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Evidence for a Core Representation for Support in Early Language Development

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ABSTRACT

Configurations of support include those that exhibit Support-From-Below (cup *on* table), as well as those involving Mechanical Support (e.g., stamp *on* envelope, coat *on* hook). Mature language users show a "division of labor" in the encoding of support, frequently using basic locative expressions (BE *on* in English) to encode Support-From-Below but lexical verbs (e.g., *stick, hang*) to encode cases of Mechanical Support. This suggests that Support-From-Below configurations may best represent the core for the category of support, and could be privileged in supporting early mappings to spatial language. We tested this hypothesis by examining spontaneous productions of children younger than 4 years found in the CHILDES corpora. Children used *on* to encode Support-From-Below more than other types of support configurations. They also showed clear distinctions in how they mapped different verbs (e.g., BE vs. lexical verbs) to Support-From-Below configurations compared to other support configurations. Analysis of parent language suggests that these observed patterns in children's language cannot be fully explained by input, although a role for input is likely for children's encoding of Mechanical Support. Thus, a concept of Support-From-Below may serve as a core representation of support, and hence the privileged spatial representation onto which spatial language for support is mapped.

Children's acquisition of spatial language is central to their ability to communicate not only about simple spatial relationships between objects ("teddy *on* table") but also much broader meanings, some of which are rather abstract ("crack *in* sidewalk," "picture *on* wall"). Despite the fact that simple spatial terms such as *in* and *on* can have quite broad uses, the terms themselves (or their cross-linguistic equivalents) appear relatively early in children's vocabulary and are prominent by age 2–3 across a wide range of languages (Johnston & Slobin, 1979). In this study, we delineate children's earliest language productions in the spatial domain of *support* to shed light on whether there is a core spatial representation that underlies children's uses, and if so, what role this representation may play in learning spatial language that goes beyond this core.

The notion of core representations has played a key role in theories of cognitive development. For example, children are thought to possess core knowledge of objects, number, and geometry and this knowledge is thought to serve as building blocks for later acquisitions in those domains (Spelke & Kinzler, 2007). Although there is debate over whether there is a universal set of core (or privileged) concepts operative in the domain of *spatial language* (Landau, 2018; Levinson & Wilkins, 2006), there is a widely held assumption that children's earliest production and comprehension of spatial terms are likely to be applied to physical configurations of objects embodying clear exemplars of fundamental spatial relationships, such as physical containment (e.g., *apple in a bowl*) or support

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from below (e.g., *cup on a plate*). Indeed, these spatial relationships are lexicalized in many languages (e.g., English, Dutch, Spanish, and Japanese) and may be canonical exemplars for the domains of containment and support, respectively (Bowerman & Pederson, 1992, as cited in Gentner & Bowerman, 2009).

We hypothesize that these canonical configurations most transparently represent the core for each domain. If they do, then we would expect some linguistic reflex corresponding to core and non-core configurations. Specifically, we would expect that the use of the basic terms *in/on* would be distributed differentially, with high uses for configurations best representing the core (e.g., "cheese sandwich on the plate"), but relatively low uses for other configurations that nevertheless embody some type of support (e.g., "peanut butter on the paddle"). As we review shortly, 4-year-olds and adults do show such differential distributions when queried about a variety of configurations within the containment and support domains. In this paper, we build on these findings, hypothesizing that this linguistic reflex – the differential distribution of *on* for core vs. non-core configurations – also appears in the language of much younger children. If it does, this would support the idea that acquisition of the simple spatial terms is guided by the same core representation of support as is evident among older children and adults. We test this hypothesis by examining the use of the term *on* in young children's spontaneous productions, focusing on their application of the term across widely varying configurations, both core and non-core.

Although it seems quite likely that children will use the term *on* when encoding configurations of Support-From-Below, it is also possible that they will use it for other kinds of configurations, and possibly even for abstract senses (e.g., *on time*). Indeed, even the simple spatial terms *in* and *on* are used in English to encode a wide variety of spatial configurations, such as cracks *in* sidewalks, Band-Aids *on* legs, pictures *on* walls, and drawings of elephants *on* paper. This variation points to a wide range in the particular means by which support is achieved. For example, cups *on* plates embody a support mechanism in which one object is contiguous with and beneath another object and thereby prevents it from falling. By contrast, for Band-Aides *on* legs, the mechanism of support is adhesion. For configurations of pictures *on* walls, hanging leads to support, and for an elephant *on* paper, embedding (e.g., via being painted on, written on) leads to a different kind of support. More generally, the use of *on* applies to a wide variety of support mechanisms that embody different kinds of "force dynamic" interactions between two objects, all resulting in support of one by another (Talmy, 1988; Vandeloise, 1991). Terms such as *in* and *on* that involve such force-dynamic interactions have often been called "functional terms" – differing from "geometric" terms, such as *above/below/left/right*, that arguably depend only on the geometric relationships between objects (Landau, 2017). The functional relevance underlying the semantics of *on* and *in* is supported by empirical research. For example, Garrod, Ferrier, and Campbell (1999) showed that location control (i.e., when a figure's location is controlled by a reference object) plays a key role in how spatial scenes embodying support are described by adults, especially when geometric cues are absent. Specifically, the higher the perceived control between X and Y, the more confident adults are in judging X to be ON Y.

Even in the early stages of language acquisition, *on* is mapped preferentially to some configurations over others. For example, Meints, Plunkett, Harris, and Dimmock (2002) showed that 15-month-olds only accepted *on* as a label for a spatial configuration when the configurations were "typical" support configurations (e.g., cat located in the center of the table and in contact with the table). In contrast, 18- and 24-month-olds accepted *on* when referring to both typical and atypical configurations (cat in contact with the table but at its corner). Thus, similar to adults, not all "support" configurations map equally to support language.

Adding to this complexity of the semantic space, support configurations are not only encoded by spatial prepositions (or adpositions across languages), but also by lexical verbs, such as *hang, stick*, and *glue*, in English. Recently a series of studies by Landau and colleagues (Johannes, Wilson, & Landau, 2016; Landau, 2018; Landau, Johannes, Skordos, & Papafragou, 2016) asked whether there is linguistic differentiation within the semantic space of support – a "division of labor" that splits the burden between prepositions and the verbs with which they co-occur, marking the distinction between core and non-core configurations. They found there is indeed such differentiation and it shows up by 4 years of age (for both English and Greek speakers). For English speakers, BE *on*, was used most frequently to describe configurations of Support-From-Below, while other lexical verbs (e.g., *stick, hang)* were used for support configurations that depended on other mechanisms, such as attachment or hanging. BE *on* is considered the "Basic Locative Construction" for English, that is, the expression that is the unmarked response to the question "Where is X?" (Levinson & Wilkins, 2006). Landau and colleagues proposed that the distributional pattern for BE *on* vs. other lexical verbs (i.e., the "division of labor") is consistent with the idea that Support-From-Below is the canonical configuration for the domain of support. This proposal is also consistent with infants' pre-linguistic understanding of support (Baillargeon, Li, Ng, & Yuan, 2009; Casasola & Cohen, 2002) and with young children's systematic description of Support-From-Below configurations (Gentner & Bowerman, 2009; Johnston & Slobin, 1979).

