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What Does Children's Spatial Language Reveal About Spatial Concepts? Evidence From the Use of Containment Expressions

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Abstract

Children's overextensions of spatial language are often taken to reveal spatial biases. However, it is unclear whether extension patterns should be attributed to children's overly general spatial concepts or to a narrower notion of conceptual similarity allowing metaphor-like extensions. We describe a previously unnoticed extension of spatial expressions and use a novel method to determine its origins. English- and Greek-speaking 4- and 5-year-olds used containment expressions (e.g., English *into*, Greek *mesa*) for events where an object moved into another object but extended such expressions to events where the object moved behind or under another object. The pattern emerged in adult speakers of both languages and also in speakers of 10 additional languages. We conclude that learners do not have an overly general concept of Containment. Nevertheless, children (and adults) perceive similarities across Containment and other types of spatial scenes, even when these similarities are obscured by the conventional forms of the language.

Keywords: Spatial language; Containment; Motion; Space; Overextension; Language and cognition; Language acquisition; Cross-linguistic analyses

1. Introduction

It is widely acknowledged that the acquisition of spatial language builds on underlying (prelinguistic) predispositions to categorize spatial events (Choi & Bowerman, 1991; Landau & Jackendoff, 1993; Miller & Johnson-Laird, 1976). Some of the most powerful evidence for children's reliance on language-independent spatial concepts comes from early non-adult (e.g., overextended) uses of spatial expressions (Barrett, 1977; Bowerman, 1978a, 1996; Clark, 1973; Slobin, 1985; Smiley & Huttenlocher, 1995). For example, children

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learning English initially use the verb *open* not only for opening doors and windows but also for pulling apart two Frisbees or for turning on the lights (Bowerman, 1978a; Clark, 1993). Interestingly, children's overextensions in their target language (e.g., "open the lights" in English) often correspond to legitimate structures in another language (e.g., the corresponding "anijo ta fota" in Greek is fine). In that sense, children sometimes behave unlike adult speakers of their own language but similarly to adult speakers of a different language. Another well-known case of overextension is the use of *from* by English-speaking children to express agents typically marked with *by* in adult speech (e.g., *He's really scared from Tommy*) or causes typically marked by *because* (e.g., *That's from I put a thing on it*); such uses appear in children's speech alongside adult-like uses of *from* that express origin in space and time (e.g., *Where that came from?, Back from fishing*; Clark & Carpenter, 1989). This overextension pattern suggests that children treat agents, causes, and spatio-temporal origins as identical or at least similar enough to license the use of a single preposition (*from*). These examples demonstrate how overextension patterns can be informative in that children are modeling their language not only after what they hear, but also after some other system, possibly a language-independent system of spatial concepts. Children's overextensions thus offer support for learner-driven contributions to the structure of spatial language.

Despite the widespread agreement on the usefulness of examining overextensions, the systematic study of overextensions and other patterns of lexical usage in children has traditionally faced a number of problems. To begin with, it has been difficult to establish the true extent of children's overextensions. There appear to be only small windows of time when overextended uses of a word occur in child speech (Hoek, Ingram, & Gibson, 1986) and relatively few words in children's early vocabulary are overextended (Bowerman, 1978b; Rescorla, 1980). Early estimates of overextensions have been affected by difficulties in interpreting children's spontaneous production. For instance, a child who uses the word *dog* when looking at a fur piece may be trying to indicate that the fur piece is "like a dog" (cf. Barrett, 1977; Rescorla, 1980; Winner, 1978). In other instances, non-adult uses of words in children's speech may be simply due to retrieval errors (Fremgen & Fay, 1979; Gershkoff-Stowe, 2001; Hoek et al., 1986; Naigles & Gelman, 1995). Early comprehension studies may also have led to inflated overextension counts. In one such study (Kuczaj, 1982), children were asked to continue looking for a label's referent after the prototypical one had already been selected; this step encouraged children to overextend the label (Naigles & Gelman, 1995). These and other methodological issues with some of the earlier studies of overextensions (e.g., small sample sizes; Barrett, 1977; Hoek et al., 1986; Kuczaj, 1982; Rescorla, 1980) have sometimes made it difficult to empirically distinguish between productive overextensions and incidental errors in the way children use a word.

A present challenge is that, to the extent that true overextensions do occur, it is unclear how exactly they should be taken to relate to children's early concepts. Prior research has raised two theoretical possibilities. One possibility is that children's overextensions result from underlying concepts that are incomplete or overly general (see discussions in Clark, 1973; Hoek et al., 1986; Naigles & Gelman, 1995). To take the example of the overextended uses of *from*, it is possible that children treat causal agents, places, and times as subtypes of a broad concept SOURCE, just as they treat dogs and cats as subtypes of the

broad category ANIMAL (Clark & Carpenter, 1989). Children may treat some of these subtypes (e.g., locative sources) as more prototypical than others (e.g., temporal sources), but they would nonetheless commit to all of them belonging to the concept SOURCE. We will refer to this as the *conceptual generality* hypothesis.

Another possibility is that children overextend words when they need to stretch their limited vocabulary to encode objects or relations for which they lack words. According to this view, overextensions can be seen as primitive metaphors (Clark, 1978; Winner, 1978) motivated by performance/communicative demands (Barrett, 1977; Fremgen & Fay, 1979). To return to the case of *from*, it is possible that children treat locative source as the basic meaning of *from* and use the preposition to also express other, non-basic meanings in much the same way that *foot* is extended in phrases such as *at the foot of the cliff* or *at the foot of the bed* (Clark & Carpenter, 1989). On this view, overextensions do not represent a genuine commitment to a single underlying concept. Nevertheless, they can still be informative about the degree of perceived overlap between two categories, since they are based largely on perceptual or functional similarity (Clark, 1973). We will call this the *conceptual overlap* hypothesis.[1]

Discussions of overextensions in spatial language have not always been explicit about whether they favor the conceptual generality or the conceptual overlap hypothesis. In some cases, overextensions that were originally taken as evidence of conceptual generality have been reanalyzed in terms of conceptual overlap when it was shown that they did not survive across different tasks (Carey, 1978; Huttenlocher, 1974; Thompson & Chapman, 1976). In many other cases, the origins of children's overextensions remain open. For instance, Clark and Carpenter (1989) pointed out that both types of hypotheses can explain *from*-overextensions and concluded that "it is unclear what would allow us to distinguish them" (p. 24).

In the present paper, we offer a novel way of assessing whether children's non-canonical uses of spatial vocabulary reveal immature concepts or a way of recruiting existing lexical resources for hard-to-describe spatial referents. Notice that the conceptual generality and the conceptual overlap hypotheses make different predictions about how often, where, and why non-canonical uses of spatial language should occur. First, the two hypotheses disagree about the frequency of canonical versus non-canonical uses of a given spatial expression in children's speech (henceforth the *Frequency* prediction). The conceptual overlap hypothesis clearly predicts that there should be an asymmetry between basic and extended/"metaphorical" uses of a spatial term, such that the former should be more frequent and robust and the latter rarer and more opportunistic. By contrast, the conceptual generality hypothesis is in principle neutral with respect to the directionality of spatial expression use, since it attributes both canonical and non-canonical uses to the presence of a single underlying general concept. (This hypothesis might appeal to prototype structure to explain why some uses appear to be canonical/basic and others non-canonical/derived, but this would require additional theoretical machinery.)

Second, the two hypotheses differ in terms of the populations in which non-canonical uses of spatial expressions are expected to appear (henceforth the *Users* prediction). The conceptual overlap hypothesis allows for the possibility that adults—alongside children—might

also use novel extensions of spatial language for spatial referents that are somehow unusual or hard to describe (as in children, such extended/"metaphorical" uses should be relatively infrequent). Furthermore, these extended uses might occur cross-linguistically, provided that they represent consistent solutions to the need to refer to hard-to-encode objects, relations, or events. By contrast, the conceptual generality hypothesis does not apply to adult usage patterns: On this view, adults are (by definition) cognitively mature and, to the extent that they extend word uses, they do so for communicative, not conceptual reasons.

Third, the two hypotheses disagree about the motivation of extended lexical uses (henceforth the *Motivation* prediction). The conceptual overlap hypothesis treats extended uses as indices of expressive breadth; therefore, it expects such uses to occur exactly where children (or even adults) face vocabulary limitations. The conceptual generality hypothesis, by contrast, treats extended uses as indices of conceptual difficulty; therefore, it expects to find independent (e.g., non-linguistic) evidence of overly general concepts just where non-conventional word extensions occur.

In the two studies we report below, we document a previously unnoticed, yet systematic and pervasive extension pattern in the use of spatial language. We then use a novel combination of developmental and cross-linguistic data to test the competing predictions of the conceptual generality versus overlap hypotheses with respect to this pattern.

1.1. Empirical focus and prospectus

Our empirical focus within the domain of spatial language is the expression of motion events, in which an object moves with respect to another object along a certain path. Our data come from two projects recently conducted for independent reasons in our laboratory to investigate the cross-linguistic expression of motion paths. Both projects study a variety of motion paths such as Containment (e.g., an object moving into another object), Cover (e.g., an object moving under another object), Support (an object moving onto another object), etc. For each path, both goal (e.g., X goes into/onto Y) and source versions (e.g., X comes out of/off of Y) are examined because prior work has indicated that goal information is encoded more precisely in language than source information (Lakusta & Landau, 2005; Papafragou, 2010; Regier & Zheng, 2007).

