?</td>
<td>the tree-OFF.OF</td>
</tr>
<tr>
<td>“From where?”</td>
<td>“From the tree” (C)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Mi-ről gondolkodik?</strong></th>
<th><strong>A madárház-ról.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>what-OFF.OF consider.3SG</td>
<td>the birdhouse-OFF.OF</td>
</tr>
<tr>
<td>“What is he thinking about?”</td>
<td>“About the birdhouse” (A)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Mi-re vár?</strong></th>
<th><strong>A buli-ra</strong></th>
</tr>
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<tbody>
<tr>
<td>what-ONTO wait.3SG</td>
<td>the party-ONTO</td>
</tr>
<tr>
<td>“What is he waiting for?”</td>
<td>“For his party” (A)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th><strong>Melyik nap-on less a szülinap-ja?</strong></th>
<th><strong>Szombat-on</strong></th>
</tr>
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<tbody>
<tr>
<td>which day-ON will.be the birthday-3SG.POSS</td>
<td>Saturday-ON</td>
</tr>
<tr>
<td>“When will his birthday be?”</td>
<td>“On Saturday” (A)</td>
</tr>
</tbody>
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<tr>
<th><strong>Melyik nap-on?</strong></th>
<th><strong>A húsz-adik-én</strong></th>
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<tbody>
<tr>
<td>which day-ON</td>
<td>the twenty-ORD-ON</td>
</tr>
<tr>
<td>“On what date?”</td>
<td>“On the twentieth” (A)</td>
</tr>
</tbody>
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<thead>
<tr>
<th><strong>Mi-ről beszélgetnek?</strong></th>
<th><strong>A buli-ról / a madárház-ról</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>what-OFF.OF talk-3PL</td>
<td>the party-OFF.OF / the birdhouse-OFF.OF</td>
</tr>
<tr>
<td>“What are they talking about?”</td>
<td>“About the party/birdhouse” (A)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Ki-től fog János kapni ezt a madárház-at?</strong></th>
<th><strong>Az anyuká-já-tól</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>who-FROM will John get this-ACC birdhouse-ACC</td>
<td>the mom-3SG.POSS-FROM</td>
</tr>
<tr>
<td>“From whom will Janos get this birdhouse?”</td>
<td>“From his mom” (A)</td>
</tr>
<tr>
<td>English</td>
<td>Hungarian</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><em>Hol van-nak?</em></td>
<td><em>Hol ülnek és áll-nak?</em></td>
</tr>
<tr>
<td><em>Where are they sitting and standing?</em></td>
<td><em>Where are they sitting and standing?</em></td>
</tr>
<tr>
<td>A kert-ben the garden-IN</td>
<td>Az asztál-nál the table-AT</td>
</tr>
<tr>
<td>“In the garden” (C)</td>
<td>“At the table” (C)</td>
</tr>
<tr>
<td><em>Mi-re néz?</em></td>
<td><em>Mi-re gondol?</em></td>
</tr>
<tr>
<td><em>What’s he looking at?</em></td>
<td><em>What’s he thinking about?</em></td>
</tr>
<tr>
<td>A tortá-ra / az ajandék-re</td>
<td>Az ajandék-ra / a madárház-ra</td>
</tr>
<tr>
<td>the cake-onto / the present-onto</td>
<td>the gift-onto / the birdhouse-onto</td>
</tr>
<tr>
<td>“At the cake” / “at the present” (F)</td>
<td>“About the present” / “about the candles” (A)</td>
</tr>
<tr>
<td><em>Ki-től kap ez-t az ajandék-et?</em></td>
<td><em>Hol van- az a madárház?</em></td>
</tr>
<tr>
<td><em>From whom did he get this present?</em></td>
<td><em>Where is the birdhouse?</em></td>
</tr>
<tr>
<td>A szűl-e-i-től the parent-3SG.POSS-3PL.FROM</td>
<td>A kez-é-ben the hand-3SG.POSS-IN</td>
</tr>
<tr>
<td>“From his parents” (A)</td>
<td>“In his hands” (C)</td>
</tr>
<tr>
<td>Question</td>
<td>English Translation</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Mi-t csinál-nak az édesapa és János?</td>
<td>What are Janos and his dad doing?</td>
</tr>
<tr>
<td>Hol van János</td>
<td>Where is Janos?</td>
</tr>
<tr>
<td>Mi-t csinál János?</td>
<td>What is Janos doing?</td>
</tr>
<tr>
<td>Mi-ról beszél?</td>
<td>What is he talking about?</td>
</tr>
<tr>
<td>Hol van-nak a madár-ok?</td>
<td>Where are the birds?</td>
</tr>
<tr>
<td>Honnan néz ki?</td>
<td>Where is he looking out of?</td>
</tr>
<tr>
<td>Fel-akaszt-ják a madárház-at a fa-ra</td>
<td>“Hanging the birdhouse onto the tree”</td>
</tr>
<tr>
<td>a létrá-n</td>
<td>“On the ladder”</td>
</tr>
<tr>
<td>Telefon-on beszél</td>
<td>“Talking on the phone”</td>
</tr>
<tr>
<td>A madar-ok-ról</td>
<td>“About the birds”</td>
</tr>
<tr>
<td>Madárház-ban</td>
<td>“In the birdhouse”</td>
</tr>
<tr>
<td>Az ajtó-ból/ az ablak-on</td>
<td>“Out of the door” / “out of the window”</td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td><strong>Mi-t csinál-nak a gyerek-ek?</strong></td>
<td><strong>kör-be tancol-nak</strong></td>
</tr>
<tr>
<td>what-ACC do-3pl the child-PL</td>
<td>circle-INTO dance-3PL</td>
</tr>
<tr>
<td>“What are the children doing?”</td>
<td>“Dancing in a circle” (F)</td>
</tr>
<tr>
<td><strong>Mi-t csinál pedig János?</strong></td>
<td><strong>Megy a fá-hoz/ madár-ok-hoz</strong></td>
</tr>
<tr>
<td>what-ACC do.3SG meanwhile John</td>
<td>go the tree-INTOTowards / bird-PL-INTOTowards</td>
</tr>
<tr>
<td>“What is Janos doing in the meantime?”</td>
<td>“Walking towards the tree/birds” (C)</td>
</tr>
</tbody>
</table>