In this study, we test the hypothesis that Support-From-Below is the canonical – the core – configuration for the domain of support by examining very young children's naturalistic, spontaneous language productions. Such productions provide an advantage for examining children's semantic representations of support because they offer the opportunity to examine a wide range of spatial relationships, including those in *dynamic scenes*, which are likely to elicit a wide range of verbs and prepositions. Indeed, pilot data collected by Landau and colleagues and preliminary results from Lakusta & Landau (in progress) suggest that configurations of support in dynamic events (toy being placed on a box vs. a static configuration of a toy on a box) elicit a different range of verbs from children (and their parents), such as "put" and "go" for dynamic events and "BE" for static configurations. Still, we hypothesize that even for these cases children's use of verbs may be distributed unevenly over the hypothesized core (Support-From-Below) and non-core (Mechanical Support) configurations, as is true for older children and adults when describing static configurations (Johannes et al., 2016; Landau et al., 2016).

If Support-From-Below is the core configuration for young children's understanding of the category of support, then children younger than 4 years should use the canonical term for support in their language – *on* in English, regardless of accompanying verbs – to encode these configurations more than other configurations. An even stronger hypothesis predicts that children in this age range should also show the mature "division of labor" between prepositions and verbs shown by 4-year-olds and adults in Landau et al. (2016; Landau, 2018). That is, when they use BE *on*, they should use it to encode configurations of Support-From-Below, and other non-BE verbs (e.g., "hang," "stick") to encode configurations of support via other mechanisms. Alternatively, it is possible that such a division of labor shows up only after a lengthy learning period in which children learn a good deal about these other mechanisms of support. If so, then children's mapping to these non-core configurations may be a relatively slow, piecemeal process, and children's early language descriptions of a broad range of support configurations should be relatively undifferentiated. We test these predictions by conducting a detailed analysis of one- to four-year-old children's spontaneous speech using the term *on* and its partner verbs.

Method

Participants and procedure

All transcripts from the American English corpora of children 4 years old and younger were retrieved from the Child Language Data Exchange System (CHILDES, MacWhinney, 2000). The Computerized Language Analysis (CLAN) was used to extract all children's utterances that included the word *on* in conjunction with any subject and/or object and/or verb. This method of extraction provided the clearest indication about the type of spatial configuration being referenced (for example, in the utterance "She is sitting on the chair," one can infer that "the chair" is supporting the figure from below); it also provided the verbs that accompanied the preposition *on*.

Initial inspection of the transcripts revealed that many utterances were ambiguous because they did not include content words as the figure and ground objects but rather included only pronouns and/or the preposition ”on” (”it on”). Given that it is impossible to determine the reference of *on* for these cases, only transcripts that included greater than five ”unambiguous” utterances containing *on* were included in the final sample. This yielded transcripts (total N = 568) from 18 children (10 males; ages 13 months to 3 years 10 months) comprised of 1,945 utterances (see Table 1). Similar to the transcript criterion explained above, utterances that were completely ambiguous (e.g., both figure and ground pronouns, both omitted, etc. n = 2,926) were excluded from further analyses. Utterances which used *on* as an idiom (i.e., a group of words that does not have a meaning deducible from the individual words; n = 267; e.g., “shame on you”) or verb particles (n = 320; e.g., “turn on the TV”) were also excluded.

Coding procedure

Utterances were coded in terms of 1) whether the utterance encoded a Support-From-Below configuration (henceforth, SFB) or not and 2) what type of verb accompanied *on*. The first coding was used to determine whether the distribution of *on* by itself varied over configuration types. The second was used to determine whether the distribution of *on* plus its partner verb varied over configuration types.

Utterance coding: SFB or not

Each utterance was coded for whether it encoded a configuration that embodied SFB or not. Initial inspection of the utterances suggested that this would sometimes be challenging given that some of the referents in the utterance were unknown (”it on that side”). Thus, two methods for this aspect of the coding were developed. First, an omnibus assessment of every utterance not excluded by the previously described criteria was made by two trained coders. Second, ratings for a subset of the utterances were made by a sample of naive adult participants using Amazon Mechanical Turk (MTurk).

In the omnibus assessment, a primary coder examined the entire utterance that included *on*, considering properties of the figure, ground, and verb. For example, the utterance ”the flower is

Table 1. CHILDES sample.

	Participant	Age range	Gender	Author	Number of Transcripts	Total number of utterances	Total number of utterances extracted with *on*
1	Adam	2;3.04– 3;11.14	M	Brown	31	56,550	255
2	Namia	1;3.7– 3;10.10	F	Providence	74	64,290	297
3	Abe	2;5.07– 3;11.25	M	Kuczaj	120	46,568	243
4	Lily	1;8.14– 3;10.25	F	Providence	56	48,179	169
5	Shem	2;2.16– 3;2.02	M	Clark	32	18,166	202
6	Peter	1;10.11– 3;1.20	M	Bloom 70	17	28,570	193
7	Ethan	1;1.17– 2;11.1	M	Providence	42	42,103	46
8	William	1;8.2– 3;4.18	M	Providence	31	42,413	77
9	Violet	1;10.12– 3;10.18	F	Providence	32	12,762	60
10	Laura	1;10.00– 3;4	F	Braunwald	21	18,707	94
11	Eve	1;6.00– 2;3.00	F	Brown	20	35,397	159
12	Georgia	1;11.15– 2;11.5	F	Davis	19	3,402	32
13	Trevor	2;0.27– 3;11.27	M	Demetras1	22	5,804	56
14	Cameron	1;3.25– 2;9.8	F	Davis	18	11,010	21
15	Allison	2;4.02– 2;10.0	F	Bloom 73	5	669	14
16	Rowan	1;10.11– 2;5.7	M	Davis	14	3,345	1
17	Nick	2;8.27– 3;0.2	M	Davis	6	1,622	7
18	Haas	1;8.15– 2;4.0	M	Cornell	8	1,995	19
Totals					**568**	**441,552**	**1,945**

laying on Jodi's lap" is likely to encode a configuration of SFB, whereas "Jodi is laying on the flower" is not. This is because the figure (flower) is likely to be smaller than the ground (Jodi) and crushable; thus, in the first case, but not the second, the figure can be supported from below by the ground. Inspection of the utterances revealed that children produced rich descriptions of figure and ground objects; they frequently included the names of objects falling into a variety of object categories (e.g., "She is sitting on the chair" refers to furniture; "Dad goes on the bike" refers to a vehicle). These ground object categories were used to organize the utterances into SFB subtypes (see Part A of Table 2, which also provides examples of the utterances that were encoded as SFB configurations across different types of ground objects).

Given that the aim of the current study is to examine configurations of physical support, utterances that were not coded as SFB were coded as either Mechanical Support (another clear case of physical support) or "Other" (Table 2, Parts B and Other)[1]. Following Landau et al. (2016), Mechanical Support was further divided into the subtypes of embedded/adhesion[2] (e.g., "You have to put a Band-Aid on it"), hanging (e.g., "What is hanging on that mirror?"), and encirclement (e.g., "A ring on him"). The "Other" category was comprised of utterances that did not describe configurations of SFB or Mechanical Support; for example, where *on* encoded the relationship to a place ("I live on Cresson Court") or donning[3] ("he got a diaper on").