In the first project, we asked adult and child speakers of English and Greek to describe a set of motion events. English and Greek were chosen because they differ in the way motion path information is encoded: In English (a "satellite-framed" language; Talmy, 1985), path information is most commonly encoded in adpositions/particles (e.g., *in/into*). In Greek (a "verb-framed" language, ibid.), path information can be encoded in either adpositions/particles (e.g., *mesa* 'in') or verbs (e.g., *beno* 'enter'). Of interest was whether patterns in the use and acquisition of spatial language would persist across different ways of lexicalizing motion paths in the two languages. In each language, we tested adults and 4- to 5-year-old children. We chose to test 4- and 5-year-old children because spatial language is still developing in the preschool years (Johnston & Slobin, 1979; Leikin, 1998), and descriptions of motion in both English- and Greek-speaking children of this age have been found to differ in several respects from those of adults (Bunger, Trueswell, & Papa-

fragou, 2012; Papafragou, 2010). In the second project in this series, we asked speakers of a larger set of languages (including both satellite- and verb-framed languages) to describe the same motion events. The impetus for this paper was an observation that emerged upon inspecting the data from the first project. We discovered that 4- and 5-year-old speakers of English and Greek used containment expressions such as *into/out of* (and their Greek equivalents) to encode movement into/out of a container but also extended their use to motion events that did not involve canonical (physical) containment. Specifically, we found that children extended containment expressions to refer to events in which an object moved behind/from behind or under/from under another object. This pattern was very striking and, to our knowledge, previously unreported in the literature on spatial language. Our goal in this paper was to use subsets of the datasets from our two projects to document this novel finding and explore its nature. (We will not report on the full project data, but see Johanson & Papafragou, unpublished data.)

This paper is structured as follows. We begin by presenting data from the English–Greek project that document children's extended use of containment expressions (Study 1). To determine whether such uses are due to conceptual generality or conceptual overlap, we compare the predictions of the two views (Study 1) by examining (a) how extended uses relate to basic uses of containment terms (the Frequency prediction), (b) whether extended uses are observed in adult speech (the Users prediction), and (c) what the underlying motivation for these uses might be (the Motivation prediction). Finally, we look at whether the extended uses of containment expressions are found in the wider set of languages sampled for our second project and test the predictions in (a)–(c) above against this additional data set (Study 2). Together, these results allow us to assess the nature of these uses in the context of existing theories about children's overextensions.

Our approach differs from much prior work on children's non-canonical lexical uses. From a methodological perspective, the fact that we draw from elicited descriptions of spatial scenes rather than spontaneous production data ensures that we attend to truly productive lexical patterns as opposed to isolated uses/incidental errors. From a theoretical perspective, the data reported here offer a novel source of evidence about the relationship between spatial language and cognition in children (and adults). Specifically, the combination of cross-linguistic and developmental data offers a novel way of testing whether children's extensions of spatial terminology reflect overly general spatial concepts or more restricted conceptual similarities among spatial relations that are exploited for purposes of communication.

2. Study 1

2.1. Method

2.1.1. Participants

Thirty native English speakers and 30 native Greek speakers participated. All participants were low to mid socioeconomic status. Participants fell into three age groups (4-year-olds, 5-year-olds, and adults) with 10 people in each group. In the English-speak-

ing group, the younger children were between the ages of 3;8 and 4;3 with a mean age of 3;11, and the older children were between the ages of 4;9 and 5;5 with a mean age of 5;0. These children were recruited from a daycare center in Newark, Delaware. The English-speaking adults were recruited from the University of Delaware and received course credit for participation. In the group of Greek participants, the younger children were between 3;9 and 4;3, with a mean age of 4;0, and the older children were between 4;10 and 5;3, with a mean age of 5;0. The Greek-speaking adults were mostly University students. All Greek data were collected in Evia, Greece, and coded by a native Greek speaker.

2.1.2. Materials

The stimuli consisted of a total of 48 dynamic motion events presented in Microsoft PowerPoint. Each event consisted of a Figure, which was always the same soccer ball, and a Reference object, which was selected from a set of simple, abstract 3D objects. We chose to use very simple schematic stimuli to elicit only or mainly path information (even from speakers of a language such as English which regularly encodes manner of motion) and to minimize cross-linguistic encoding differences for object names.

The motion events depicted eight different spatial relations, each with a source and a goal version: Containment (IN/OUT OF), Cover (UNDER/FROM UNDER), Contact (TO/FROM), Support (ONTO/OFF OF), Vertical Proximity (TOWARD THE SIDE OF/AWAY FROM THE SIDE OF), Horizontal Proximity (TOWARD THE TOP OF/AWAY FROM THE TOP OF), Occlusion (BEHIND/FROM BEHIND), and Front (IN FRONT OF/FROM IN FRONT OF). Three exemplars were shown for each different relation, each with a source and a goal version, for a total of 48 stimuli. The source and goal versions of the same exemplar were identical except for the color of the Reference object and the direction of the motion path (see Fig. 1 for example scenes). The motion events lasted 3 s and then the end state of the event remained on the screen until a key was pressed.

A pseudo-random presentation order was used to ensure that no exemplars of the same spatial relation were within three scenes of each other. We also created a reverse order, so that half of the participants received the original and half the reverse order.

2.1.3. Procedure

Children were told that they were going to play a game where animals play with balls and "toys." They were then shown a screen with all Reference objects used in the materials and told to call them all "toys." Second, in order to help the children maintain attention, a slide with a small cartoon animal in one of the bottom corners was presented before each motion event. The children's attention was drawn to the animal by the experimenter who said, "Look at the (animal)! Let's see what the (animal)'s ball will do!" (English)/"Kitakse to (zoo)! As dume ti tha kani i bala tu (zou)!" (Greek). The motion clip was then played and remained on the screen; then the experimenter asked the child to describe what the animal's ball did. The children completed at least three practice

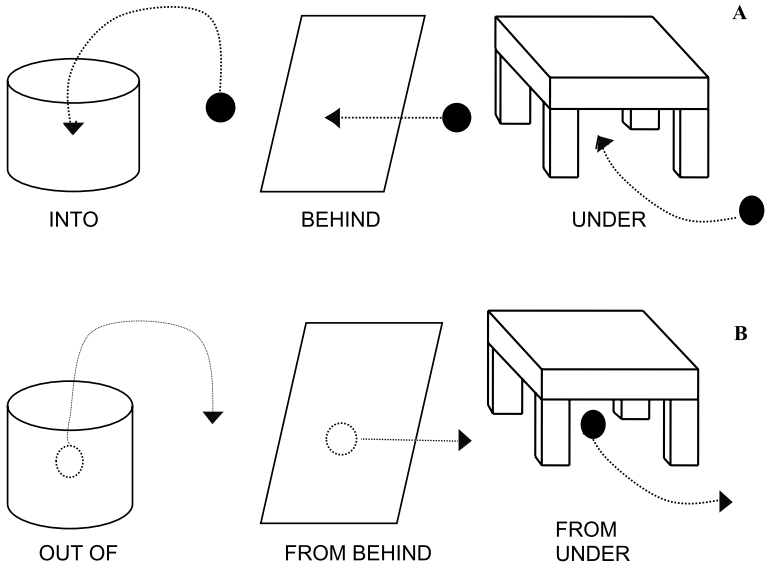

Fig. 1. Schematic examples of motion events for Containment (INTO/OUT OF), Occlusion (BEHIND/FROM BEHIND), and Cover (UNDER/FROM UNDER) relations. Our actual stimuli were three-dimensional color objects shown against a light blue background. Panel A depicts the goal and Panel B the source version of each event. (*Note*. In the second panel, the ball was occluded in the beginning of the OUT OF and FROM BEHIND events. We use a dotted-line circle to depict the ball when it is occluded.)

trials before beginning the experiment. Materials were distributed over two sessions, usually a few days apart, to keep the sessions reasonably short.

Adults were simply told that they would see a series of motion events involving a ball and another "toy" and they would have to describe what the ball did. The animal slides were not used, and there was only one practice trial.

2.2. Results

2.2.1. The expression of motion: Background

In two analyses, we sought to confirm the cross-linguistic differences between English and Greek in the expression of motion. For each linguistic description, we coded whether motion information appeared in an adposition (preposition) and/or a verb (for purposes of this paper, particles were considered adpositions). An ANOVA with the proportion of path adpositions as the dependent variable and Language (English, Greek) and Age (4-year-olds, 5-year-olds, Adults) as factors revealed a significant main effect of Language [$F(1, 54) = 11.17$, $p = .0015$]; as expected, English speakers were more likely to use path adpositions than Greek speakers ($M_{ENG} = .92$, $M_{GR} = .78$). The ANOVA also returned a main effect of Age [$F(2, 54) = 5.97$, $p = .0045$, $M_{4Y} = .80$, $M_{5Y} = .81$, $M_{AD} = .95$]: adults used significantly more path adpositions than 5-year-old [$F(1, 38) = 9.05$,

$p = .0046$] and 4-year-old children [$F(1, 38) = 8.96$, $p = .0048$], but there was no difference between the two groups of children ($p = .86$, n.s.). The ANOVA returned no interaction between Language and Age.