Note: This picture serves mainly to transition from Fall to Winter. The questions are mainly filler, though some of the older children were able to answer the 3rd one.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most melyik évszák?</strong></td>
<td><strong>Ősz</strong></td>
</tr>
<tr>
<td>now which season</td>
<td>Fall</td>
</tr>
<tr>
<td>“Now what season is it?”</td>
<td>“Fall” (F)</td>
</tr>
<tr>
<td><strong>Mi-t csinál János?</strong></td>
<td><strong>Integet</strong></td>
</tr>
<tr>
<td>what-ACC do.3SG John</td>
<td>wave.3SG</td>
</tr>
<tr>
<td>“What is John doing?”</td>
<td>“Waving” (F)</td>
</tr>
<tr>
<td><strong>Hova men-nek a madár-ok?</strong></td>
<td><strong>Déleri, Afrika ba, Meleg ország ba</strong></td>
</tr>
<tr>
<td>where.to go-3PL the bird-PL</td>
<td>south-INTO, Africa-INTO, warm country-INTO</td>
</tr>
<tr>
<td>“Where are the birds going?”</td>
<td>“To the South, to Africa, to a warm country” (A)</td>
</tr>
<tr>
<td>Question</td>
<td>Translation</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Mi-re emlékezik János?</td>
<td>nyár-ra</td>
</tr>
<tr>
<td>what-ONTO remember.3SG John</td>
<td>summer-ONTO</td>
</tr>
<tr>
<td>“What is Janos remembering?”</td>
<td>“Summer” (A)</td>
</tr>
<tr>
<td>Mi-t csinál az édesanya?</td>
<td>Ki-megy a szóbá-ból, megy a konyhá-ba</td>
</tr>
<tr>
<td>what-ACC do.3SG the mother</td>
<td>out-go.3SG the room-OUT.OF go.3SG kitchen-INTO</td>
</tr>
<tr>
<td>“What is the mother doing?”</td>
<td>“Leaving the room, entering the kitchen” (C)</td>
</tr>
<tr>
<td>Hova razjol?</td>
<td>a füzet-be</td>
</tr>
<tr>
<td>where.to draw.3SG</td>
<td>the notebook-INTO</td>
</tr>
<tr>
<td>“Where is Janos drawing?”</td>
<td>“Into the notebook” (F)</td>
</tr>
<tr>
<td>Hol razjol?</td>
<td>A fá-nál</td>
</tr>
<tr>
<td>where draw.3SG</td>
<td>the tree-AT</td>
</tr>
<tr>
<td>“Where is he drawing?”</td>
<td>“Next to the tree” (C)</td>
</tr>
<tr>
<td>Mi-t csinál-nak a madár-ok?</td>
<td>Be-men-nek a madárház-ba</td>
</tr>
<tr>
<td>what-ACC do-3PL the bird-PL</td>
<td>into-go-3PL the birdhouse-INTO</td>
</tr>
<tr>
<td>“What are the birds doing?”</td>
<td>“Going into the birdhouse” (C)</td>
</tr>
</tbody>
</table>
### Appendix B: Stimuli for Experiment 2