A second coder categorized all the utterances as SFB or not, yielding 91.48% agreement. Any disagreement between two coders was reviewed by the coders together, and with a third coder if needed, until all discrepancies were resolved.

To verify that our first coding method produced reliable categorization of utterances into SFB and other types, we recruited 32 English speaking, US residents from MTurk, who were asked to rate a subset of the CHILDES utterances (~10%; 205 utterances) on the degree to which each utterance encoded an example of SFB. In order to ensure that we sampled a variety of utterances with different types of figures, grounds, and verbs from the set of 205 utterances, utterances were evenly divided (and randomly selected) across the subtypes (listed in Table 2). Half of each set was presented in a random order on the MTurk platform to participants, who were asked "To what extent do you agree that the following utterance describes an example of support from below?" And were provided a 5-point Likert scale for their responses, ranging from "Strongly Disagree" (1) to "Strongly Agree (5)." Prior to test, participants received one training trial in which they were acquainted with the SFB configuration, specifically, an image of a cup on a saucer along with the following text: "Support-From-Below scenes can be thought of as something supporting something else from below." Then, they were asked a question that checked their understanding and proceeded to test.

Utterances that our primary coders coded as SFB received a mean rating of 3.44 (SE = .09; Range = 3.69); a one sample t-test revealed that this was significantly greater than 2.5 (the median rating on our 5-point scale), $t\,(108) = 10.38$, $p < .001$. In contrast, the utterances that our primary coders coded as not SFB-Mechanical received a mean rating of 1.82 (SE = .08; Range = 2.00), which was significantly less than 2.5, $t\,(38) = -8.55$, $p < .001$. Similarly, the utterances that our primary coders coded as not SFB -'Other' received a mean rating of 1.50 (SE = .07; Range = 2.81), which was also significantly less than 2.5, $t(96) = -14.18$, $p < .001$. This confirms the reliability of the omnibus coding by the two trained coders. Further, examination of the mean ratings for each of the sub-types (listed in Table 2) reveals that 9 of the 10 SFB sub-types received an average rating greater than 2.5, with the only exception being Food (e.g., *"I have bologna on my sandwich"*; Mean rating = 2.375). In contrast, 9 of the 10 non-SFB sub-types received an average rating less than 2.5, with the only exception being Body Position *(e.g., "I standing on my tippy-toes")*. This further confirms the grouping of our sub-types as SFB and non-SFB.

Verb coding

The three most frequent verb types used by children and adults to encode support in Landau et al.'s (2016) elicited production task were BE *on*, posture (e.g., *sit)*, and manner of attachment (e.g., *hang*) verbs. Thus, as a first pass we classified each verb as BE *on* ("Mommy, our shoe *is* on the stair"), posture

Table 2. Children's use of "on" (independent of verb) across different types of support.

Support type	Utterances with "on"	
Part A.	#	Proportion
Support-From-Below, subtypes and examples		
Furniture (e.g., *"She is sitting on the chair")*	208	0.11
Body Part (e.g., *"I sit on your lap")*	149	0.08
Large Flat Surface (e.g., *"The bag is on the floor")*	143	0.07
Vehicle (Enclosed) (e.g., *"everybody on the airplane")*	125	0.05
Structure (e.g., *"The baby's on the roof")*	72	0.04
Animal (e.g., *"he's riding on the elephant!")*	63	0.03
Vehicle (Open) (e.g., *"Dad goes on the bike")*	40	0.02
Plant (e.g.,*"Bird is on the tree")*	17	0.01
Food (e.g., *"I have bologna on my sandwich")*	7	0.004
Other SFB (e.g., *"Cheese sandwich on a plate")*	221	0.18
Total	**1045**	**.59**
Part B.		
Mechanical Support, subtypes and examples		
Embedded/Adhesion (e.g.,*"You have to put a Band-Aid on it")*	345	0.12
Hanging (e.g., *"What is hanging on that mirror?")*	30	0.01
Encirclement (e.g., *"A ring on him")*	13	0.01
Total	**388**	**0.14**
Other, subtypes and examples		
Place (e.g., "I live on Cresson Court")	50	0.02
Donning (e.g., "He got a diaper on")	173	0.12
Action (e.g., "He knocking on the door")	151	0.07
Temporal (e.g., "It goes off to school on Sunday morning")	51	0.02
Body Position (e.g., "I standing on my tippy-toes")	21	0.01
Improper Use (e.g., "A raccoon knocked ‹on [= over] › the garbage.")	14	0.12
Other (e.g.,"It's dark on the train.")	52	0.003
Total	**512**	**.36**
Grand Total	**1945**	

(e.g., "baby *sit* on pottie"), or manner of attachment verb (henceforth, MoA; e.g., "*clipping* your microphone on your hair"; See Table 3, Part A.). We also classified verbs as Light verbs – verbs that are also semantically empty like BE (*come, do, get, go, has, put, went)* but often encode physical support. Verbs that did not fall into one of these four types, but were used in more than 5% of the total utterances that were coded as SFB or Mechanical Support (N = 1188; see Table 3) were classified according to Levin's (1993) semantic analysis of verb classes (Table 3, Part B). Other verb types that were used infrequently (i.e., <5%) or did not fall into one of Levin's verb classes, are shown in Appendix A.

Results

Analysis of on

We first tested the prediction that children, regardless of the verb used, would use *on* primarily to encode configurations of SFB. As Table 2 shows, of the 1945 utterances produced in our samples, children used *on* to encode SFB a majority of the time. One sample t-tests (2-tailed) revealed that the overall average proportion for which *on* was used for SFB configurations (M = .59, SE = .04) was significantly greater than .50, $t(17) = 2.24$, $p = .039$. *On* was used much less for "Other" (M = .27, SE= .03) and Mechanical Support (M = .14, SE= .02).

In order to explore these effects further, we also asked whether the effects change within the age range being considered. Therefore, we did a median split and examined the effects within each age group for the 14 children who contributed data to both age groups (13–30 months: N = 722 utterances; 31–47 months: N = 1037 utterances). Striking differences were observed, with the preponderance of *on* being used for SFB, but a distinct trend for younger children to use it in this way the majority of time, and older children to begin to generalize to wider categories (see Figure 1a). Paired sample t-tests (2-tailed)

Table 3. Raw number of verb types (appearing with "on") as a function of whether they were used to encode configurations of Support-From-Below or Mechanical Support.

	Support type	
Verb type	Support from Below (*N* = 888)	Mechanical Support (*N* = 300)
Part A.		
Verb types found to encode support in Landau et al. (2016)		
BE on	96	38
Posture (sit, stand, lay)	209	0
Manner of Attachment (hang, tape, stick)	0	37
Total	**305**	**75**
Part B.		
Verb types used in more than 5% of children's utterances		
Light (go, put, get)	329	118
Motion (ride, jump, fall)	168	1
Creation and Transformation (write, draw, make)	3	79
Total	**500**	**198**
"Other" verbs (see Appendix A)	**83**	**27**

The three most frequent specific verbs are listed after each verb type (e.g., Posture: *sit, stand, lay*) with the verbs listed in order of most frequent (*sit*) to least frequent (*lay*).

revealed that the overall average proportion for which *on* was used for SFB configurations for the younger age group ($M = .67$, $SE = .04$) was significantly greater than that for the older age group ($M = .51$, $SE = .05$), $t(13) = 2.92$, $p = .012$. Ten out of the 14 children showed this pattern, Wilcoxon signed ranks test, $z = -2.29$, $p = .022$, two-tailed. This suggests that when children used the preposition *on* (regardless of verb) it primarily encoded configurations of SFB, and more so, this effect was strongest for the youngest children, who, by hypothesis are the most likely to have a "core-defined" usage of *on*. This is consistent with the core support hypothesis.

