Get out but don't fall down: verb-particle constructions in child language

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Abstract

Much has been discussed about the challenges posed by Multiword Expressions (MWEs) given their idiosyncratic, flexible and heterogeneous nature. Nonetheless, children successfully learn to use them and eventually acquire a number of Multiword Expressions comparable to that of simplex words. In this paper we report a wide-coverage investigation of a particular type of MWE: verb-particle constructions (VPCs) in English and their usage in child-produced and child-directed sentences. Given their potentially higher complexity in relation to simplex verbs, we examine whether they appear less prominently in child-produced than in child-directed speech, and whether the VPCs that children produce are more conservative than adults, displaying proportionally reduced lexical repertoire of VPCs or of verbs in these combinations. The results obtained indicate that regardless of any additional complexity VPCs feature widely in children data following closely adult usage. Studies like these can inform the development of computational models for language acquisition.

1 Introduction

There has been considerable discussion about the challenges imposed by Multiword Expressions (MWEs) which in addition to crossing word boundaries act as a single lexical unit at some levels of linguistic analysis (Calzolari et al., 2002; Sag et al., 2002; Fillmore, 2003). They include a wide range of grammatical constructions such as verb-particle constructions (VPCs), idioms, compound nouns and listable word configurations, such as terminology and formulaic linguistic units (Wray, 2009). Depending on the definition, they may also include less traditional sequences like *copy of* in *They gave me a copy of the book* (Fillmore et al., 1988), greeting formulae like *how do you do?*, and lexical bundles such as *I dont know whether* or memorized poems and familiar phrases from TV commercials (Jackendoff, 1997). These expressions may have reduced syntactic flexibility, and be semantically more opaque so that their semantics may not be easily inferred from their component words. For instance, to *play down X* means to *(try to) make X seem less important than it really is* and not literally a playing event.

These expressions may also breach general syntactic rules, sometimes spanning phrasal boundaries and often having a high degree of lexicalisation and conventionality. They form a *complex of features that interact in various, often untidy, ways and represent a broad continuum between non-compositional (or idiomatic) and compositional groups of words* (Moon, 1998). In addition, they are usually sequences or groups of words that co-occur more often than would be expected by chance, and have been argued to appear in the same order of magnitude in a speaker's lexicon as the simplex words (Jackendoff, 1997).

In terms of language acquisition difficulties may arise as the interpretation of these expressions often demands more knowledge than just about (1) unitary words and (2) word-to-word relations. This introduces a distinction between what a learner is able to computationally disambiguate or figure out automatically from language and what must be explicitly stored/memorized and *retrieved whole from memory at the time of*

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use, rather than being subject to generation or analysis by the language grammar (Wray, 2009, p. 9). Yet, according to Fillmore et al. (1988), in an ideal learning environment, most of the knowledge about how to use a language should be computable while explicitly memorized sequences should be kept to a minimum.

Due to these idiosyncrasies they have been noted as easily phonetically mislearned: e.g. *by and large* mistaken for *by in large, to all intents and purposes* for *to all intensive purposes*, and *an arm and a leg* for *a nominal egg* (Fillmore, 2003). For second language (L2) learners in particular (Wray, 2002) MWEs are indeed a well-known cause of problems and less likely to be used by them than by native speakers in informal spoken contexts (Siyanova and Schmitt, 2007). Even if L2 learners may be capable of producing a large number of MWEs, their underlying intuitions and fluency do not match those of native speakers (Siyanova and Schmitt, 2008) and they may produce marked combinations that are not conventionally used together (e.g. plastic surgery/?operation, strong/?powerful tea) (Pearce, 2002; Siyanova and Schmitt, 2007).

Given the potential additional sources of complexity of MWEs for learning, in this paper we investigate whether children shy away from using them when they communicate. We focus on a particular type of MWEs, VPCs, which present a wide range of syntactic and semantic idyosincrasies examining whether children produce proportionally less VPCs than adults. In addition, we analyze whether any potential added processing costs for VPCs are reflected in a reduced choice of VPCs or verbs to form these combinations in child-produced sentences compared to adult usage. Finally, given the possibility of flexible word orders in VPCs with the verb and particle not only occurring adjacently but also with an NP object between them, we compare these two groups in terms of distances between the verb and the particle in these combinations, to determine whether there is a preference for a joint or a split configuration and if children and adults adopt distinct strategies for their usage. By profiling the VPC usage by children our aim is to provide the basis for a computational modeling of the acquisition of these constructions.

This paper is structured as follows: in section 2 describes VPCs and related works; section 3 presents the resources and methods used in this paper. The analyses of VPCs in children and adults sentences are in section 4. We finish with conclusions and possibilities of future works.