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>(1) <em>Mikor van az ovis kirándulás?</em>&lt;br&gt;<strong>when be.3sg the preschool hiking.trip</strong>&lt;br&gt;“When is the preschool hiking trip?”</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>(2) <em>Melyik nap-on van az ovis kirándulás?</em>&lt;br&gt;<strong>which day-on be.3SG the preschool hiking.trip</strong>&lt;br&gt;“On which day is the preschool hiking trip”</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>(3) <em>Mikor van a születésnap-ja?</em>&lt;br&gt;<strong>when be.3SG the birthday-3SG.POSS</strong>&lt;br&gt;“When is his birthday?”</td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td>(4) <em>Melyik nap-on van a születésnap-ja?</em>&lt;br&gt;<strong>which day-on be.3SG the birthday-3SG.POSS</strong>&lt;br&gt;“On which day is his birthday?”</td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td>(5) <em>Mikor reggelizik?</em>&lt;br&gt;<strong>when eat.breakfast.3SG</strong>&lt;br&gt;“When does he eat breakfast?”</td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /></td>
<td>(6) <em>Hány óra-kor reggelizik?</em>&lt;br&gt;<strong>how many hour-AT eat.breakfast</strong>&lt;br&gt;“At which time does he eat breakfast?”</td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td>(7) <em>Mikor vacsorázik?</em>&lt;br&gt;<strong>when eat.dinner.3sg</strong>&lt;br&gt;“When does he eat dinner?”</td>
</tr>
<tr>
<td><img src="image8.png" alt="Image" /></td>
<td>(8) <em>Hány óra-kor vacsorázik?</em>&lt;br&gt;<strong>how many hour-AT eat.dinner.3SG</strong>&lt;br&gt;“At which time does he eat dinner?”</td>
</tr>
<tr>
<td></td>
<td>Question</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>9</td>
<td><em>Mikor megy vissza az óvodába?</em></td>
</tr>
<tr>
<td>10</td>
<td><em>Melyik hónap-ban megy vissza az óvodába?</em></td>
</tr>
<tr>
<td>11</td>
<td><em>Mikor játszik a strandon?</em></td>
</tr>
<tr>
<td>12</td>
<td><em>Melyik hónapban játszik a strand-on?</em></td>
</tr>
</tbody>
</table>
Appendix C: Stimuli for Experiment 3