A similar analysis for path verbs showed a significant main effect of Language [$F(1, 54) = 32.57$, $p < .0001$; $M_{ENG} = .59$, $M_{GR} = .85$], a significant main effect of Age [$F(2, 54) = 25.77$, $p < .0001$; $M_{4Y} = .84$, $M_{5Y} = .83$, $M_{AD} = .49$], as well as a significant interaction between Language and Age [$F(2, 54) = 5.84$, $p = .005$]. A one-way ANOVA found that the tendency of Greek speakers to include more path verbs compared to English speakers held up only in adults [$F(1, 18) = 31.74$, $p < .0001$; $M_{ENG} = .25$, $M_{GR} = .73$] and 5-year-old children [$F(1, 18) = 4.68$, $p = .04$; $M_{ENG} = .76$, $M_{GR} = .90$], but not in 4-year-old children ($M_{ENG} = .77$, $M_{GR} = .92$), even though the results here appear to be in the same direction as in the other two age groups. Overall, we see the predicted cross-linguistic differences where English speakers are more likely to use path adpositions than Greek speakers and Greek speakers are more likely to use path verbs. Thus, to ensure that we interpret the data fairly for each language, we will look at uses of containment expressions separately for adpositions and verbs for the remainder of the analyses.

2.2.2. Containment expressions: Testing the frequency and users' predictions

For our main analyses, we looked first at the use of English and Greek containment expressions beginning with adpositions. We coded the English *in, into, inside,* and *out* (*of*), and the Greek *mesa (se)* 'in' and *ekso (apo)* 'out (of)' as containment adpositions. Fig. 2 depicts the distribution of containment adpositions for each language. As the Figure shows, containment adpositions were used very frequently by both 4- and 5-year-olds in the two languages to refer to canonical Containment scenes; children further extended these adpositions to refer to the Occlusion and Cover scenes. Containment adpositions were almost never used in all other types of relations combined, so this extension pattern was very specific. Examples of extended uses of containment expressions are given in Table 1.

Is this extension pattern due to conceptual generality (i.e., children's inability to discriminate between canonical Containment, Occlusion, and Cover scenes) or to conceptual overlap (i.e., children's metaphor-like use of containment expressions to refer to Occlusion and Cover scenes)? Recall that, on the conceptual overlap account but not the conceptual generality account, the use of containment expressions should be more frequent for canonical Containment scenes than for any other scene (the Frequency prediction). Furthermore, on the conceptual overlap account but not the conceptual generality account, adults may exhibit some of the same extension patterns as children (the Users prediction). A quick inspection of the data in Fig. 2 tests both of the predictions of the conceptual overlap theory. First, children in both English and Greek used containment expressions most frequently in the canonical Containment scenes and less frequently (but still very consistently) in Occlusion and Cover scenes. Second, adults also showed this extension pattern (with the same directionality) in both languages.

To confirm these patterns statistically, we conducted a MANOVA using the proportion of containment adpositions as the dependent variable, Language (English, Greek) and Age

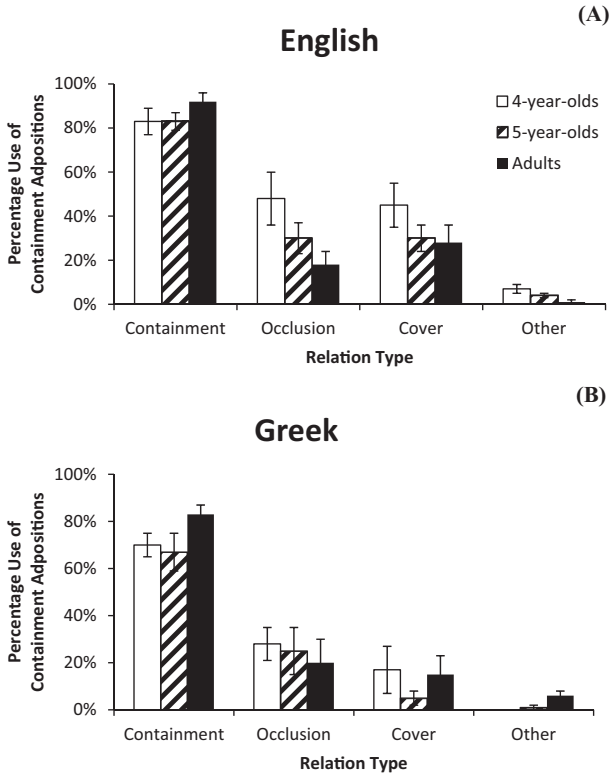

Fig. 2. Percentage of uses of containment adpositions in Containment, Occlusion, and Cover relations in English (Panel A) and Greek (Panel B).

(4-year-olds, 5-year-olds, Adults) as between-subjects factor and Relation (Containment, Cover, Occlusion) as a within-subjects factor. The analysis showed a significant main effect of Language [$F(1, 54) = 9.66$, $p = .003$]: English-speakers used a higher proportion of containment adpositions compared to Greek-speakers ($M_{ENG} = .51$, $M_{GR} = .36$). This is to be expected given that adpositions and other non-verb elements are the main means of expressing motion path information in English (as seen in the previous section, Greek also encodes path information in verbs). The analysis also revealed a significant main effect of Relation [$F(2, 53) = 158.69$, $p < .0001$]: Containment expressions were used more frequently for Containment scenes than either Cover [$t(59) = -15.81$, $p < .0001$] or Occlusion scenes [$t(59) = -12.83$, $p < .0001$; $M_{CONT} = .80$, $M_{COV} = .23$, $M_{OCCL} = .28$)]. In addition, there was an interaction between Age and Relation [$F(4, 106) = 2.99$, $p = .022$]. Further investigation showed that, within the Containment scenes, adults used significantly more containment expressions than either the 5-year-old [$F(1,38) = 4.78$, $p = .04$; $M_{AD} = .88$, $M_{5YR} = .75$] or the 4-year-old children [$F(1,38) = 4.39$, $p = .04$; $M_{4YR} = .77$], but the two groups of children did not perform differently from each other. Pairwise comparisons between age groups for each of the

Table 1
Examples of containment expressions (adpositions and/or verbs) in English and Greek used to describe the spatial relations of Containment, Occlusion, and Cover. As the table shows, containment expressions occur in Occlusion/Cover relations with or without more specific expressions for these relations (such as English (from) behind or (from) under respectively)

	English		Greek	
Relation in Scene				
Containment	It popped out of the toy. (5;3)		I bala vjike mesa apo to antikimeno. (adult) 'the ball exited inside-from the object'	
Occlusion	It came out from behind the toy. (4;9)	It came out of the triangle. (5;10)	Vjike apo eki pu itan. (5;0) 'exited from where (it) was'	I bala vjeni apo to pehnidi. (adult) 'the ball exits from the toy'
Cover	It went out from underneath toy. (4;9)	It came out of the toy. (3;11)	Vjike ekso. (3;10) 'exited out'	Vjike apo to trapezi. (4;1) 'exited from the table'

Cover and Occlusion scenes revealed no differences between age groups in the Cover scenes and only a marginal difference between adults and 4-year-olds [$F(1,38) = 3.79$, $p = .059$; $M_{AD} = .19$, $M_{4YR} = .38$] in the Occlusion scenes. Interestingly, 4-year-old children used *more* containment expressions than adults in the Occlusion scenes, suggesting that the children were not modeling their language use after adult speakers. The main MANOVA revealed no other main or interaction effects. Thus, even though English speakers used containment adpositions more frequently than Greek speakers overall, children and adults in both languages had canonical containment expressions (used most frequently for Containment relations) and extended their use beyond true physical containment.

Recall that Greek speakers encoded containment information not only in adpositions but also in the path verbs *beno* 'enter,' *vjeno* 'exit,' and their compounds (such as *parabeno* 'enter too deeply,' *ksanavjeno* 'exit again'), as well as their more formal counterparts (such as *iserhome* 'enter' and *ekserhome* 'exit') or related verbs (*ksetriponome* lit.'come out of a hole'). Therefore, it was important to look at whether the extension pattern we discovered held for Greek verbs as well. (In the English data, there was only one occurrence of a containment verb, *enter*, so no equivalent analysis could be performed.) We conducted a MANOVA using the proportion of containment verbs as the dependent variable, Age (4-year-olds, 5-year-olds, Adults) as a between-subjects factors, and Relation (Containment, Cover, Occlusion) as a within-subjects factor. Results are presented in Fig. 3 (see also Table 1 for examples). The analysis revealed a significant main effect of Relation [$F(2, 26) = 33.82$, $p < .0001$]: Containment verbs were used more frequently for Containment scenes than for either Cover [$t(29) = -7.68$, $p < .0001$] or Occlusion scenes [$t(29) = -6.91$, $p < .0001$; $M_{CONT} = .64$, $M_{COV} = .24$, $M_{OCCL} = .26$]. There was no

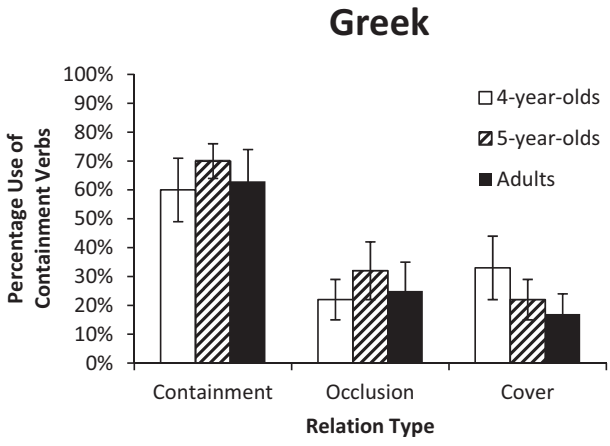

Fig. 3. Percentage of uses of containment verbs in Containment, Occlusion, and Cover relations in Greek.

effect of Age Group or interaction between Age Group and Relation. These results show that, just as with adpositions, containment verbs are used more often for canonical/Containment than for non-canonical uses (Frequency prediction) and appear in the speech of both children and adults (Users prediction) in accordance with the conceptual overlap account.

