Pragmatic aspects of spatial language acquisition and use across languages

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Abstract

Across languages, *back* is produced earlier and more frequently than *front*. This asymmetry has been attributed either to a conceptual/semantic asymmetry in the early meanings of these locatives (with *back* being more basic than *front*; *conceptual immaturity* account) or to the fact that Back configurations are inherently more 'noteworthy' than Front configurations (*pragmatic* account). Here, we tested the two accounts. In Study 1, children and adult speakers of English and Greek described Front/Back motion events. In Study 2, adult speakers of 10 additional languages described the same events. Despite cross-linguistic differences, speakers of all age and language groups typically used more Back than Front adpositions; furthermore, they often encoded Back information in occlusion verbs (e.g. *hide*) but no such verbs were available for Front. Thus, the *front/back* asymmetry is not due to children's conceptual immaturity but should be linked to pragmatic factors that also shape adult spatial language production cross-linguistically.

Keywords: front; back; motion events; spatial cognition; language production; pragmatics; theories of acquisition

Introduction

It is widely recognized that children acquire spatial locatives in a consistent order cross-linguistically (e.g., E. Clark, 1980; E. Clark, 1977; Johnston & Slobin, 1979; Parisi & Antinucci, 1970). In many cases, patterns of language use in children, especially when these emerge cross-linguistically, have been argued to point to shared (possibly universal) conceptual asymmetries in underlying representations (Bowerman, 1996). For instance, the early emergence of prepositions such as *in* and *on* has been considered to reflect the early development of the notions of containment and support (Johnston & Slobin, 1979; Piaget & Inhelder, 1967).

However, it remains unclear whether patterns of spatial language use in children can be attributed merely to *conceptual* factors. For instance, unlike their positive counterparts *in* and *on*, 'negative' containment and support prepositions such as *out* and *off* are used extremely infrequently by children to mark locations, although, in principle, both 'positive' and 'negative' prepositions should present the same level of conceptual difficulty for the learner (compare *The egg is in the cage* vs. *The egg is out of the cage*; Papafragou, Viau, & Landau, 2013). By contrast, a *pragmatic* explanation seems more adequate to account for these facts: 'negative' prepositions are used less frequently because their informational contribution is low (they do not specify where something *is*) unless they can be interpreted as indicating a change of location (*The bird is out of the cage* is more felicitous than *The egg is out of the cage*; ibid.). Even though it is often acknowledged that both conceptual and pragmatic factors shape the way spatial language is used and acquired (e.g., E. Clark, 1973; Levinson & Wilkins, 2006), the exact contribution of each factor remains open. The objective of the current study is to contribute to this debate.

Case study: the acquisition of *front* and *back*

The acquisition of the locatives *front* and *back* presents a particularly good domain to explore the division of labor between pragmatic and conceptual explanations of spatial language acquisition and use. A number of studies have shown that, across different languages, the locative *back* is produced earlier and appears more frequently in children's speech than the locative *front* (Johnston, 1984; Johnston & Slobin, 1979; Kubena, 1968). Some researchers have suggested that this asymmetry should be attributed to the *conceptual immaturity* underlying children's early representations of the relations *front* and *back*. According to this view, although the adult meanings of *front*/*back* are geometric and semantically symmetrical ("first/second in-line-of-sight"), children's early meanings are immature, function-based and asymmetrical: *front* means "visible" and *back* means "occluded". This conceptual/semantic asymmetry in the early meanings of Front and Back results in the asymmetric acquisition of the locatives (Johnston, 1984; Johnston & Slobin, 1979).

Other researchers have argued that the asymmetry in the acquisition of *front* and *back* should be attributed to the *pragmatics* of these spatial expressions (Hill & Vandeloise, 1991; Tanz, 1980). On this view, occlusion and visibility characterize typical Back and Front configurations, with occlusion (the functional corollary of Back) being, typically, more informative than visibility (the functional corollary of Front). Thus, children use *back* more frequently than *front* because the communicative need to mark that an object is occluded is (in most cases) more pressing than the need to mark that an object is visible.

The two explanations converge on the view that children should encode Back more frequently than Front but, crucially, they differ on whether adults should also exhibit a

similar asymmetry. If the asymmetry is due to early, immature meanings for the prepositions *front* and *back* (i.e., visibility and occlusion), as posited by the conceptual immaturity account, adults, having mature spatial semantics, should use the two terms equally frequently. By contrast, if the *front/back* asymmetry is driven by the inherent 'noteworthiness' of occlusion, as proposed by the pragmatic account, adults–just like children–might also exhibit the asymmetry.