Training Stimuli
Each cell represents a different condition

<table>
<thead>
<tr>
<th>Training Stimuli</th>
<th>Training Stimuli</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>a lány a nyusi tamap-já-nál van</em></td>
<td><em>a lány a nyusi lepec-é-nél van</em></td>
</tr>
<tr>
<td>the girl the bunny tamap-3SG.POSS-AT be.3SG</td>
<td>the girl the bunny lepec-3SG.POSS-AT be.3SG</td>
</tr>
<tr>
<td>“the girl is at the tamap of the bunny”</td>
<td>“the girl is at the lepec of the bunny”</td>
</tr>
<tr>
<td><em>a nyusi tamap-ja a lány-on van</em></td>
<td><em>a nyusi lepec-e a lány-on van</em></td>
</tr>
<tr>
<td>the bunny tamap-3SG.POSS the girl-ON be.3SG</td>
<td>the bunny lepec-3SG.POSS the girl-ON be.3SG</td>
</tr>
<tr>
<td>“the bunny tamap is on the girl”</td>
<td>“the bunny lepec is on the girl”</td>
</tr>
<tr>
<td><em>a lány a kocsi tamap-já-nál van</em></td>
<td><em>a lány a kocsi lepec-é-nél van</em></td>
</tr>
<tr>
<td>the girl the car tamap-3SG.POSS-AT be.3SG</td>
<td>the girl the car lepec-3SG.POSS-AT be.3SG</td>
</tr>
<tr>
<td>“the girl is at the tamap of the car”</td>
<td>“the girl is at the lepec of the car”</td>
</tr>
<tr>
<td><em>a kocsi tamap-ja a lány-on van</em></td>
<td><em>a kocsi lepec-e a lány-on van</em></td>
</tr>
<tr>
<td>the car tamap-3SG.POSS the girl-ON be.3SG</td>
<td>the car lepec-3SG.POSS the girl-ON be.3SG</td>
</tr>
<tr>
<td>“the car tamap is on the girl”</td>
<td>“the car lepec is on the girl”</td>
</tr>
<tr>
<td>English</td>
<td>Hungarian</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>The boy is at the tamap of the ball</strong></td>
<td><em>a fiú a labda tamap-já-nál van</em></td>
</tr>
<tr>
<td><strong>The boy is at the lepec of the ball</strong></td>
<td><em>a fiú a labda lepec-é-nél van</em></td>
</tr>
<tr>
<td><strong>The ball tamap is on the boy</strong></td>
<td><em>a labda tamap-ja a fiú-n van</em></td>
</tr>
<tr>
<td><strong>The ball lepec is on the boy</strong></td>
<td><em>a labda lepec-e a fiú-n van</em></td>
</tr>
<tr>
<td><strong>The girl is at the tamap of the sandwich</strong></td>
<td><em>a lány a szendvics tamap-já-nál van</em></td>
</tr>
<tr>
<td><strong>The girl is at the lepec of the sandwich</strong></td>
<td><em>a lány a szendvics lepec-é-nél van</em></td>
</tr>
<tr>
<td><strong>The sandwich tamap is on the girl</strong></td>
<td><em>a szendvics tamap-ja a lány-on van</em></td>
</tr>
<tr>
<td><strong>The sandwich lepec is on the girl</strong></td>
<td><em>a szendvics lepec-e a lány-on van</em></td>
</tr>
<tr>
<td>Left Side</td>
<td>Right Side</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td><em>a fiú a fagyi tamap-ja-nál van</em></td>
<td><em>a fiú a fagyi lepec-é-nél van</em></td>
</tr>
<tr>
<td>the boy the ice cream tamap-3SG.POSS-AT be.3SG</td>
<td>the boy the ice cream lepec-3SG.POSS-AT be.3SG</td>
</tr>
<tr>
<td>“the boy is at the tamap of the ice cream”</td>
<td>“the boy is at the lepec of the ice cream”</td>
</tr>
<tr>
<td><em>a fagyi tamap-ja a fiú-n van</em></td>
<td><em>a fagyi lepec-e a fiú-n van</em></td>
</tr>
<tr>
<td>the ice cream tamap-3SG.POSS the boy-ON be.3SG</td>
<td>the ice cream lepec-3SG.POSS the boy-ON be.3SG</td>
</tr>
<tr>
<td>“the ice cream tamap is on the boy”</td>
<td>“the ice cream lepec is on the boy”</td>
</tr>
</tbody>
</table>

Test Stimuli
*(Each row represents an example from a different condition)*

<table>
<thead>
<tr>
<th>Left Side</th>
<th>Right Side</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>a lány a szendvics tamap-ja-nál van</em></td>
<td><em>a sütő tamap-ja a lány-on van</em></td>
</tr>
<tr>
<td>the girl the sandwich tamap-3SG.POSS-AT be.3SG</td>
<td>the cupcake tamap-3SG.POSS the girl-ON be.3SG</td>
</tr>
<tr>
<td>“the girl is at the tamap of the sandwich”</td>
<td>“the cupcake tamap is on the girl”</td>
</tr>
<tr>
<td><em>a lány a szendvics tamap-já-nál van</em></td>
<td><em>a lány a sütő tamap-já-nál van</em></td>
</tr>
<tr>
<td>the girl the sandwich tamap-3SG.POSS-AT be.3SG</td>
<td>the girl the cupcake tamap-3SG.POSS-AT be.3SG</td>
</tr>
<tr>
<td>“the girl is at the tamap of the sandwich”</td>
<td>“the girl is at the tamap of the cupcake”</td>
</tr>
</tbody>
</table>