2.2.3. More detailed tests of the frequency and users predictions

To explore these findings further, we investigated more closely the use of containment terms for different types of paths (source, goal) for each language. Overall, these more specific analyses also confirm the predictions of the conceptual overlap hypothesis for both the frequency and the users of the containment extension patterns. Beginning with the English adposition data, we conducted a MANOVA using the proportion of containment adpositions in source scenes as the dependent variable and Relation (OUT OF, FROM BEHIND, FROM UNDER) and Age (4-year-olds, 5-year-olds, Adults) as factors (see panel A of Fig. 4). The MANOVA found only a significant effect of Relation [$F(2, 26) = 14.26$, $p < .0001$]: Participants used *out (of)* more frequently in the OUT OF scenes than in the FROM BEHIND [$F(1, 27) = 26.37$, $p < .0001$] or FROM UNDER [$F(1, 27) = 10.55$, $p = .003$] scenes. For goal scenes, the same type of analysis showed again a significant effect of Relation [$F(2, 26) = 95.40$, $p < .0001$], with the proportion of containment expressions being significantly higher in INTO scenes than in BEHIND [$F(1, 27) = 133.38$, $p < .0001$] or UNDER [$F(1, 27) = 157.78$, $p < .0001$] scenes. In addition, a significant effect of Age [$F(2, 27) = 8.44$, $p = .0014$] was found. Specifically, 4-year-old children used containment expressions much more frequently than either adults or 5-year-old children [$F(1, 18) = 11.47$, $p = .003$; $F(1, 18) = 7.11$, $p = .02$, respectively]. Inspection of panel B of Fig. 4 reveals that, especially for BEHIND and UNDER scenes, 4-year-old English learners used *in/into/inside* about 40% of the time, whereas adult speakers of English never did so (and older children only did so in UNDER scenes

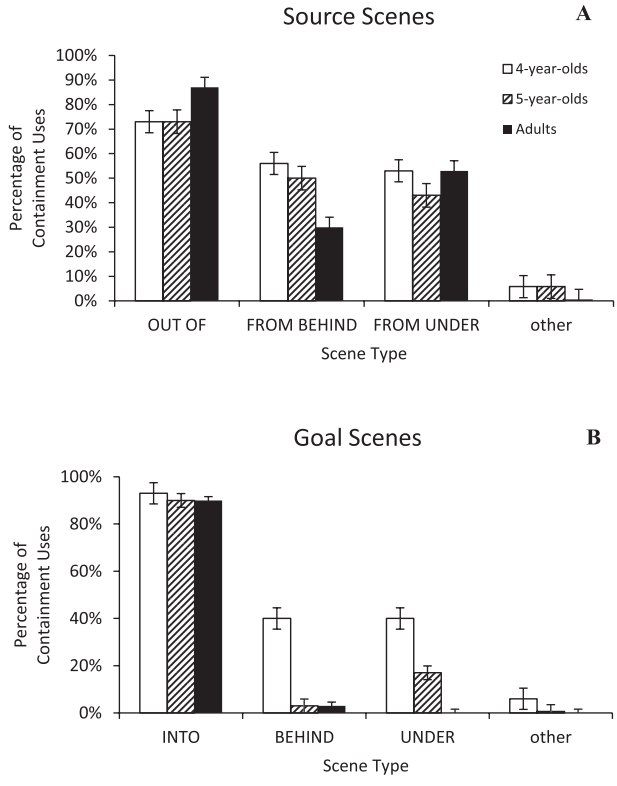

Fig. 4. Percentage of English containment adpositions used in source (Panel A) and goal (Panel B) scenes.

and for a meager 17% of the time). This pattern reflects a true overextension of spatial language, since 4-year-old English learners seem to apply containment terms to spatial scenes in the absence of relevant linguistic input from adults.

The Greek adposition data revealed similar patterns (see Fig. 5). Beginning with source scenes in panel A of Fig. 4, a MANOVA with Relation (OUT OF, FROM BEHIND, FROM UNDER) and Age (4-year-olds, 5-year-olds, Adults) as factors returned only a main effect of Relation [$F(2, 26) = 11.82$, $p = .0002$], with containment adpositions again used significantly more often in OUT OF scenes compared to FROM BEHIND and FROM UNDER scenes [$F(1, 27) = 21.16$, $p < .0001$; $F(1, 27) = 19.75$, $p = .0002$, respectively]. For goal scenes, a similar analysis also returned only a significant effect of Relation [$F(2, 26) = 115.94$, $p < .0001$; see panel B of Fig. 5]. As before, containment adpositions were used significantly more frequently in INTO scenes than in BEHIND [$F(1, 27) = 42.92$, $p < .0001$] or UNDER [$F(1, 27) = 237.68$, $p < .0001$] scenes. In addition, there was a significant difference in the proportion of containment adpositions used in the last two types of scene [$F(1, 27) = 7.54$, $p = .011$; $M_{BEHIND} = .32$, $M_{UNDER} = .08$].

Finally, the corresponding results for Greek containment verbs are presented in Fig. 6. A MANOVA using the proportion of containment verbs in source scenes as the dependent

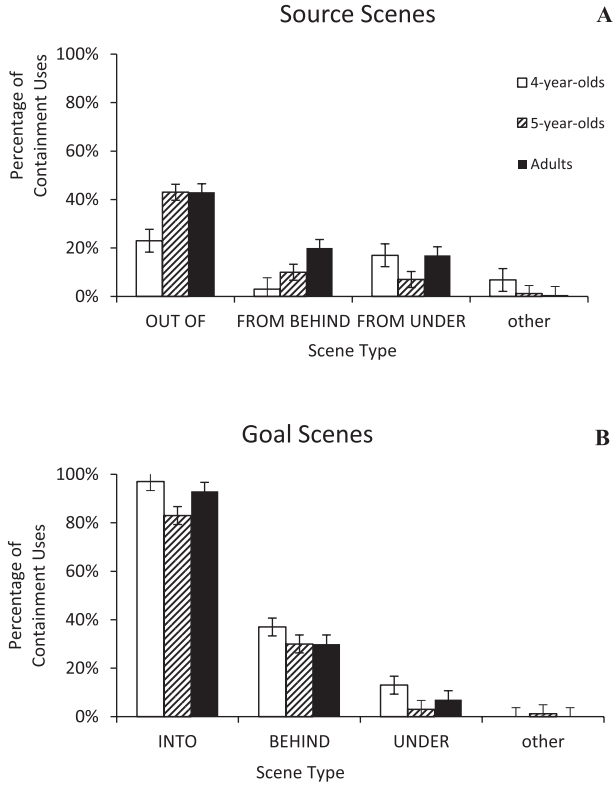

Fig. 5. Percentage of Greek containment adpositions used in source (Panel A) and goal (Panel B) scenes.

variable and Relation (OUT OF, FROM BEHIND, FROM UNDER) and Age (4-year-olds, 5-year-olds, Adults) as factors revealed only an effect of Relation [$F(2, 26) = 21.61$, $p < .0001$; see panel A of Fig. 6]: Containment verbs were used more in OUT OF scenes than in FROM BEHIND [$F(1, 27) = 20.64$, $p < .0001$] or FROM UNDER [$F(1, 27) = 44.61$, $p < .0001$] scenes. There was no difference in use of containment verbs between FROM BEHIND and FROM UNDER scenes. An identical MANOVA for the goal scenes again revealed only a significant effect of Scene [$F(2, 26) = 17.04$, $p < .0001$; see panel B of Fig. 6]: Containment verbs were used significantly more in the INTO scenes than in the BEHIND [$F(1, 27) = 28.17$, $p < .0001$] or UNDER [$F(1, 27) = 27.27$, $p < .0001$] scenes. In sum, as with adpositions, Greek containment verbs were used most often in true Containment (INTO/OUT OF) scenes but were often extended to Occlusion (BEHIND/FROM BEHIND) and Cover (UNDER/FROM UNDER) scenes. Again, there was no difference in use of containment verbs in the BEHIND and UNDER scenes.