For "other" configurations, (e.g., temporal, donning, see Table 2) use of *on* was significantly greater for the older age group ($M = .31$, $SE = .04$) compared to the younger age group ($M = .21$, $SE = .04$), $t(13) = 2.62$, $p = .021$. Twelve out of the 14 children showed this pattern, Wilcoxon signed ranks test, $z = -2.35$, $p = .019$, two-tailed. Use of *on* for mechanical support configurations did not significantly differ between the two age groups (*M*s = .12, .18, *SE*s = .02, .03, for young and old, respectively), $t(13) = -1.66$, $p = .12$.

At first glance, the results from this last comparison may suggest that the younger and older age groups encode Mechanical Support configurations similarly. However, note that in the analyses above we focused exclusively on children's utterances that contained the preposition *on*. Lexical verbs (henceforth, Manner of Attachment verbs – MoA), such as *hang* and *glue*, also encode configurations of support and are often used without *on* (e.g., "the coat is *hanging from* the hook"). To explore in more depth how the two age groups encoded Mechanical Support, we also extracted utterances in the transcripts that included *hang, stick, tape, tie, buckle, clip, pin*, and *glue* – verbs that often are used without *on* (e.g., "the coat is *hanging from* the hook") to encode Mechanical Support and that were reported by Landau et al. (2016) to be used by children. This resulted in 92 utterances. We next performed a median split on this data set to explore the frequency that the younger and older groups used these MoA verbs. The results revealed that 82 of these utterances were produced by the older children and only 10 were produced by the younger children. Thus, although older and younger children use of *on* for Mechanical Support does not change significantly with age, use of MoA verbs does.

Verb analysis

We next tested the prediction that children would show a "division of labor" between the preposition *on* and partner verbs, with different types of verbs encoding configurations of SFB vs. Mechanical Support.

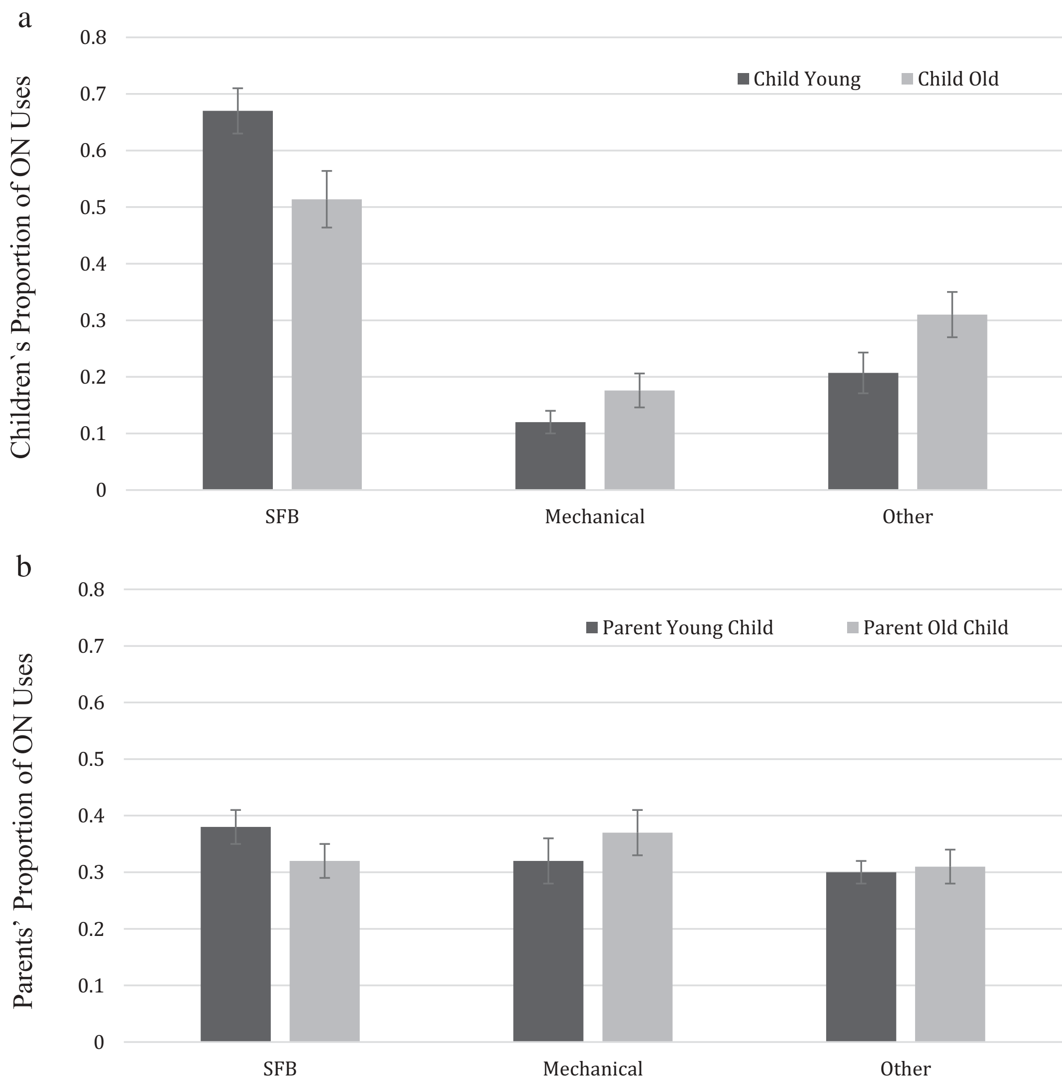

Figure 1. Proportions of *on* use by younger vs. older children for Support-From-Below, Mechanical Support, and "Other" relationships.

To test this, we focused on the utterances including *on* that encoded SFB (N = 1045) and Mechanical Support (N = 388) and examined the distribution of the partner verbs along with the preposition *on*. Utterances in which there was no verb (e.g., "it on that side"; N = 157 for SFB and N = 88 for Mechanical Support) were excluded from the analysis, yielding a total of 1188 utterances with a verb + *on* (SFB = 888; Mechanical Support = 300). Table 3, Part A shows the number of times children's utterances included one of the verb types that children and adults tend to produce when encoding support (Landau et al., 2016); these include BE *on*, posture verbs (e.g., "sit"), and MoA verbs (e.g., "hang"). Table 3, Part B shows the number of times children's utterances included other verb types that appeared in over 5% of children's utterances. For each verb type in Table 3, Figure 2 shows how often it was used to describe a configuration of SFB (the reciprocal for each verb type, not shown in Figure 2, were utterances that were used to encode configurations of Mechanical Support, see Figure note).