Furthermore, the two accounts share the assumption that the meanings of the prepositions *front* and *back* involve the notions of visibility and occlusion, but they disagree on whether adults should entertain such meanings. On the conceptual immaturity account, adults (unlike children) should not have a bias to mark occlusion (as opposed to visibility) with expressions beyond *front* and *back* (e.g., with verbs such as *hide*, etc.) because such function-based representations should characterize only the early immature child semantics. By contrast, on the pragmatic account, adults–just like children–might also show a bias to mark occlusion.

Current study

In the current study we test the predictions of the conceptual immaturity and pragmatic explanations. In Study 1, we elicit descriptions of Front/Back motion events from children and adult speakers of two typologically distinct languages (English and Greek). In Study 2, adult speakers of 10 additional languages describe the same events.

To evaluate the predictions of the conceptual immaturity and pragmatic explanations we compare Front/Back motion descriptions in both children and adults. Although previous research, surprisingly, did not include adults, adult data, especially if they represent a wide cross-linguistic sample, are crucial for validating theories of spatial language acquisition and use.

Furthermore, we look at elicited descriptions of motion paths. Unlike prior work on locative *front/back*, the choice of motion paths allows us to compare not only the use of 'front' and 'back' adpositions (prepositions and postpositions) across the languages in our sample but also the use of functional information (occlusion/visibility) encoded in verbs (see Landau & Jackendoff, 1993; Miller & Johnson-Laird, 1976; Talmy, 1983, on the role of spatial verbs). To ensure cross-linguistic validity, we include both satellite-framed languages that tend to encode motion paths in particles/non-verb elements, and verb-framed languages that tend to encode motion path information in the verb (Talmy, 1985). In study 1, we compare English (a satellite-framed language) to Greek (a verb-framed language). In study 2, our language sample contains an equal number of verb-framed and satellite-framed languages. For completeness in path descriptions, each Front or Back path has a goal variant (e.g., figure moving *in front of/ behind* the reference object) and a source variant (e.g., figure moving *from front of/ from behind* the reference object). In the case of Back paths, figures undergo a dynamic change of state from visibility to occlusion (for goals) or vice versa (for sources). In the case of Front paths, figures undergo a change of location without a change of visibility (e.g., when figure X moves *to/from front of* Y, X moves along a trajectory while being continuously visible).

Study 1

Methods

Participants Participants were 40 native English speakers and 40 native Greek speakers. They fell into two age groups (Children, Adults) with 20 participants in each age group for each language. The English-speaking children were recruited at daycares in Newark, DE and ranged between the ages of 3;8 and 5;5 (M=4;6). The English-speaking adults were undergraduate students at the University of Delaware and received course credit for their participation. The Greek-speaking children were recruited at daycares in Evia, Greece and ranged between the ages of 3;9 and 5;3 (M=4;6). The Greek-speaking adults were University students or young professionals and were recruited in Evia and Athens, Greece.

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).

The motion events depicted a total of eight different spatial relations, each with a source and a goal version. This battery was part of a larger project investigating cross-linguistic descriptions of motion paths. In the present study, we focus on Front (IN FRONT OF/FROM IN FRONT OF) and Back (BACK/FROM BACK). Stimuli depicting the Back relation always involved occlusion but stimuli depicting the Front relation never did (see Fig.1).

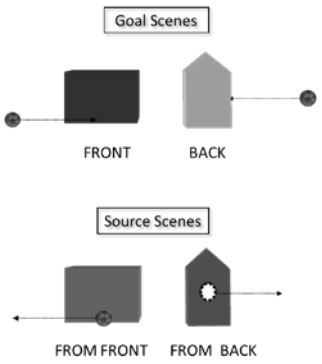

Figure 1: Schematic examples of test events. In FRONT/FROM FRONT scenes, the ball is always visible but in BACK/FROM BACK scenes it is occluded at the endpoint (goal scenes) or the beginning (source scenes) of the event.

The remaining relations were Containment (IN/OUT OF), Cover (UNDER/FROM UNDER), Support (ONTO/OFF OF), Contact (TO/FROM), Vertical Proximity (TOWARDS THE SIDE OF/AWAY FROM THE SIDE OF), and Horizontal Proximity (TOWARDS THE TOP OF/AWAY FROM THE TOP OF).

Six events were shown for each relation (3 exemplars, each with a goal and a source version). 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. The motion events lasted for three seconds and then the end state of the event remained on the screen until a key was pressed.