Together, these results support the conceptual overlap theory in two ways. First, speakers used containment adpositions and verbs primarily in Containment scenes (the Frequency prediction). Second, the lack of an Age effect in both the source and goal scenes

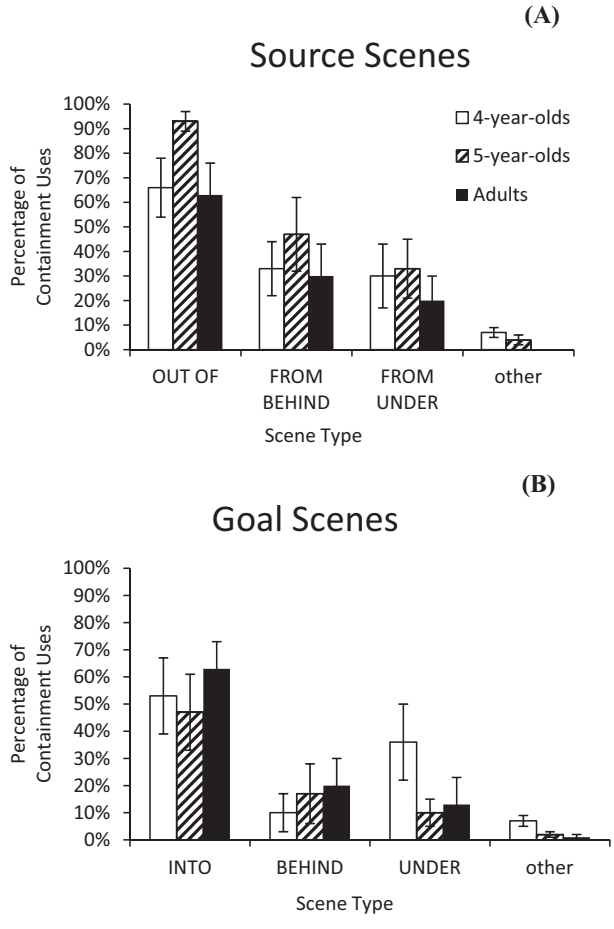

Fig. 6. Percentage of Greek containment verbs used in source (Panel A) and goal (Panel B) scenes.

supports the idea that this extension pattern is metaphorical and does not reflect a developing or immature concept of containment (the Users prediction).

2.2.4. Containment expressions: Testing the Motivation prediction

Why should speakers extend containment expressions in the way we have observed? The two theories of early overextensions differ in terms of their Motivation predictions. According to the conceptual overlap hypothesis, containment extensions occur when children stretch their limited vocabulary to refer to hard-to-encode relations. In contrast, on the conceptual generality hypothesis, extensions of containment expressions to non-canonical scenes arise for conceptual, not expressive reasons. If the conceptual overlap theory is correct, we might expect to find evidence that children in our sample have difficulties with specific expressions for the Occlusion and Cover scenes. There is indeed such evidence: English-speaking children were not consistent in using *(from) behind/back* in the

Occlusion scenes (M_{4Y} = .20; M_{5Y} = .43, M_{AD} = .87; 4- and 5-year-olds do not differ but both groups differed from adults, $p < .05$) or *(from) under* in the Cover scenes (M_{4Y} = .25; M_{5Y} = .52, M_{AD} = .90; 4- and 5-year-olds do not differ but both groups differed from adults, $p < .05$). Similarly, Greek-speaking children used *(apo) piso* ('(from) behind') infrequently in the Occlusion scenes (M_{4Y} = .20; M_{5Y} = .02, M_{AD} = .60; all groups different, $p < .05$) and used *(apo) kato* ('(from) down/under') in Cover scenes only about half of the time (M_{4Y} = .52; M_{5Y} = .42, M_{AD} = .70; adults' and 5-year-olds' performance marginally different, $p = .06$).

It is possible to be even more specific about the locus of difficulty children (and, to some degree, adults) face in encoding Occlusion and Cover. Recall that goal scenes have been found to be encoded more precisely in language compared to source scenes: Goal expressions are often shorter and semantically more specific/dedicated compared to source expressions cross-linguistically (Lakusta & Landau, 2005; Papafragou, 2010; Regier & Zheng, 2007). When children have limited access to the most appropriate (in this case, source) expressions, they will co-opt a related term. This leads to the following set of second-order predictions flowing from the Motivation prediction: (a) The difficulty of using specific expressions for Occlusion and Cover events should be higher in the source than the goal versions of these events; furthermore, this difficulty should characterize both children's and adults' production. (b) Because of (a), non-canonical/extended uses of containment expressions should be co-opted more frequently for source compared to goal versions of Occlusion/Cover events by both children and adults (since such expressions would need to be stretched to accommodate more events in the source compared to the goal versions).

Both of these second-order predictions were confirmed in our data. Beginning with (a), we tested whether the difficulty with Occlusion and Cover expressions was concentrated in source rather than goal versions of the Occlusion and Cover events (for present purposes, we collapsed across Occlusion/Cover). To do this, we conducted a MANOVA for each language using the proportion of use of the target (Occlusion/Cover) adpositions in Occlusion/Cover scenes as the dependent variable, Scene Version (Source, Goal) as a within-subjects variable and Age (4-year-olds, 5-year-olds, Adults) as a between-subjects variable. In English, the results revealed a main effect of Scene Version [$F(1, 27) = 8.32$, $p = .008$], with source versions eliciting fewer specific target adpositions than goal versions (M_{SOURCE} = .44, M_{GOAL} = .61). There was also a main effect of Age [$F(2, 27) = 20.20$, $p < .0001$]. Further comparisons found a difference in target adposition use between the adults and the 4-year-olds [$F(1, 18) = 42.39$, $p < .0001$; M_{AD} = .88, M_{4Y} = .23], the adults and the 5-year-olds [$F(1, 18) = 24.42$, $p < .0001$; M_{5Y} = .48], and (marginally) between the 4- and 5-year-olds [$F(1, 18) = 3.97$, $p = .06$]. This Age effect demonstrates that as language experience and age increase, the ability to use the appropriate adposition also increases. No interaction between Scene Version and Age was found.

In Greek, the same analysis also returned a main effect of Scene Version [$F(1, 27) = 17.23$, $p = .0003$], with source versions eliciting fewer target adpositions compared to goal versions (M_{SOURCE} = .32, M_{GOAL} = .50). There was also a main effect of Age [$F(2, 27) = 9.21$, $p = .0009$]. Further comparisons found a difference in target adposition use between the adults and the 4-year-olds [$F(1, 18) = 6.42$, $p = .02$; M_{AD} = .65,

M_{4Y} = .36], as well as the adults and the 5-year-olds [$F(1, 18) = 16.67$, $p = .0007$; M_{5Y} = .22]. Again, the Age effect suggests that, as children get older, they become better at using the appropriate adpositions. In both languages, then, as predicted, the challenge to encode Occlusion and Cover events was greater for the source than the goal versions of these events. Both adults and children used fewer specific expressions for removal from an occluder or cover (e.g., English *from behind, from under,* and Greek *apo piso, apo kato*) than for reaching an occluder or a cover (e.g., English *behind, under,* and the corresponding Greek equivalents *piso, kato*).

To test the second-order prediction (b), we took the previous finding to its logical conclusion: We asked whether extended uses of containment expressions appeared more frequently in source compared to goal versions of Occlusion/Cover scenes (see Figs. 4 and 5). To test this, we ran a MANOVA for each language with the proportion of containment adpositions used in Occlusion/Cover scenes as the dependent variable, Age (4-year-olds, 5-year-olds, Adults) as a between-subjects variable, and Scene Version (Source, Goal) as a within-subjects variable. In English, this analysis returned a significant main effect of Scene Version in the predicted direction [$F(1, 27) = 14.77$, $p = .0007$; M_{SOURCE} = .48, M_{GOAL} = .19]. There was also a marginal effect of Age [$F(2, 27) = 3.08$, $p = .06$] due to a significant difference in the use of containment adpositions between 4-year-olds and adults [$F(1, 18) = 4.9$, $p = .04$; M_{AD} = .24, M_{4Y} = .47]. In Greek, the same analysis revealed no effect of Scene Version or Age; however, the overall proportion of extended containment adposition uses was relatively low (M_{SOURCE} = .15, M_{GOAL} = .21). We ran a similar analysis using the proportion of Greek containment verbs used in Occlusion/Cover scenes as the dependent variable, Age (4-year-olds, 5-year-olds, Adults) as a between-subjects variable, and Scene Version (Source, Goal) as a within-subjects variable. This time, the results showed a main effect of Scene Version in the expected direction [$F(1, 27) = 4.49$, $p = .04$; M_{SOURCE} = .32, M_{GOAL} = .17] and no other main effects or interactions. We conclude that, in both English and Greek, the tendency to use containment expressions for non-canonical (Occlusion/Cover) events was stronger in source compared to goal scenes—in accordance with the hypothesis that such uses covered expressive gaps in spatial language.[2] This conclusion speaks to the Motivation prediction and supports the conceptual overlap hypothesis: People are more likely to extend containment expressions where they lack the appropriate word, which in this case happens more for source scenes than for goal scenes.

2.3. Discussion

Our results reveal a cross-linguistic bias in spatial language: Both English- and Greek-speaking 4- and 5-year-old children extended motion expressions of containment to relations of Occlusion and Cover in addition to their regular uses denoting (true) Containment. For instance, when a ball went behind or under a reference object, children sometimes said that the ball went *in*; similarly, when a ball moved away from the space behind or from under an object, children sometimes said that the ball came *out*. Such extensions were limited to the Occlusion and Cover scenes; that is, there was no evidence

of generalized over-use of containment terms. Furthermore, this pattern extended to different grammatical devices for encoding containment (English and Greek adpositions and Greek containment verbs). As far as we can tell, this systematic pattern of use has not been discussed before—despite the fact that containment expressions have been known to be among the first spatial expressions to be acquired by children cross-linguistically (Corrigan, Halpern, Aviezer, & Goldblatt, 1981; Johnston & Slobin, 1979; Leikin, 1998).