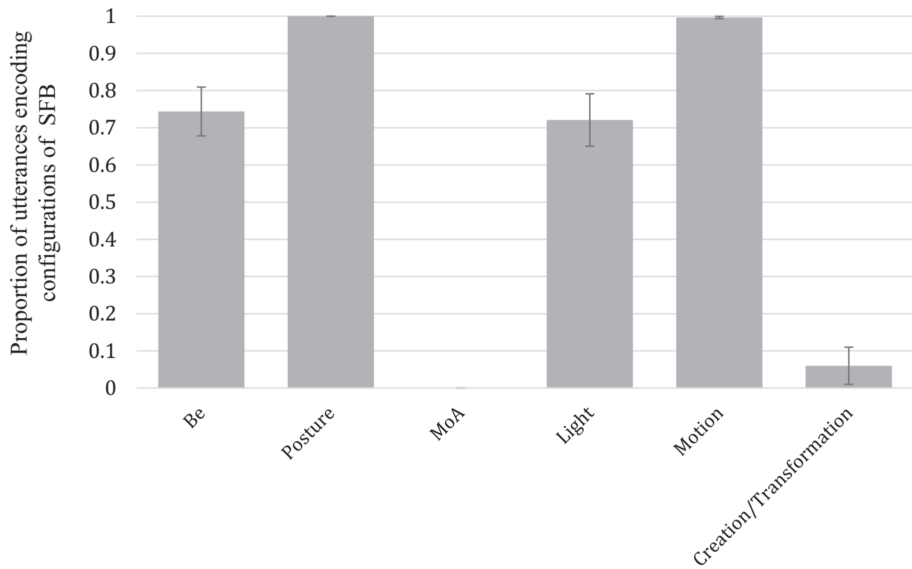

Figure 2. Average proportions of each verb type (and *SE*s) that children used to encode a Support-From-Below (SFB) configuration.
Figure Legend:1. For each verb type (Be, Posture, etc.), children who never used this type of verb to encode Support-From-Below or Mechanical Support in any of their utterances were excluded from the analyses (Ns = 5 for Be, 2 for Posture, 11 for Manner of Attachment, and 9 for Creation/Transformation). 2. For the analyses that correspond to the data shown in Figure 2 (see Results), we examined how often each verb type was used for SFB configurations. Thus, we asked, out of the utterances that were coded as SFB and Mechanical Support, how often was BE *on*, etc. used and we compared this to chance. The remainder of children's utterances in Figure 2 was utterances that encoded a configuration of Mechanical Support.3. Children's use of Posture verbs to encode configurations of Support-From-Below was 100% (thus, *SE* = 0), whereas their use of Manner of Attachment verbs was 0 (they used Manner of Attachment verbs 100% to encode configurations of Mechanical Support).

Table 3 and Figure 2 reveal clear distinctions in how children used verbs + *on* to encode SFB vs. Mechanical Support. BE *on* – the hypothesized Basic Locative Construction to encode SFB – was asymmetrically distributed over SFB ($M = .74$) and Mechanical Support ($M = .26$). A one sample t-test revealed that children used BE *on* to encode configurations of SFB significantly more often than .50, $t(12) = 3.71$, $p = .003$, two-tailed. This suggests that BE *on* is a privileged construction for encoding SFB, consistent with a "division of labor" in young children's spontaneous production, similar to what has been observed for older children and adults (Johannes et al., 2016; Landau et al., 2016).

Children also showed distinctions in their use of posture and MoA verbs. When children used a posture verb with *on* (e.g., "sit on") they *always* did so to encode SFB, whereas when they used a MoA verb (e.g., "hang") they *never* did so to encode SFB (rather, they *always* used this construction to encode Mechanical Support) (Table 3). This is also consistent with the findings for 4-year-olds and adults (Johannes et al., 2016; Landau et al., 2016) and extends these patterns to children younger than 4 years.

Johannes et al. (2016) and Landau et al. (2016) found that when describing static support configurations, older children and adults overwhelmingly used BE *on* and posture verbs to encode configurations of SFB – a pattern also found in the current study. Given that we examined children's spontaneous utterances that are likely to encode dynamic properties of the world around them, it is perhaps not surprising that children also frequently used light verbs such as "put" and "go," specific motion verbs such as "ride" and "jump," and verbs of creation and transformation such as "write" and "draw" (Table 3). One sample t-tests revealed that children also showed biases in their use of these verbs to encode different support relationships. They used light verbs (e.g., "put on") and motion verbs (e.g., "jump on") to encode configurations of SFB significantly more often than .50, *t*

(14) = 3.14, $p = .007$, two-tailed, and $t(17) = 143.00$, $p < .001$, two-tailed, for light and motion verbs, respectively. In contrast, children used verbs of creation and transformation (e.g., "write on") to encode configurations of SFB significantly less often than chance, $t(8) = -9.51$, $p < .001$, two-tailed (Figure 2).

Similar to the previous median split analysis which examined younger and older children's use of *on*, we also examined the average proportion of each verb type that encoded SFB configurations for the younger and older age groups. For each verb type (see Figure 2), paired t-tests were conducted to test whether there were any differences between the two age groups in how often each verb type was used to encode SFB. No significant differences emerged (*M*s for younger and older children, respectively, = .78, .77 for BE, 1.0 and 1.0 for posture and motion verbs, and .13 and .17 for verbs of creation; *p*s > .10), with the exception of light verbs (e.g., "put"). Of the 11 children who had utterances using light verbs in both age groups, a paired samples t-test revealed that younger children were significantly more likely to use light verbs to encode SFB configurations (*M*=. 84, *SE*= .05) compared to older children (*M*=. 59, *SE* = .09), $t(10) = 2.81$, $p = .018$. Thus, similar to how younger children used *on* predominantly for SFB and older children used *on* more broadly, younger children also use light verbs predominantly for SFB and older children used light verbs more broadly (for SFB and Mechanical Support).

These findings suggest that young children do distinguish between SFB and Mechanical Support through their use of partner verbs (which combine with the preposition *on*). However, this conclusion hinges on the assumption that the verbs themselves did not "give away" the coding category to our coders. For example, if the sentence included "hang on", then this verb could strongly suggest to our coders that the sentence did not encode SFB. On the other hand, it seems likely that the figure and reference object may be sufficient to decide whether the support relation encodes SFB or Mechanical Support. In order to address these possibilities, we asked a new group of coders to judge the category of support from sentences whose verbs had been deleted.

In order to explore this, the 40 utterances that were coded as Mechanical Support, and a randomly selected set of 40 utterances that were coded as SFB, were presented in a random order to 10 Montclair State University undergraduates who were naïve to the specific hypotheses of the study, but familiar with concepts used in linguistics, such as "figure," "ground," "preposition." Coders were first reminded about the definitions of "figure" and "ground" objects and asked to identify these objects in an example sentence. They were then trained on one example of a SFB configuration and one Mechanical Support configuration, and asked to identify which of six new sentences was another example of each type of support. Feedback was given after each part of the training. Following training, coders were presented sequentially with the 80 utterances in a random order, all which had the verb omitted and asked to 1) "identify the figure and ground objects," 2) judge whether the utterance was an example of SFB or Mechanical Support, and 3) select how confident they were in their judgment (5-point Likert scale; "Not At All Confident" to "Very Confident"). If the specific verb used fully determined the reference of the utterances encoding support, coders should be at chance in how they coded the utterances in terms of SFB and Mechanical Support. However, this was not the case. These new coders were significantly above chance in how likely they were to match the coding of the original coders (*p*s < .05; *M* = .80 for utterances originally coded as SFB and *M*= .69 for utterances originally coded as Mechanical Support). This suggests that the specific verbs included in the children's utterances did not fully determine how the utterances were coded with respect to the type of support. Rather, properties of the figure and ground objects likely played a major role.