The goal of this item was to make sure the children could perform the task.
This item tested whether the child learned the construction they were taught

This item introduced the notion of dynamic thought (thought occurring)
This item tested the child’s knowledge of the meaning of thought bubbles

a fiúnak eszébe jut a könyv gondolata
the boy-DAT mind-POSS.3SG-INTO come the book thought-3SG.POSS
“The thought of the book occurred to the boy”

a fiúnak van egy igazi könyve
the boy-dat be.3SG a real book-3SG.POSS
“The boy has a real book”

This was the main test item

a lány a hajó tamapjától megy
the girl the boat tamap-3SG.POSS-FROM go
“The girl is going away from the boat tamap”

a lányra megy a hajó tamapja
the girl-OFF.OF go the boat tamap-3SG.POSS
“The boat tamap is going off of the girl”

a lány a hajó lepecétől megy
the girl the boat lepec-3SG.POSS-FROM go
“The girl is going away from the boat lepec”

a lányra megy a hajó lepecéhez meg
the girl-OFF.OF go the boat lepec-3SG.POSS
“The boat lepec is going onto the girl”

188
Appendix D: Stimuli for Experiment 4

A kisfiúnak kedve van a répától
the little-boy-DAT desire be.3SG the carrots-FROM
„the little boy wants away from the carrots”

A kisfiúnak a répától van kedve
the little-boy-DAT the carrots-FROM desire be.3SG
„the little boy wants away from the carrots”

A fiú szerelmes a lányból
the boy in.love the girl-OUT.OF
“the boy is out of love with the girl”

A fiú a lányból szerelmes
the boy the girl-OUT.OF in.love
“the boy is out of love with the girl”
a diák figyel a tanárról
the student attend.3SG the teacher-OFF.OF
“The student is paying attention away from the teacher”

a diák a tanárról figyel
the student the teacher-OFF.OF attend.3SG
“The student is paying attention away from the teacher”

A róka fél a macskához
the fox fear.3SG the cat-towards
„the fox is afraid towards the cat”

A róka a macskához fél
the fox cat-TOWARDS fear.3SG the
„the fox is afraid towards the cat”

23 This pair of items was not included in the analysis
### Appendix E: Stimuli for Experiment 5

<table>
<thead>
<tr>
<th>Relational Prime (-ról)</th>
<th>Target (-ról)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pohár! Asztál !</strong></td>
<td><strong>Álmodik a fiú !</strong></td>
</tr>
<tr>
<td>“Cup ! Table !”</td>
<td>dream.3SG the boy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sentence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A pohár le-esik az asztál-ról !</strong></td>
<td>The boy is dreaming !</td>
</tr>
<tr>
<td>the cup down-fall the table-OF</td>
<td>“the cup is falling off the table !”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conceptual</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A málna-lé véletlen ki-ömlik!</strong></td>
<td></td>
</tr>
<tr>
<td>the raspberry-juice accidentally out-spill.3SG</td>
<td>“The raspberry juice accidentally spilled!”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Object Prime (-ról)</th>
<th>Target (-ról)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sok edény !</strong></td>
<td><strong>Mesél a fiú!</strong></td>
</tr>
<tr>
<td>A lot of dishes !</td>
<td>talk.3SG the boy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sentence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Milyen sok edény van ott !</strong></td>
<td>The boy is talking!</td>
</tr>
<tr>
<td>how much dish be.3SG there</td>
<td>There are a lot of dishes there!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conceptual</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Milyen sok edény van ott !</strong></td>
<td></td>
</tr>
<tr>
<td>how much dish be.3SG there</td>
<td>There are a lot of dishes there!</td>
</tr>
<tr>
<td><strong>Relational Prime (-ra)</strong></td>
<td><strong>Target (-ra)</strong></td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td><img src="72x210" alt="Image" /></td>
<td><img src="164x57" alt="Image" /></td>
</tr>
</tbody>
</table>
| **Vocabulary** | **Milyen nagy papír kupac!**  
What a big pile of paper!  
Boy! Picture! Wall!  
Emlékszik a fiú!  
The boy is remembering! |
| **Sentence** | A fiú fel-ragaszt-ja a kép-et a fal-ra!  
the boy up-attach-DEF the picture-ACC the wall-ONT  
the boy is hanging the picture on the wall!  
a fiú szeret-i ez-t a tehen-es kép-et!  
the boy like.3SG-DEF the cow-ADJ picture-ACC  
The boy likes this cow picture! |
| **Conceptual** | |