The literature on early lexical development (reviewed in the Introduction) suggests two hypotheses that could be used to explain this pattern. According to the conceptual generality hypothesis, children treat the Occlusion, Containment, and Cover scenes as subcategories of a broad and abstract concept of CONTAINMENT. According to the conceptual overlap hypothesis, children engage in a metaphor-like extension of containment verbs/adpositions in their language to encode relations that are similar to Containment but more difficult to express. For both hypotheses, the fact that this pattern emerges in the speech of children in two different languages is significant: It could be interpreted either as evidence of a broader conceptual limitation in learners that affects the use of spatial language or as an indication of a shared communicative solution to the problem of expressing certain hard-to-encode motion configurations.

The two hypotheses make a number of different predictions. To begin with, the conceptual overlap hypothesis predicts that basic uses of containment terms (i.e., those that refer to canonical Containment) should be more frequent compared to extended/"metaphorical" ones; in contrast, the conceptual generality hypothesis treats all uses of containment expressions as equal in principle since they stem from the same underlying broad concept (the Frequency prediction).[3] Furthermore, the conceptual overlap hypothesis allows for the possibility that adults—alongside children—might also extend containment terms for scenes that are somehow unusual or hard to describe; this possibility is excluded by the conceptual generality hypothesis, since adults cannot be assumed to lack the ability to distinguish between Containment, Cover, and Occlusion (the Users prediction). Finally, the conceptual overlap hypothesis expects extended uses of containment expressions to occur in domains that can be independently shown to challenge children's (and possibly adults') *lexical* resources; the conceptual generality hypothesis expects extensions to occur in domains that can be shown to challenge children's (but, by definition, not adults') *conceptual* resources (the Motivation prediction).

Our data support the predictions of the conceptual overlap over the conceptual generality hypothesis. Beginning with the Frequency prediction, children clearly preferred to use containment expressions in Containment scenes compared to Occlusion and Cover scenes. This shows that participants treat spatial expressions such as *into* and *out of* in English (and their equivalents in Greek) primarily as denoting canonical Containment (as opposed to a more general concept that would encompass Occlusion and Cover).

Turning to the Users prediction, adults in both languages also extended containment expressions to express Occlusion and Cover. English-speaking adults did so only for source but not goal containment adpositions; roughly, they said that the ball came *out* when it emerged from behind/under an object, but they did not say that it went *in* for the inverse motion (see next paragraph for an explanation of this source-goal asymmetry).

Greek-speaking adults extended both source and goal containment expressions. Since adults are by definition cognitively mature, these extensions cannot be motivated by the inability to differentiate these scenes conceptually.

In terms of the Motivation prediction, we found evidence that children in both languages had difficulties with the more specific adpositions for Occlusion [English *(from) behind*, Greek *(apo) piso*) and Cover (English *(from) under*, Greek *(apo) kato*]—a finding that supports the view that children had to co-opt other expressions to express the corresponding motion scenes. Furthermore, both children and adults extended containment expressions more frequently in source compared to goal scenes: In English, this pattern held in containment adpositions and in Greek it was observed in containment verbs (Greek containment adpositions were extended less frequently to non-Containment scenes and were equi-biased between source and goal versions of such scenes). The overall source advantage is consistent with the well-established finding that, across languages, the linguistic resources dedicated to encoding source scenes are more limited and semantically less specific compared to those dedicated to encoding goal scenes (Lakusta & Landau, 2005; Papafragou, 2010; Regier & Zheng, 2007)—hence, source scenes should be more likely to invite (over)extensions of spatial language compared to goal scenes.

There are independent arguments to support the conclusion that children's extended uses of containment terms are not due to lack of conceptual sophistication. Previous research has demonstrated that even infants as young as 2 months have concepts corresponding to canonical (physical) Containment (Baillargeon & Wang, 2002; Casasola, Cohen, & Chiarro, 2003; Hespos & Baillargeon, 2001; Spelke & Hespos, 2002). Furthermore, infants can distinguish Containment from Occlusion and Cover events (Baillargeon & Wang, 2002; Casasola et al., 2003). For instance, Casasola et al. (2003) found that 6-month-old infants treated Containment events (e.g., a bear placed in a basket) differently from Occlusion events (e.g., a bear placed behind a basket). Similarly, Baillargeon and Wang (2002) found that 4.5-month-old infants could detect impossible Occlusion events (e.g., a tall cylinder lowered behind a short occluder) but not impossible Containment events (e.g., the same tall cylinder lowered into a short container). In another experiment (ibid.), it was found that 9-month-old infants could detect impossible Containment events but not impossible Cover events (e.g., a short cover lowered over a tall cylinder). The fact that infants did not generalize across these events showed that they viewed canonical Containment as distinct from both Occlusion and Cover events.

In sum, the evidence suggests that the tendency to extend the use of containment expressions was motivated by the communicative need to encode hard-to-describe scenes that are considered similar to Containment (rather than by the presence of an undifferentiated concept that encompasses Containment but also Occlusion and Cover). This tendency therefore reveals a pattern of perceived conceptual overlap across spatial scenes that is obscured by the conventional forms of the language. This tendency was observed in children and adults in two different languages and persisted across different grammatical means of expressing containment (adpositions/verbs). Strikingly, this bias was present

in children's speech even without evidence from adult input: Recall that English-speaking children extended the containment adpositions *in/into/inside* for BEHIND and UNDER goal scenes despite the fact that adults never did so.

To further examine the nature of this finding, it is worth asking whether the extension of containment terms occurs in a wider sample of adult data from multiple languages. A richer array of cross-linguistic data would allow us to compare the three types of predictions of the conceptual overlap and the conceptual generality hypotheses more stringently. Preliminary support for the possibility that the pattern we have uncovered has wider cross-linguistic distribution comes from reports that some Australian languages often use the same expression to encode static 'in' and 'under' displays (Levinson & Wilkins, 2006). In our second study, we sought to test this possibility more fully.

3. Study 2

In Study 2, we tested 14 native speakers of 10 languages (Cantonese, Dhivehi, German, Javanese, Korean, Pashto, Malay, Spanish, Swahili, and Turkish) on a paradigm almost identical to that in Study 1. We included both satellite-framed languages that, like English, tend to encode motion paths in particles/non-verb elements, and verb-framed languages that, like Greek, tend to encode motion path information in the verb (Talmy, 1985). Our new sample was split almost evenly between these two language types (Spanish, Turkish, Korean, and Swahili are verb-framed; German, Cantonese, and Javanese are satellite-framed; and Dhivehi, Malay, and Pashto are of unknown type).

3.1. Method

3.1.1. Participants

Native speakers of nine languages (Cantonese, Dhivehi, German, Korean, Malay, Pashto, Spanish, Swahili, and Turkish) were recruited from the graduate student population of the University of Delaware. All students were proficient in English as well as their native language and had spent on average 5 years in the United States. Data from one additional language (Javanese) were collected at a site abroad (Jakarta, Indonesia); see Table 2 for all 10 languages and language families. One to two informants from each language were tested. The average age of the informants was 26 years. Participants received a $10 gift certificate for their time.

3.1.2. Materials

The same 48 dynamic motion events as in Study 1 were used but with one additional event for each relation (shown in both a source and goal version) for a total of 64 items. A pseudo-random presentation order was created, such that no exemplars of the same spatial relation were within three scenes of each other. This order was then reversed. Each participant was assigned to one of the two orders.

Table 2
Languages (with number of speakers tested), language families, and countries of origin in Study 2

Language	Language Family	Country
Cantonese (n = 1)	Sino-Tibetan	China
Dhivehi (n = 1)	Indo-Aryan/Indo-European	Maldives
German (n = 2)	Indo-European	Germany
Indonesian/Malay (n = 2)	Austronesian	Malaysia
Javanese (n = 1)	Austronesian	Central Java
Korean (n = 1)	Altaic	Korea
Pashto (n = 1)	Indo-Iranian/Indo-European	Pakistan
Spanish (n = 2)	Indo-European	Mexico, Columbia
Swahili (n = 1)	Niger-Congo	Tanzania
Turkish (n = 2)	Altaic	Turkey

3.1.3. Procedure

The procedure was the same as in Study 1 except that participants entered the descriptions of the events in a spreadsheet using their native language. These descriptions were glossed at a later stage by the participants and coded by the experimenters. Further interviews with participants were held to resolve any coding questions.

3.2. Results

We recorded how frequently containment adpositions/non-verb elements and containment verbs were used in Containment, Occlusion, and Cover scenes cross-linguistically, averaging across informants of the same language (see Tables 3 and 4). Containment adpositions or verbs had to encode true containment information (i.e., general directionals/locatives were excluded). As seen in Table 3, 7 of the 10 languages sampled (Dhivehi, German, Javanese, Korean, Malay, Spanish, and Turkish) consistently used a containment adposition or other non-verb expression in the goal Containment scenes. However, none of these languages extended the use of this term to either Cover or Occlusion scenes. For the source Containment scenes, four languages consistently used a containment expression (Dhivehi, German, Javanese, and Turkish). Again, none of these expressions were extended to the Cover or Occlusion scenes.