Analysis of parent input

The findings thus far suggest that the configuration of SFB is a core exemplar for the domain of support in the early stages of language acquisition. However, there is another possibility, not completely independent from the "core exemplar" hypothesis, that also should be considered.

Does parental input fully determine the children's preferences for SFB mapped to *on* and specifically, to BE *on*?

In order to explore this possibility, *the parents'* utterances including *on* (for the children in our sample) were also extracted (using the CLAN method; two children did not have parent utterances in their transcripts, yielding a total of 16 transcripts with parent utterances). Coding procedures were the same as those used for the children's utterances, yielding a final sample of 1887 utterances. The following utterances were excluded: ambiguous (n = 676), *on* used as an idiom (n = 158), *on* used as verb particle (n = 314). Reliability coding yielded 92.32% agreement.

We first asked whether parents would use *on* primarily to encode configurations of SFB, as was found for the children. Of the 1887 utterances produced in our samples, parents' use of *on* was about equally distributed for encoding SFB ($M = .39$, $SE = .05$), Mechanical Support ($M = .31$, $SE = .03$), and "Other" configurations ($M = .30$; $SE = .03$). One sample t-tests (2-tailed) revealed that the overall average proportion for which *on* was used for SFB configurations ($M = .39$, $SE = .05$) was significantly *below* chance (.50), $t(15)$ −2.28, $p = .03$. This is a pattern very different than that found for children who used *on* for SFB significantly above chance ($M = .59$; see Table 2). An independent sample t-test revealed that average proportion of *on* for SFB significantly differed between children and parents, $t(32) = 3.21$, $p = .003$. The preponderance of *on* usage for SFB by children, but not parents, suggests that children's bias to map *on* to SFB is unlikely to be fully explained by the linguistic input that they receive (at least as measured in these transcripts). Rather, the privileging of SFB being mapped to *on* is likely to play a key role – consistent with our core support hypothesis.

In order to further explore a role for parent input we next performed the same median split as we did for the children; that is, we examined the effects within each age group for the *parents* of the children who contributed data to both age groups (N = 12 parents[4]) (13–30 months: N = 1266 parent utterances; 31–47 months: N = 621 parent utterances). Figure 1b shows parents' use of *on* for SFB, Mechanical Support, and "Other" over younger vs. older children. Paired samples t-test did not reveal any significant differences ($ps > .05$). In addition, unlike the pattern observed for either younger or older children (see Figure 1a), parents' use of *on* for SFB for both younger and older children was below 50%.

Lastly, we performed an exploratory analysis testing whether each parent's use of *on* (for encoding SFB, Mechanical Support and "Other" configurations) correlated with his/her child's use of *on*. Of particular interest was whether parents' use of *on* when children were younger (i.e., at 13–30 months – 'Time 1′) would correlate with children's use of *on* when they were older (i.e., at 31–47 months – 'Time 2′). We performed these bivariate correlations for each type of support configuration (SFB, Mechanical, and "Other"); see Table 4a–c, respectively. As a check, we also performed correlations for parents at Time 1 and children at Time 1, parents at Time 2 and children at Time 2, and parents at Time 2 and children at Time 1.

As shown in Tables 4a,c, no significant correlations were found between parents and children for SFB (Table 4a) or "Other" (Table 4c). However, parents' use of *on* for Mechanical Support configurations at Time 1 (i.e., when children were younger) was significantly related to the children's use of *on* for Mechanical Support configurations at Time 2 (i.e., when children were older); see Table 4b. Thus, it seems likely that parents' linguistic input for Mechanical Support relationships guides children's learning of the relevant linguistic expressions. We return to this in the General Discussion below.

Table 4a. Pearson correlations among ON use for parents and children for Support-From-Below.

	Child T1 SFB	Child T2 SFB
Parent T1 SFB	.30	.46
Parent T2 SFB	.36	.16

No significant correlations found at the .01 (2-tailed) or .05 level (2-tailed)

Table 4b. Pearson correlations among ON use for parents and children for Mechanical Support.

	Child T1 Mechanical	Child T2 Mechanical
Parent T1 Mechanical	.18	.73**
Parent T2 Mechanical	.26	.47

** Correlation is significant at the .01 (2-tailed)
No other significant correlations found at the .01 (2-tailed) or .05 level (2-tailed)

Table 4c. Pearson correlations among ON use for parents and children for "Other."

	Child T1 "Other"	Child T2 "Other"
Parent T1 "Other"	.19	.10
Parent T2 "Other"	−.24	.21

No significant correlations found at the .01 (2-tailed) or .05 level (2-tailed)

General discussion

We tested the hypothesis that the configuration of Support-From-Below is a core exemplar for the domain of support in the early stages of language acquisition. Our findings support this hypothesis. Examination of spontaneous language productions revealed that when children one to 4 years of age used *on* (regardless of verb), they were encoding configurations of SFB a majority of the time. Further, children showed a differential distribution of specific verbs + *on* to encode configurations of SFB vs. Mechanical Support. The expression BE *on* was used predominantly to encode configurations of SFB; by contrast, expressions including MoA verbs (e.g., *hang, stick)* were used only to encode Mechanical Support. This reflects the "division of labor" previously observed in 4-year-olds and adults for static configurations of support (Johannes et al., 2016; Landau, 2018; Landau et al., 2016). In addition, children used a variety of other verbs (e.g., *sit, put, jump*, and *make*) to encode support – not surprising, given that we examined *spontaneous* language productions that likely encoded dynamic properties of the event. Notably, these other semantic verb classes also showed clear distinctions in how they mapped to SFB vs. Mechanical Support. Children used posture (e.g., *sit*), light (e.g., *put*), and motion (e.g., *jump*) verbs when encoding configurations of SFB, but much less often (or not at all) when encoding Mechanical Support. In contrast, children rarely used creation/transformation verbs (e.g., *make, draw*) when encoding configurations of SFB, but did so frequently when encoding a type of Mechanical Support ("I wanna *draw* right on this page").

These findings raise the question of *why* SFB is privileged in the acquisition of spatial terms encoding support – why it may be a core exemplar onto which children map their language's canonical terms for encoding support (*on*, in English). We hypothesize that the privileged status of SFB may be rooted in pre-verbal representations. This is consistent with Baillargeon's recent account of how infants develop understanding of support configurations (see Baillargeon & DeJong, 2017). At about 4.5–5 months of age infants learn the "location-of-contact" rule; they expect that an object on-top-of a base will remain stable. Baillargeon and DeJong (2017) propose, "this first rule thus serves to establish a new event category, "support" (or more specifically, "passive support from below"), which describes a causal interaction between two objects with distinct event roles: A "support" blocks the fall of a "supportee" "(p. 1513). In this account, SFB configurations play a central role in very young children's earliest understandings of support, and our findings suggest that this privileged representation of SFB has reflexes in the linguistic encoding of support. Current research in our lab is further exploring the role of a privileged core representation of SFB by testing how pre-verbal infants categorize SFB versus Mechanical Support.