<table>
<thead>
<tr>
<th><strong>Object Prime (-ra)</strong></th>
<th><strong>Target (-ra)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image](280x258 to 351x351)</td>
<td>![Image](351x351 to 442x351)</td>
</tr>
</tbody>
</table>
| **Vocabulary** | **Milyen nagy papír kupac!**  
What a big pile of paper!  
Gondol a fiú!  
Think.3SG the boy  
The boy is thinking! |
| **Sentence** | Milyen nagy papír kupac van ott!  
what big paper pile be.3SG there  
There is a big pile of paper there! |
| **Conceptual** | Milyen nagy papír kupac van ott!  
what big paper pile be.3SG there  
There is a big pile of paper there! |
<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Relational Prime (tól)</th>
<th>Target (tól)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image1" alt="Toy car! Tree!" /></td>
<td><img src="image2" alt="Elephant! Boy!" /></td>
</tr>
<tr>
<td>Játékaútó! Fa!</td>
<td>the toy-car the tree-from leave.3SG</td>
<td>Elképed a fiú! surprise.3SG the boy</td>
</tr>
<tr>
<td>Toy car! Tree!</td>
<td>The toy car is leaving from the tree!</td>
<td>The boy is surprised!</td>
</tr>
</tbody>
</table>

| Sentence         | A játékaútó a fá-tól indul! | the toy-car the tree-from leave.3SG |
|                  | The toy car is leaving from the tree! |
| Conceptual       | a játékaútó gyorsan tud menni! | the toy-car fast can.3SG go.INF |
|                  | The toy car can go fast! |

<table>
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<tr>
<th>Vocabulary</th>
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<tbody>
<tr>
<td></td>
<td><img src="image3" alt="Many planes!" /></td>
<td><img src="image4" alt="Boy!" /></td>
</tr>
<tr>
<td>Sok repülő!</td>
<td>A lot of planes!</td>
<td>Fél a fiú!</td>
</tr>
<tr>
<td></td>
<td>fear.3SG the boy</td>
<td>The boy is afraid!</td>
</tr>
</tbody>
</table>

<p>| Sentence         | Ott sok repülő van! | there many plane be.3SG |
|                  | There are a lot of planes there! |
| Conceptual       | Ott sok repülő van! | there many plane be.3SG |
|                  | There are a lot of planes there! |</p>
<table>
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<tr>
<th><strong>Relational Prime (-ban)</strong></th>
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<tbody>
<tr>
<td><strong>Vocabulary</strong></td>
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<tr>
<td><em>Plüss állatok</em></td>
</tr>
<tr>
<td>Stuffed animals! Toy box!</td>
</tr>
<tr>
<td><strong>Sentence</strong></td>
</tr>
<tr>
<td><em>A plüss állat-ok a játék-doboz-ban van-nak!</em></td>
</tr>
<tr>
<td>the stuffed animal-pl the toy-box-in be.3SG</td>
</tr>
<tr>
<td>There are stuffed animals in the toy box!</td>
</tr>
<tr>
<td><strong>Conceptual</strong></td>
</tr>
<tr>
<td><em>a fiú össze-rak-t-a a plüss állat-a-i-t</em></td>
</tr>
<tr>
<td>the boy together-collect-past.3SG-DEF animal-POSS-PL-ACC</td>
</tr>
<tr>
<td>The boy gathered the stuffed animals together!</td>
</tr>
</tbody>
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</tr>
<tr>
<td><em>Bízik a fiú!</em></td>
</tr>
<tr>
<td>trust.3SG the boy</td>
</tr>
<tr>
<td><strong>Sentence</strong></td>
</tr>
<tr>
<td>There are a lot of toys there!</td>
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<td><strong>Conceptual</strong></td>
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<td><em>Ott sok játék van!</em></td>
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<tr>
<td>there many toy be.3SG</td>
</tr>
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<td>There are a lot of toys there!</td>
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References