The behavior of containment verbs was quite different. Table 4 shows that 6 of the 10 languages (Malay, Cantonese, Javanese, Korean, Spanish, and Turkish) consistently used a goal ('enter') verb in the canonical Containment scenes. Of these, two languages (Spanish and Turkish) extended the verb to the Occlusion scenes, and a larger subset of four languages (Cantonese, Korean, Spanish, and Turkish) extended the verb to the Cover scenes. Similarly, 9 of the 10 languages (Cantonese, Dhivehi, Javanese, Korean, Malay, Pashto, Spanish, Swahili, and Turkish) consistently used a source ('exit') verb in the canonical Containment scenes. Of these, eight languages (Dhivehi, Javanese, Korean, Malay, Pashto, Spanish, Swahili, and Turkish) extended the verb to the Occlusion scenes

Table 3
Percentage of containment adpositions/non-verb elements used in Containment (IN/OUT OF), Occlusion (BEHIND/FROM BEHIND), and Cover (UNDER, FROM UNDER) scenes

	Goal Scenes				Source Scenes			
Language	IN	BEHIND	UNDER	Containment Adposition/ Non-Verb Expression	OUT OF	FROM BEHIND	FROM UNDER	Containment Adposition/ Non-Verb Expression
Cantonese (n = 1)	–	–	–		–	–	–	
Dhivehi (n = 1)	50	–	–	there—ah ‘inside-to’	100	–	–	there—in ‘inside-from’
German (n = 2)	100	–	–	in … hinein ‘in… into’	87.5	–	–	aus…heraus ‘out…out of’
Javanese (n = 1)	100	–	–	nang njerone ‘into deep’	50	–	–	tekok njerone ‘from deep’
Korean (n = 1)	75	–	–	euro ‘into’	–	–	–	
Malay (n = 2)	87.5	–	–	ke dalam ‘to inside’	–	–	–	
Pashto (n = 1)	–	–	–		–	–	–	
Spanish (n = 2)	50	–	–	a dentro ‘to inside’	–	–	–	
Swahili (n = 1)	–	–	–		–	–	–	
Turkish (n = 2)	87.5	–	–	ic+GEN+DAT ‘to its inside’	62.5	–	–	ic+GEN+ABL ‘from its inside’

Table 4
Percentage of containment verbs used in Containment (IN/OUT OF), Occlusion (BEHIND/FROM BEHIND), and Cover (UNDER, FROM UNDER) scenes

	Goal Scenes				Source Scenes			
Language	IN	BEHIND	UNDER	Containment Verb	OUT OF	FROM BEHIND	FROM UNDER	Containment Verb
Cantonese (n = 1)	100	–	100	jap6 (heoi3 dou6/dai2) 'in-(go at/under)'	50	–	–	zau ceot1 lei 'go come-out'
Dhivehi (n = 1)	–	–	–	–	100	100	75	nukuthee 'came.out'
German (n = 2)	–	–	–	–	–	–	–	–
Javanese (n = 1)	50	–	–	mlebu 'get.into'	50	75	–	metu 'move.out'
Korean (n = 1)	75	–	50	deuleogakdda 'enter'	75	100	–	nawakdda 'came.out'
Malay (n = 2)	25	–	–	masuk 'go.in'	87.5	12.5	25	keluar 'go.out'
Pashto (n = 1)	–	–	–	–	100	25	50	rawoowato 'came.out.toward.me'
Spanish (n = 2)	62.5	50	50	metio 'go.in'	100	100	62.5	salio 'go.out'
Swahili (n = 1)	–	–	–	–	75	100	100	unatoka 'coming.out'
Turkish (n = 2)	87.5	50	37.5	gir 'enter'	100	75	50	cik 'exit'

and a further subset of six (Dhivehi, Malay, Pashto, Spanish, Swahili, and Turkish) also extended the verb to the Cover scenes.[4]

3.3. Discussion

Data from Study 2 show that the extended use of containment expressions observed in Study 1 has a robust cross-linguistic presence: In one form or another, this pattern of use appeared in nine languages from five different language families. As in Study 1, several aspects of the data support the conceptual overlap hypothesis. First, the use of containment expressions was most stable in the Containment scenes but was often extended to the Occlusion and Cover scenes (the Frequency prediction). Second, though we cannot know whether children learning these languages would show the extension pattern, we do see the pattern with adults, suggesting that, even with a mature understanding of distinct spatial relations, containment expressions can be co-opted selectively when the need arises (the Users prediction). Third, as in the previous study, the observed extension pattern was more pronounced for source compared to goal scenes (the Motivation prediction). For instance, as shown in Table 4, of the six languages that used a goal verb meaning 'enter' for Containment (IN) scenes, only one-third extended the verb to both Occlusion (BEHIND) and Cover (UNDER) scenes; however, of the nine languages that used a source verb meaning 'exit' for Containment (OUT OF) scenes, two-thirds extended the verb to both Occlusion (FROM BEHIND) and Cover (FROM UNDER) scenes.

For reasons that are not clear at present, containment verbs in Study 2 were more likely to be extended to Occlusion/Cover scenes than containment adpositions/particles. This pattern is different from Study 1, where both verbs and adpositions participated in extensions. Since our sample in Study 2 was split almost evenly between verb-framed and satellite-framed languages, the verb-adposition difference cannot simply be the result of oversampling verb-framed systems. Of the nine languages that showed the extension pattern in containment verbs, four were verb-framed (Korean, Spanish, Swahili, and Turkish), two were satellite-framed (Cantonese and Javanese), and three were unclassified (Dhivehi, Malay, and Pashto). Further research is needed to clarify the source of the verb-adposition difference.

Taken together, findings from this study strengthen the conclusion that there is a strong cross-linguistic bias to extend the use of containment expressions to refer to scenes that do not involve physical containment (e.g., Occlusion and Cover scenes). The bias is not motivated by the inability to perceive distinctions between individual scene types. Nevertheless, this pattern is unlikely to have arisen again and again in historically unrelated languages unless there was some property of the minds of speakers of those languages that licensed it. In this sense, the uses of containment terms point to perceived commonalities across spatial scenes. We explore the nature of these commonalities more fully in the General Discussion.

4. General discussion

Children's non-canonical uses of spatial words have often been taken as evidence for underlying biases in parsing spatial referents. However, prior work has not always specified whether these biases were due to children's inability to distinguish between different spatial configurations (*conceptual generality* hypothesis) or their willingness to extend spatial vocabulary in metaphor-like ways to refer to similar spatial configurations when they lack the appropriate expression (*conceptual overlap* hypothesis). Here, we documented a new pattern in children's use of containment expressions and explored its implications for theories of early uses of spatial language. Specifically, we found that English- and Greek-speaking 4- and 5-year-old children extended use of containment adpositions such as *in/out of* and *mesa/ekso* 'in/out' to refer to scenes that do not involve physical containers (Study 1). For instance, when a ball went behind or under a reference object, English-speaking children said that the ball went *in* 25% of the time; similarly, when a ball moved away from the space behind or under an object, children said that the ball came *out* 51% of the time. Additionally, Greek-speaking children using *beno* 'enter' 18% of the time to refer to a ball which ended up behind or under the reference object and *vjeno* 'exit' 35% of the time when a ball moved away from the space under or behind the reference object.

We further explored the tendency to extend containment expressions to encode Occlusion (BEHIND/FROM BEHIND) and Cover (UNDER/FROM UNDER) scenes to evaluate contrasting predictions made by the conceptual generality and the conceptual overlap hypothesis about the frequency, the users, and the motivation of such extensions. We found first that, in accordance with the conceptual overlap hypothesis, basic uses of containment terms (i.e., those that refer to canonical Containment) were more frequent compared to extended/"metaphorical" ones in both English and Greek (Study 1). Second, we found that English- and Greek-speaking adults showed a broadly similar pattern of extension of containment terms as young children (Study 1)—a result that is compatible with the conceptual overlap hypothesis but is less compatible with the conceptual generality view (since adults cannot be assumed to possess immature/overly general concepts). Third, we found that, for both English- and Greek-speaking children, extended uses of containment terms were used for scenes in which more specific expressions (*from) under, (from) behind*, and their Greek equivalents *(apo) kato, (apo) piso*) were used at non-adult rates, and were sometimes rare (Study 1). Furthermore, for both English- and Greek-speaking children and adults, extended containment uses were more frequent in source than goal scenes, where the more specific expressions were used less often (Study 1): This is compatible with the well-known observation that source expressions are less specific and more diffuse in their uses compared to goal expressions cross-linguistically (Lakusta & Landau, 2005; Papafragou, 2010; Regier & Zheng, 2007). Both of these distributional facts reinforce the conclusion that the observed bias in the use of containment expressions has its roots in expressive, not conceptual, difficulty.

Finally, we showed that containment extensions were robust in adult production data from Cantonese, Dhivehi, Javanese, Korean, Malay, Pashto, Spanish, Swahili, and Turkish (Study 2). In addition, these cross-linguistic data reproduced the frequency asymmetry

between canonical and extended containment uses as well as the source-goal asymmetry in extended containment uses that were initially observed in our English–Greek sample. Taken together, these data support the conceptual overlap over the conceptual generality view.