2 Related Work

VPCs are combinations of verbs and prepositional (*up, down, ...*), adverbial (*away, back,...*), adjectival (*short,...*) or verbal (*go, be,...*) particles, and in this work we focus on VPCs with prepositional or adverbial particles like *put off* and *move on*. From a language acquisition perspective, the complexity of VPCs arises from their wide syntactic as semantic variability.

Syntactically, like simplex verbs, VPCs can occur in different subcategorisation frames (e.g. intransitive in *break down* and transitive in *print NP up*). However, the type of verb and the number of arguments of a VPC seem to have an impact in learning as both children with typical development and with specific language impairments (SLI) seem to use obligatory arguments and inflectional morphology more consistently with general all purpose verbs, like *make, go, do, put*, than with more specific verbs. Moreover, as the number of obligatory arguments increases children with SLI seem to produce more general and fewer specific verbs (Boynton-Hauerwas, 1998). Goldberg (1999b) refers to these verbs as light verbs, suggesting that due to their frequency of use, they are acquired earlier by children, and subsequently act as centers of gravity from which more specific instances can be learnt. These verbs are very common and frequent in the everyday communication, that could be used in place of more specialized instances (e.g. *make* instead of *build*).

In transitive VPCs there is the additional difficulty of the particle appearing in different word orders in relation to the verb: in a joint configuration, adjacent to the verb (e.g. *make up NP*) or in a split configuration after the NP complement (*make NP up*) (Lohse et al., 2004). While some VPCs can appear in both configurations, others are inseparable (*run across NP*), and a learner has to successfully account for these. Gries (2002) using a multifactorial analysis to investigate 25 variables that could be linked to particle placement like size of the direct object (in syllables and words), type of NP (pronoun or lexical), type of determiner (indefinite or definite). For a set

of 403 VPCs from the British National Corpus he obtains 84% success in predicting (adult) native speakers' choice. Lohse et al. (2004) propose that these factors can be explained by considerations of processing efficiency based on the size of the object NP and on semantic dependencies among the verb, the particle, and the object. In a similar study for children Diessel and Tomasello (2005) found that the type of the NP (pronoun vs lexical NP) and semantics of the particle (spatial vs non-spatial) were good predictors of placement on child language data.

Semantically, one source of difficulties for learners comes from the wide spectrum of compositionality that VPCs present. On one end of the spectrum some combinations like *take away* compositionally combine the meaning of a verb with the core meaning of a particle giving a sense of motion-through-location (Bolinger, 1971). Other VPCs like *boil up* are semi-idiomatic (or aspectual) and the particle modifies the meaning of the verb adding a sense of completion or result. At the other end of the spectrum, idiomatic VPCs like *take off*, meaning *to imitate* have an opaque meaning that cannot be straightforwardly inferred from the meanings of each of the components literally. Moreover, even if some verbs form combinations with almost every particle (e.g., *get, fall, go,...*), others are selectively combined with only a few particles (e.g., *book* and *sober* with *up*), or do not combine well with them at all (e.g., *know, want, resemble,...*) (Fraser, 1976). Although there are some semi-productive patterns in these combinations, like verbs of cooking and the aspectual *up* (*cook up, boil up, bake up*), and stative verbs not forming VPCs, for a learner it may not be clear whether an unseen combination of verb and particle is indeed a valid VPC that can be produced or not. Sawyer (1999) longitudinal analysis of VPCs in child language found that children seem to treat aspectual and compositional combinations differently, with the former being more frequent and employing a larger variety of types than the latter. The sources of errors also differ and while for compositional cases the errors tend to be lexical, for aspectuals there is a predominance of syntactic errors such as object dropping, which accounts for 92% of the errors in split configuration for children under 5 (Sawyer, 1999). Children with SLI tended to produce even more object dropping errors for VPCs than children with typical development, despite both groups producing equivalent numbers of VPCs (Juhasz and Grela, 2008). Given that compositionality seems to have an impact on learning, to help reduce avoidance of phrasal verbs Sawyer (2000) proposes a semantic driven approach for second language learning where transparent compositional cases would be presented first to help familiarization with word order variation, semi-idiomatic cases would be taught next in groups according to the contribution of the particle (e.g telicity or completiveness), and lastly the idiomatic cases that need to be memorized.

In this paper we present a wide coverage examination of VPC distributions in child produced and child-directed sentences, comparing whether children reproduce the linguistic environment to which they are exposed or whether they present distinct preferences in VPC usage.