Procedure The adult participants were told that they would see a series of motion events involving a ball and another "toy." After viewing each event, the participants had to describe, in their native language, what the ball did in each event. Events remained on the screen until a key was pressed. The adult participants performed one practice trial.
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, and were told to call them all "toys." In order to help 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 saying "Look at the (animal)! Let's see what the (animal)'s ball will do!". 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 trials before beginning the experiment.

Coding Each linguistic description for the Front and Back relations was first coded for the presence of a target preposition that had to correspond to the type of scene (goal/source). For Front (goal scenes), the target prepositions were *in front of/to front of* in English and *brosta apo/brosta sto* 'in front of' in Greek. For Front (source scenes), target prepositions included *from (in) front (of)* in English and *(apo) brosta* (apo) '(from) front (of)' in Greek. For Back (goal scenes), the target prepositions included *behind, to back/in back* in English and *piso (apo)/apo piso* 'behind' in Greek. For Back (source scenes), the target prepositions included *from behind* in English and *apo piso (apo)* 'from behind (of)' in Greek.

The linguistic descriptions were also coded for the presence of spatial expressions of visibility or occlusion. For the Front relation, there were no expressions encoding visibility. This fact is highly significant, and we return to it in the Results section. For the Back relation, we coded predominantly appearance/disappearance verbs that encoded occlusion (or, more accurately, a change of state from or to occlusion): *disappear* and *hide* (goal scenes), *appear, emerge* (source scenes) in English, and *hanome* 'disappear', *krivome* 'hide' (goal scenes) and *emfanizome* 'appear', *apokaliptome* 'reveal oneself' (source scenes) in Greek.

Finally, all linguistic descriptions of Front and Back relations were coded in terms of the total target spatial information they contained (i.e., target preposition or occlusion expression). This was done because there was often overlap in the use of target prepositions and other expressions to describe an event (e.g., in Greek *I bala krivete piso apo to pehnidi* 'the ball is hiding behind the toy'), so analyzing each separately might not accurately represent the way Front and Back relations are linguistically represented.

Results and discussion

In three separate analyses, we test the competing predictions of the conceptual immaturity and the pragmatic account in terms of (a) the use of *front*/*back* prepositions, (b) the use of a broader set of visibility/occlusion expressions, (c) the use of the devices in (a) and (b) combined.

Use of *front* vs. *back* prepositions

Beginning with prepositions, we performed a mixed 2 ×2 ×2 ANOVA with Relation (Front, Back) as a within subjects factor, Age (children, adults) and Language (English, Greek) as between subjects factors, and the proportion of target prepositions as the dependent variable. The analysis yielded a significant main effect of Relation ($F(1, 76) = 11.29$, $p = .001$, $\eta^2 = .13$): participants, overall, mentioned Back prepositions more frequently than Front prepositions ($M_F = .35$, $M_B = .45$). The analysis also yielded a main effect of Age ($F(1, 76) = 70.65$, $p < .001$, $\eta^2 = .48$): unsurprisingly, adults used more prepositions than children ($M_{CH} = .17$, $M_{AD} = .65$). Finally, the analysis returned a marginally significant effect of Language ($F(2, 76) = 3.55$, $p = .063$, $\eta^2 = .05$) in the expected direction: English speakers exhibited a small tendency to use more target prepositions than Greek speakers ($M_{ENG} = .50$, $M_{GR} = .29$). The ANOVA did not show any other effects or interactions.

Use of visibility vs. occlusion terms

We moved beyond *front/back* prepositions in the two languages under study to consider a broader set of expressions encoding visibility for Front and occlusion for Back relations. As already mentioned, across ages and languages, there was a great variety of expressions encoding occlusion in Back scenes in the present dataset, but no expressions encoding visibility in Front scenes. We, thus, analyzed only expressions marking occlusion (since visibility was not encoded). A two-way factorial ANOVA, with the proportion of occlusion expressions as the dependent variable and Age and Language as factors, returned a main effect of Language ($F(1, 76) = 10.51$, $p = .002$, $\eta^2 = .12$): because the occlusion expressions were mainly verbs, Greek speakers used occlusion expressions more frequently than English speakers ($M_{ENG} = .38$, $M_{GR} = .60$). Crucially, the ANOVA did not yield an effect of Age ($F(2, 76) = 0.87$, $p = .769$, n.s.): adults used occlusion expressions as frequently as children.