Although our findings support the hypothesis that young children are predisposed to distinguish between SFB and Mechanical Support, and to map these two different kinds of support differentially to *on* and to different verbs, our findings suggest this is unlikely to be the *only* driving force. Rather, linguistic input is also likely to play a role. We consider this next.

In the current study, for SFB configurations, parents' use of *on* seemed to have minimal effects on children's use of *on* (at least in the current data set). In our analysis, parents did not show a bias to use *on* for SFB, as did children, and exploratory analyses did not reveal any significant relations between children's and parents' use of *on* for SFB (see Table 4a). However, the findings for configurations of Mechanical Support – a sub-domain of support that, by hypothesis, is *not* "core" – revealed a different pattern. Parents' use of *on* for Mechanical Support configurations when children were younger predicted children's use of *on* for Mechanical Support configurations when they were older (Table 4b). Thus, similar to how children from the age of 2 are sensitive to how their native language carves up the semantic space in other domains of spatial language (e.g., Bowerman, 1996; Bowerman & Choi, 2003), children may be sensitive to how *on* – the canonical term marking support in English – is used to encode Mechanical Support. Further research is needed to understand the precise role of such input. Does it help children learn that *on* can be used to encode Mechanical Support? Or, does language play a stronger role such that hearing *on* in the context of both SFB and Mechanical Support configurations leads children to notice the similarity across SFB and Mechanical Support configurations in that both involve one object preventing another object from falling? Current research in our lab is further exploring the role of parent input by testing not only how pre-verbal infants categorize support configurations but also how young children describe SFB vs. Mechanical Support in an elicited production task, and how the parents of these very same children describe support configurations to their children. The current findings that SFB is indeed privileged in the spontaneous productions of very young children set the stage for these future studies to test precisely *how* pre-verbal representations may work in concert with linguistic input.

The joint contributions between a "core" representation of SFB and linguistic input are also exemplified when examining the "division of labor" that characterizes children's and adults' semantic space for support. Our finding that children younger than 4 years of age show a "division of labor" – mapping BE *on* to SFB and MoA verbs to Mechanical Support – suggests that children's semantic space for support is highly differentiated even in the earliest stages of language development and that the mappings between semantic representations and verb classes are learned quite early. Thus, acquiring a "division of labor" does *not* appear to be a relatively slow, piecemeal process. Still, children clearly have much to learn about the many ways that support of one object by another can occur – for example, the difference between tape and suction cups, or the functional consequences of wood vs. mesh in support relations (Johannes, 2015). Such support relationships may be encoded felicitously by the specific verbs that encode the mechanism of attachment (e.g., *taped, suctioned*). We hypothesize that these later advances will rely on the earlier acquired distinction between core and non-core configurations, as well as their correlated linguistic expressions – the specific verbs that encode these configurations as well as the verb's semantic and syntactic structures. For example, in the current study, the verb types that were used frequently to encode SFB (BE, Light, Posture, and Motion verbs; see Table 3 and Figure 2) differ in semantic and syntactic structure from the verb types that were primarily used to encode Mechanical Support (e.g., Creation/Transformation verbs). Verbs such as "sit" and "go" ("sit on the chair," "go on the bus") often require goal locations that are endpoints of motion along a horizontal surface constrained by gravity. In contrast, verbs like "write" and "make" have different semantics requirements; they require goals that are end states – goals that are very different in nature from physical endpoints.[5] Thus, although pre-verbal representations of core vs. non-core configurations may provide a crucial divide that guides both early and later learning, exposure, and acquisition of specific verbs and their semantic and syntactic structures also likely plays a role (see also, Johannes et al., 2016). That is, it is the interplay between a pre-verbal differentiation of core/non-core in combination with corresponding linguistic predispositions (unmarked expressions for the "core" and marked, specialty verbs for the non-core) that likely guides acquisition in this domain. Future research can systematically explore how children's development of lexical resources (verbs and their structures) interacts with the acquisition of Mechanical Support language.

Lastly, our finding that children, often use light verbs (e.g., *put, go*) to encode SFB (rather than primarily BE *on* as reported by Landau and colleagues, Johannes et al., 2016; Landau et al., 2016) suggests that the hypothesized Basic Locative Construction, BE *on*, may be somewhat restricted to static configurations of SFB, and not widely used for encoding SFB in dynamic events. It will be important to examine how SFB in dynamic events is encoded *across languages* as well; we predict that speakers of languages other than English will also show a tendency to use light verbs in contexts that otherwise elicit BE *on* in English. Both BE and the light verbs encode little spatial content, and so should be interchangeable, as suggested by our data.

In conclusion, our findings suggest that the configuration of Support-From-Below is a "core exemplar" upon which children can map early language expressing support. This occurs prior to 4 years of age, continues throughout early childhood, and appears in adults. Thus, a domain that is arguably quite abstract and broad in the mature language user – involving complex interactions of objects with each other – is highly structured, even in the earliest stages of language learning.

Notes

1. The current study focuses on clear configurations of physical support (SFB and Mechanical Support) that have been examined and discussed in the previous literature and theory (see Landau et al., 2016). These cases make reference to a clear concrete spatial configuration. Thus, analyses of the preposition *on* and its partner verbs focus on this circumscribed set of utterances. Although the current study does not aim to examine children's entire range of *on* uses, examination of Table 2 ("other") and Appendix A suggest that even for these qualitatively different relations, children use *on*, raising a question for future research of how children acquire such varied and often "abstract" uses of *on*.
2. We collapsed over embedding and adhesion because it was often impossible to differentiate the two in children's utterances. For example, "Put windows on your house" can mean stick (adhere) the windows on to the house or draw (embed) the windows on the house. Since our goal was to evaluate children's descriptions of Mechanical Support per se, we collapsed over these two mechanisms.
3. We decided to treat donning as a subtype in the "other" category because donning is not always encirclement (e.g., "hat on head" is not the same as "diaper on") and donning is seems to be treated as a special type of spatial relation cross-linguistically (e.g., in Dutch and Korean), with distinct verbs encoding different kinds of donning (see Bowerman, 1996). However, even if donning is considered as encircling (thus a subtype of mechanical support), the results remain the same (*on* used for Mechanical Support in Table 2 remains less than 50%).
4. Four parents had a child that only fell in younger age group and were thus dropped from the analyses.
5. We thank an anonymous reviewer for this suggestion and motivating us to elaborate more on the effects of lexical resources.

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References

Baillargeon, R., Li, J., Ng, W., & Yuan, S. (2009). An account of infants' physical reasoning. In A. Woodward & A. Needham (Eds.), *Learning and the infant mind* (pp. 66–116). New York, NY: Oxford University Press.