What exactly is the nature of the overlap in the properties of Containment, Occlusion, and Cover scenes that licenses extensions of containment expressions? One possibility is that the locus of overlap is the feature of visual access: When something goes in, behind, or under another object, visual access to it is typically blocked; when something moves out of, from behind, or from under another object, visual access is restored. One problem for this view is that, even though visual access/lack thereof was relevant for our stimuli for both Containment and Occlusion scenes (see Fig. 1), it was irrelevant for the stimuli for Cover scenes: In those stimuli, the ball always stopped underneath/emerged from underneath a chair- or table-like object, and visual access was never blocked.

Another possibility is that speakers may be drawing on the containment-like features in the Occlusion and Cover events when attempting to label the event, hence the use of containment expressions. Notice that the non-linguistic spatial concept of CONTAINMENT is quite abstract: "a perceived container has a particular size, shape, and so forth, but the spatial primitive *container* used to interpret it does not: It consists only of a thing with an inside and an outside and a boundary between" (Mandler, 2007, p. 747; cf. also Mandler, 1992; Shutts & Spelke, 2004). In typical cases of physical containment (shown in the Containment scenes), the "thing with an inside and an outside and a boundary between" is a Reference object with an open top, closed bottom, and side walls (see also Hespos & Piccin, 2009). It is possible that in the instances where children cannot use the most informative term, Occlusion and Cover are treated as similar enough to containment to allow for the extension of containment expressions. For this metaphorical containment, the Reference object lacks a fully defined inside–outside physical boundary: In the Occlusion scenes, the physical boundary is a single vertical surface, whereas in the Cover scenes it is the horizontal surface and four "legs" of the Reference object. Thus, the locus of conceptual overlap between Containment, Occlusion, and Cover might be this metaphorical containment where the boundary between what is inside versus outside is incompletely specified by physical properties of the Reference object. Containment simply involves inclusion in a bounded three-dimensional space (or volume), where boundedness is only partly physically defined.[5]

This metaphoric extension of containment expressions can accommodate the fact that loss or gain of visual access may or may not be involved when something is said to *go in* or *come out*. For schematic boundaries, visual access may be irrelevant; for instance, our Cover events, that only involved movement under/from under table- or chair-like objects with hard tops and four "legs" did not block/enable visual access to the moving object. However, it is possible to imagine other Cover events in which motion *into/out of* a container would be accompanied by appearance/disappearance (e.g., an object moving under/from under a china cup). Appearance/disappearance of the moving figure is, therefore, a possible, though not necessary, feature of containment.

This metaphoric extension hypothesis predicts that containment expressions could be extended to other motion configurations beyond Occlusion and Cover provided that such configurations include Reference objects that can be construed as containers. This prediction is borne out: In an extension of the present studies, we found that English-speaking 4-year-old children sometimes use containment terms to refer to motion culminating in the space *between* two elongated objects (offering descriptions such as *The ball is going into the bars*; see Johanson & Papafragou, unpublished data; cf. also Johnston & Slobin, 1979). This use is unattested in the adult data (ibid.), so it must be driven purely by the learners' construal of the corresponding spatial scenes. Interestingly, just as in the present data, children's extension of containment terms is unlikely to be due to a conceptual inability to differentiate going-between from going-into events: There is evidence that even infants possess the concept BETWEEN (Quinn, Doran, & Papafragou, 2011; Quinn, Norris, Pasko, Schmader, & Mash, 1999). A more likely explanation is that children lack the more specific adposition *between* and co-opt containment expressions to express between-relations since the space between two objects can be treated as a bounded volume (see Johnston & Slobin, 1979; Skordos, Johanson, & Papafragou, unpublished data; for cross-linguistic evidence for the late emergence of *between*).[6]

In sum, we have presented evidence that adults and children extend spatial language in a way that points to shared conceptual features between abstract underlying spatial representations (such as those of Containment, Cover, and Occlusion scenes). We believe that the tendency to view spaces in but also under and behind other objects as types of containers is a natural, probably universal, bias in parsing space and motion. Two features of our data support this view. First, extended spatial uses are present in children's speech even without adult input. As we saw, English-speaking 4-year-olds extended *in/into/inside* to refer to BEHIND and UNDER scenes despite the fact that English-speaking adults never did so (Study 1; adults did extend *out/out of* to refer to FROM BEHIND and FROM UNDER scenes). This true overextension pattern points to an underlying bias in the learners' spatial construal that emerges without guidance from the linguistic community. Second, extensions of containment expressions to denote non-canonical containment are present in unrelated languages belonging to several different language families (Study 2). Speakers of these languages seem to independently converge on the same generalization about what "counts" as a container (this generalization includes both canonical/physical and metaphoric containers).

The extension of containment expressions is reminiscent of other systematic cross-linguistic metaphorical patterns that expose conceptual similarities exploited for the purpose of communication. For instance, cross-linguistically, words for body parts are known to be extended to denote non-bodily locations (*foot of the mountain*; Heine, 1997) and spatial expressions are known to take on temporal meanings (*move the meeting up a week*; Traugott, 1978). In these cases, as in the present case study, the cross-linguistic robustness of the metaphorical pattern is an argument for shared, presumably universal biases in the human mind that license such systematic extensions. In time, such uses may become conventionalized. In our own data, it is an open question whether some of the extended uses of containment terms we documented have become conventionalized, especially in our cross-linguistic data of Study 2.

Our findings and approach break novel ground in the study of children's overextensions and the relation between linguistic usage and (non-linguistic) cognition. Along with many prior studies (e.g., Clark & Carpenter, 1989), we took children's overextensions of spatial vocabulary to be informative about underlying spatial-conceptual biases. Unlike many previous studies, however, we offered more specific diagnostics for determining the nature of these biases. Specifically, we presented a novel combination of developmental and cross-linguistic data to ascertain whether early non-standard uses of spatial language are due to overly general/immature spatial concepts or to expressive difficulties solved by co-opting conceptual neighbors of the more specific/standard spatial terms. The present method also allowed us to avoid pitfalls of earlier studies of children's spatial language production by ensuring that the patterns studied were systematic and widespread, rather than isolated. We believe that this convergent approach holds promise for research into children's early spatial language by demonstrating how language-internal evidence, when properly constrained, can be used as a window into underlying non-linguistic cognitive representations.

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Notes

1. Clark and Carpenter (1989) mentioned a third possible explanation for overextensions, which they call the *property* view. According to this view, different uses of an expression such as *from* simply share an abstract feature (e.g., [+ SOURCE]). As far as we can tell, this view is not able to account for the fact that some types of overextension of the same expression appear earlier and more systematically in child speech than others. Therefore, we will not discuss this view further.
2. Could the higher frequency of extended uses of containment adpositions (English) or verbs (Greek) in source compared to goal scenes simply be a result of a difference in lexical frequency? Closer inspection of the data shows that this explanation does not hold: When used to describe canonical Containment scenes, containment adpositions/verbs showed a different pattern (see Figs. 2–4). A MANOVA using the

proportion of use of containment adpositions in Containment scenes in English as the dependent variable, and Age Group and Scene Version as variables, returned only a main effect of Scene Version—but in the opposite direction from what was seen earlier: Expressions of containment were more frequent in the *goal* than the source versions of Containment scenes [$F(1, 27) = 6.64$, $p = .02$; $M_{SOURCE} = .79$, $M_{GOAL} = .93$]. We also ran the same analysis using containment verbs in Greek as the dependent variable. The results revealed a main effect of Scene Version [$F(1, 27) = 6.81$, $p = .01$; $M_{SOURCE} = .74$, $M_{GOAL} = .54$] and a Scene Version by Age Group interaction [$F(2, 27) = 3.28$, $p = .05$]. Further comparisons revealed that the interaction was caused by the fact that adults and 4-year-olds did not show a source-goal scene difference but 5-year-olds did [$F(1, 8) = 5.82$, $p = .04$; $M_{SOURCE} = .93$, $M_{GOAL} = .48$]. This shows that the source advantage observed in the extended uses of containment expressions is rather specific: When these expressions were used canonically, this advantage was either reversed (English adpositions) or neutralized (Greek verbs—with the exception of the 5-year-old group).

3. One might argue that canonical Containment scenes correspond to the most prototypical members of this broad concept and Occlusion/Cover scenes to more peripheral instances. This argument could explain the directionality of the use of containment terms. In the absence of independent evidence for such typicality effects, however, this argument appears ad hoc.
4. Even though our Cantonese informant did not spontaneously extend the verb during production, post-experiment discussion revealed that the Cantonese containment expression (*zau ceot1 lei* 'go come-out') could be used to describe Occlusion and Cover scenes. Our data may therefore underrepresent the extent of the extension patterns in the languages of Study 2. Here, we treat them as existence proof for the cross-linguistic presence of these patterns.
5. A third possibility is that distinct features of the concept CONTAINMENT overlap with (and motivate extensions to) Occlusion and Cover. For Occlusion, the critical feature may be lack of visual access; for Cover, it may be the presence of "sides" and a top. We opt here for a more parsimonious account in which a single feature is responsible for extension of containment terms to both Occlusion and Cover scenes.
6. The "metaphoric containment" hypothesis is also consistent with the fact that containment terms in many languages have historically taken on various non-spatial uses that are even further removed from canonical physical containment (e.g., *get in line/trouble*—see Herskovits, 1986; Zwarts & Winters, 2000; cf. the Greek equivalents *beno sti grami/se belades*, etc.).

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