Use of total Front vs. Back information

Finally, to explore the predictions of the conceptual immaturity and pragmatic accounts at a more comprehensive level of spatial encoding, we analyzed the proportion use of total spatial information (target prepositions and occlusion expressions) to mark Front and Back relations. We conducted a mixed 2 ×2 ×2 ANOVA with Relation (Front, Back) as a within subjects factor, Language (English, Greek) and Age (children, adults) as between subjects factors, and the proportion of total spatial information as the dependent variable (see Fig.2). Results yielded a significant main effect of Relation ($F(1, 76) = 137.42$, $p < .001$, $\eta^2 = .64$) and a main effect of Age ($F(1, 76) = 52.19$, $p < .001$, $\eta^2 = .41$), qualified by an Age by Relation interaction ($F(1, 76) = 11.53$, $p = .001$, $\eta^2 = .13$). T-tests within each relation revealed that the interaction was due to the fact that although adults used a higher amount of spatial information for both the Front and Back relations than children (ps < .001), this difference was smaller for the Back relation ($M_{FRONT\_DIFF} = .47$ vs. $M_{BACK\_DIFF} = .22$). Importantly for present purposes, spatial information was used more frequently to encode Back compared to Front relations by both age groups (children: $t(39) = -10.33$, $p < .001$; adults: $t(39) = -6.22$, $p < .001$).

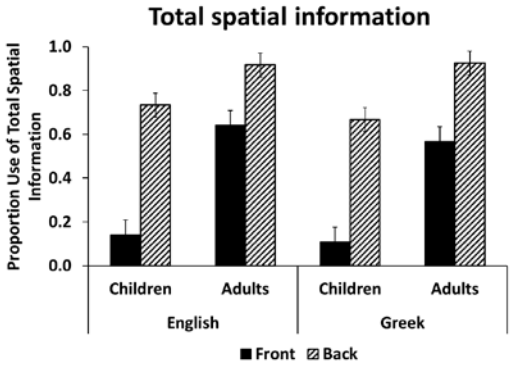

Figure 5: Proportion of total spatial information given by English and Greek speakers for the Front and Back relations. Error bars represent standard error.

Overall, these results show that both children and adults encode Back information more frequently than Front information at the three levels of spatial encoding. The analysis of Front and Back prepositions showed an asymmetry in the use of 'front'- and 'back'-denoting prepositions in both age and language groups. Furthermore, the asymmetry generalized to a broader range of occlusion/visibility expressions: Back scenes often elicited expressions encoding the change to or from occlusion (e.g., verbs denoting appearance/disappearance), and these expressions were used equally frequently by adults and children. By contrast, Front scenes did not elicit any expressions encoding visibility in any age or language group. Finally, an examination of the total spatial information offered in Front and Back paths confirmed the conclusion that asymmetries in encoding the two types of path are largely informational: both children and adult speakers of English and Greek marked Back paths more frequently than Front paths. These findings are in accordance with the pragmatic hypothesis, which allows for the asymmetry to be present in various age groups and at any level of spatial encoding.

Study 2

In Study 2, we tested 14 native speakers of 10 languages (Cantonese, Dhivehi, German, Javanese, Korean, Pashto, Malay, Spanish, Swahili, 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).

Methods

Participants Native speakers of 9 languages (Cantonese, Dhivehi, German, Korean, Malay, Pashto, Spanish, Swahili, 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 US. Data from one additional language (Javanese) were collected at a site abroad (Jakarta, Indonesia); see Table 1 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 as compensation for their participation.

Table 1: Languages sampled in the cross-linguistic survey (with number of participating speakers), language families, countries of origin and typological classification in the motion domain

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

Materials The same 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 stimuli.

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.

Results

To compare the two contrasting predictions of the conceptual immaturity and pragmatic accounts, we recorded how frequently 'front' and 'back' adpositions (prepositions and postpositions) and visibility and occlusion expressions were used in Front and Back scenes cross-linguistically, averaging across informants of the same language (see Table 2). Beginning with adpositions, numerical data showed that in 6 out of 10 languages (German, Javanese, Korean, Malay, Spanish, and Turkish) 'back'-denoting adpositions were mentioned more frequently than 'front'-denoting adpositions, while in 3 languages (Dhivehi, Pashto, and Swahili) both types of adpositions were mentioned equally frequently. The opposite pattern was exhibited in the remaining language (Cantonese).