Baillargeon, R., & DeJong, G. F. (2017). Explanation-based learning in infancy. *Psychonomic Bulletin & Review*, *24*(5), 1511–1526. doi:10.3758/s13423-017-1334-4
Bowerman, M. (1996). Learning how to structure space for language: A crosslinguistic perspective. In P. Bloom, M. A. Peterson, L. Nadel, & M. F. Gerritt (Eds.), *Language and space* (pp. 385–436). Cambridge, MA: MIT Press.
Bowerman, M., & Choi, S. (2003). Space under construction: language-specific spatial categorization in first language acquisition. In D. Gentner & S. Goldin- Meadow (Eds (Eds), *Language in mind: advances in the study of language and cognition* (pp. pp. 387–428). Cambridge, MA: MIT Press.
Bowerman, M., & Pederson, E S. C. Levinson (Ed (1992). Topological relations picture series. In S. C. Levinson (Ed (Ed), *Space stimuli kit 1.2 (pp. 51)*. Netherlands: Max Planck Institute for Psycholinguistics: Nijmegen.
Casasola, M., & Cohen, L. (2002). Infant categorization of containment, support and tight-fit spatial relationships. *Developmental Science*, *5*(2), 247–264. doi:10.1111/1467-7687.00226
Garrod, S. C., Ferrier, G., & Campbell, S. (1999). In and On: Investigating the functional geometry of spatial prepositions. *Cognition*, *72*(2), 167–189. doi:10.1016/S0010-0277(99)00038-4
Gentner, D., & Bowerman, M. (2009). Why some spatial semantic categories are harder to learn than others: The typological prevalence hypothesis. In J. Guo, E. Lieven, N. Budwig, S. Ervin-Tripp, K. Nakamura, Ş. Õzçalişkan, & Ş. Õzçalişkan (Eds.), *Crosslinguistic approaches to the psychology of language: Research in the tradition of Dan Isaac Slobin* (pp. 465–480). New York, NY: Psychology Press.
Johannes, K. (2015). *Geometric and functional knowledge in the acquisition of spatial language (unpublished doctoral dissertation)*. Baltimore, MD: Johns Hopkins University.
Johannes, K., Wilson, C., & Landau, B. (2016). The importance of lexical verbs in the acquisition of spatial prepositions: The case of in and on. *Cognition*, *157*, 174–189. doi:10.1016/j.cognition.2016.08.022
Johnston, J. R., & Slobin, D. I. (1979). The development of locative expressions in English, Italian, Serbo-Croatian and Turkish. *Journal of Child Language*, *6*(3), 529–545. doi:10.1017/S030500090000252X
Landau, B. (2017). Update on 'what' and 'where' in spatial language: A new division of labor for spatial terms. *Cognitive Science*, *41*(Suppl 2), 321–350. doi:10.1111/cogs.12410
Landau, B. (2018). doi:10.1111/tops.12394
Landau, B., Johannes, K., Skordos, D., & Papafragou, A. (2016). Containment and support: Core and complexity in spatial language learning. *Cognitive Science*. doi:10.1111/cogs.12389
Levin, B. (1993). English Verb Classes and Alternations: A Preliminary Investigation, University of Chicago Press, Chicago, IL
Levinson, S. C., & Wilkins, D. P. (2006). *Grammars of space: Explorations in cognitive diversity*. New York, NY: Cambridge University Press. doi:10.1017/CBO9780511486753
MacWhinney, B. (2000). *The CHILDES project: Tools for analyzing talk*. The database (Vol. 2). Mahwah, NJ: Lawrence Erlbaum Associates.
Meints, K., Plunkett, K., Harris, P., & Dimmock, D. (2002). What is 'on' and 'under' for 15-, 18-, and 24-month-olds? Typicality effects in early comprehension of spatial prepositions. *British Journal of Developmental Psychology*, *20*(1), 113–130. doi:10.1348/026151002166352
Spelke, E. S., & Kinzler, K. D. (2007). Core knowledge. *Developmental Science*, *10*(1), 89–96. doi:10.1111/desc.2007.10.issue-1
Talmy, L. (1988). Force dynamics in language and cognition. *Cognitive Science*, *12*(1), 49–100. doi:10.1207/s15516709cog1201_2
Vandeloise, C. (1991). *Spatial prepositions: a case study from french*. A.R.K. Bosch, Trans.). Chicago, IL: The University of Chicago Press.

Appendix A.

Appendix A. List of “other” verbs paired with *on* (N = 110) that occurred infrequently (i.e., <5% of the total 1188 utterances listed in Table 3)[1,2].

Verb (and example)	Support type	
Verb of existence	SFB	Mechanical
Live (e.g., worms live on my leg)	3	0
Stay (e.g., the ballerina won't stay on the horse)	2	1
Rest (e.g., do you want to see my butterfly rest on my hand ?)	2	0
Total	**7**	**1**
Verb of Putting		
Spill (e.g., he spilled some glue on the table)	2	1
Spit (e.g., Sarah spit on my finger)	0	3
Splash (e.g., paint's splashing on the paper)	0	3
Pour (e.g., he can pour water on it)	1	0
Total	**3**	**7**
Verb of Ingesting		
Eat (e.g., eat it on the small table)	9	0
Total	**9**	**0**
Verb of Throwing		
Throw (e.g., I can throw him on the floor)	5	0
Total	**5**	**0**
Verb of Change of Possession		
Find (e.g., we find ice on the floor)	1	1
Catch (e.g., I caught them on a chair. look . look . look . look)	1	0
Total	**2**	**1**
Other verbs		
Sleep (e.g., he has to sleep right on the floor)	17	0
Poop (e.g., he pooped on the potty)	13	0
Play (e.g., I played on the slide)	5	1
Wear (e.g., Mom, what's he's wearing on his neck ?)	1	1
Hold (e.g., he needs a little something like a stool so I can hold him on it)	5	0
Land (e.g., you're going to land on Daddy)	4	0
Belong (e.g., tape doesn't belong on houses)	1	2
Color (e.g., color on the table)	0	3
Take (e.g., I'm just gonna take rocks on the airplane then take them home)	3	0
Drool (e.g., you drool on my finger)	0	2
Keep (e.g., see. that's why you hafta keep the tape on it)	1	1
Peck (e.g., uhhuh and then I can't walk when them peck holes on me)	0	2
Pee (e.g., I wanna get a Pocahontas and after I pee on the potty)	2	0
Say (e.g., what does it say on the card ?)	0	2
Want (e.g., I want play dough on this)	1	1
Wipe (e.g., I wipe it off on my Mommy's dress)	0	2
Dress ('cause I want bear that's dressed with a hat on like Santa does)	1	0
Fit (e.g., could it fit on a plate ?)	1	0
Hide (e.g., we're gonna hide on the hill)	1	0
Rain (e.g., uhhuh and it's raining on him and I drawed the rain)	0	1
Wrestle (e.g., and we wrestled on the grass)	1	0
Total	**57**	**18**
Grand Total	**83**	**27**

[1]The categorization of verbs into the verb types presented in this Appendix follows Levin's (1989) semantic class categorization of verbs.

[2]As noted in the “Method, Verb Coding” section, these verbs were infrequently used by children (<5%) and thus excluded from the statistical analyses of verb types. However, examination of Appendix A reveals that even most of these infrequently used verbs show clear distinctions in the type of support that is encoded, further supporting the results (e.g., “eat,” “throw,” “sleep” all overwhelmingly encode SFB more than Mechanical Support).