We also inspected the proportion of expressions indicating visibility (in the context of Front scenes) and occlusion (in the context of Back scenes). This inspection revealed that there were no visibility expressions for Front in any of the languages surveyed but occlusion expressions for Back occurred in 8 of the 10 languages in the sample (e.g., verbs with meanings such as 'hide', 'appear'/'disappear' etc.).

Table 2: Percentage of adpositions and expressions of visibility and occlusion used for the FRONT and BACK relations across languages

Language	FRONT Adpositions	BACK Adpositions	Visibility Expressions	Occlusion Expressions
Cantonese (n=1)	62.5	50	0	0
Dhivehi (n=1)	100	100	0	50
German (n=2)	75	100	0	0
Javanese (n=1)	0	50	0	37.5
Korean (n=1)	12.5	100	0	100
Malay (n=2)	25	100	0	12.5
Pashto (n=1)	100	100	0	100
Spanish (n=2)	87.5	100	0	100
Swahili (n=1)	100	100	0	12.5
Turkish (n=2)	87.5	100	0	62.5

Overall, the present cross-linguistic data largely replicated the key findings from Study 1. Adult speakers of 9 different languages (with the exception of the Cantonese speaker) used 'back'-denoting adpositions and/or occlusion expressions more frequently than 'front'-denoting adpositions. Similarly to the English and Greek data, there were no expressions denoting visibility for Front scenes in any of the languages in this wider cross-linguistic dataset. Despite the limitations of working with such low numbers of informants, this set of data presents suggestive evidence that our developmental conclusions from Study 1 generalize across languages.

General discussion

Previous research shows that the acquisition of spatial language follows a stable, potentially universal, cross-linguistic timetable. However, the precise factors involved are not always clear. The acquisition of the locatives *front* and *back* is a case in point. Across languages, the locative *back* is produced earlier and is more frequent than the locative *front*. This asymmetry has been attributed either to a conceptual/semantic asymmetry in the early meanings of these locatives (with *back* being more basic than *front*; *conceptual immaturity* account) or to the fact that Back configurations are inherently more 'noteworthy' than Front configurations (*pragmatic* account). The present study put these two accounts to test.

Results showed that, in Study 1, both children and adult speakers of English and Greek typically used more Back than Front prepositions. Furthermore, speakers of all age and language groups often encoded Back information in occlusion verbs (e.g. *hide*) but no such verbs were available for Front. Study 2 provides suggestive evidence that the English and Greek developmental findings extend to a wider cross-linguistic sample of adult speakers of 10 additional languages. Taken together, these data support the predictions of the pragmatic hypothesis over those of the conceptual immaturity hypothesis.

Why do speakers prefer to encode Back over Front? On a pragmatic account that treats spatial language production as a form of communication governed by broadly Gricean (1975) or post-Gricean (Herskovits, 1985; Levinson, 2000; Sperber & Wilson, 1985/1995) pragmatics, speakers need to mark occlusion (or the change to/from occlusion in our dynamic stimuli) so that the location (or path) of the Figure can be identified correctly by a hearer, even if the hearer has no visual access to the scene. By contrast, visibility for Front (or no change of visibility in our stimuli) is a default situation that speakers are less likely to mark. In our stimuli, speakers used many other alternatives instead of 'front' (e.g., 'beside', 'near', 'to/from the middle of'). It is possible that the bias favoring Back might be supported by non-linguistic factors relating to how occlusion is represented (e.g., see Hespos, Gredebäck, von Hofsten, & Spelke, 2009; Spelke & von Hofsten, 2001).

The present results have intriguing implications about the nature of spatial language acquisition and use. According to traditional theories of linguistic and cognitive development,

the order in which children acquire spatial locatives (and other non-spatial vocabulary) is considered as an index of conceptual growth (e.g., see E. Clark, 1973; Bowerman, 1996; Huttenlocher, Smiley, & Charney, 1983; Johnston & Slobin, 1979). Our results raise the possibility that pragmatic pressures, which are active in adult communicators as well, can also shape the way spatial language is acquired and used. Furthermore, our findings suggest that pragmatic factors may also yield cross-linguistically stable, and potentially universal, patterns of spatial language use. Interestingly, the pragmatic preference to encode Back over Front may also affect the shape of cross-linguistic spatial semantic systems. In an extensive cross-linguistic report, Levinson and Wilkins (2006) state that, if a language has a 'front'-denoting locative it will necessarily have a 'back'-denoting locative but the reverse pattern does not occur. The way pragmatic considerations interact with conceptual and other factors to shape spatial language acquisition and use cross-linguistically is a rich avenue for future research.

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