3 Materials and Methods

For this work we use the English corpora from the CHILDES database (MacWhinney, 1995) containing transcriptions of child-produced and child-directed speech from interactions involving children of different age groups and in a variety of settings, from naturalistic longitudinal studies to task oriented latitudinal cases. These corpora are available in raw, part-of-speech-tagged, lemmatized and parsed formats (Sagae et al., 2010). Moreover the English CHILDES Verb Construction Database (ECVCD) (Villavicencio et al., 2012) also adds for each sentence the RASP parsing and grammatical relations (Briscoe and Carroll, 2006), verb semantic classes (Levin, 1993), age of acquisition, familiarity, frequency (Coltheart, 1981) and other psycholinguistic and distributional characteristics. These annotated sentences are divided into two groups according to the speaker annotation available in CHILDES, the **Adults Set** and the **Children Set** contain respectively all the sentences spoken by adults and by children[1], as shown in table 1 as Parsed.

VPCs in these corpora are detected by looking in the RASP annotation for all occurrences of verbs followed by particles, prepositions and adverbs up to 5 words to the right, following Baldwin (2005), shown as Sentences with VPCs

[1]For the latter sentences which did not contain information about age were removed.

Sentences	Children Set	Adults Set
Parsed	482,137	988,101
with VPCs	44,305	83,098
with VPCs Cleaned	38,326	82,796
% with VPCs	7.95	8.38

Table 1: VPCs in English Corpora in the Children and Adults Sets

in table 1. The resulting sentences are subsequently automatically processed to remove noise and words mistagged as verbs. For these candidates with non-alphabetic characters, like @ in *a@l up*, were removed as were those that did not involve verbs (e.g. *di, dat,*), using the Comlex Lexicon as reference for verb validity (Macleod and Grishman, 1998). The resulting sets are listed as Sentences with VPCs Cleaned in table 1. The analyses reported in this paper use these sentences, and the distribution of VPCs per children age group is shown in table 2. Given the non-uniform amounts of VPC for each age group, and the larger proportion of VPC sentences in younger ages in these corpora, we consider children as a unique group. For these, the individual frequencies of the verb, the particle and the VPC are collected separately in the children set and in the adult set, using the mwetoolkit (Ramisch et al., 2010).

Age in months	VPC Sentences
0-24	2,799
24-48	26,152
48-72	8,038
72-96	1,337
>96	514
No age	4,841

Table 2: VPCs in Children Set per Age

To evaluate the VPCs in these sets, we use:

- English VPC dataset (Baldwin, 2008); which lists 3,078 VPCs with valency (intransitive and transitive) information;
- Comlex lexicon (Macleod and Grishman, 1998) containing 10,478 phrasal verbs;
- the Alvey Natural Language Tools (ANLT) lexicon (Carroll and Grover, 1989) with 6,351 phrasal verbs.

4 VPCs in Child Language

To investigate whether any extra complexity in the acquisition of VPCs is reflected in their reduced presence in child-produced than in child-directed sentences, we compare the proportion of VPCs in the Children and Adults Sets, table 3. In absolute terms adults produced more than double the number of VPCs that children did. However, given the differences in size of the two sets, in relative terms there was a similar proportion of VPC usage in these corpora for each of the groups: 7.95% of the sentences produced by children contained VPCs vs 8.38% of those by adults. Moreover, the frequencies with which these VPCs are used by both children and adults reflects the Zipfian distribution found for the use of words in natural languages, with a large part of the VPCs occurring just once in the data, table 4. In addition, in terms of frequency, children's production of VPCs resembles that of the adults.

Total VPC	Children Set	Adults Set
Tokens	38,326	82,796
Types	1,579	2,468

Table 3: VPC usage in CHILDES

Frequency	Children Set	Adults Set
1	42.62%	43.03%
2	13.05%	15%
3	8.36%	6.48%
4	4.05%	4.5%
≥5	31.92%	31%

Table 4: VPC types per frequency

Another possible source of divergence between children and adults is in the lexical variety found in VPCs. The potential difficulties with VPCs may be manifested in children producing a reduced repertoire of VPCs or using a smaller set of verbs to form these combinations. As shown in table 3, adults, as expected, employ a larger VPC vocabulary with 1.56 more types than children. However, an examination of the distributions of types reveals that they only differ by a scale. As a result when children frequencies are multiplied by a factor of 2.16, which corresponds to the ratio between VPC tokens used by adults and children (table 3), the resulting distribution has a very

good match with the adult distribution, see figure 1. Therefore, the lower number of VPC types used by children can be explained totally by the lower number of sentences they produced, and the hypothesis that difficulties in VPCs would lead to their avoidance is not confirmed by the data.

Nonetheless, there is a discrepancy between the distributions found for the higher frequency VPCs. Children have a more uniform distribution and adults tend to repeat more often the higher frequency combinations (top left corner of figure 1). An evidence that this discrepancy is particular for high frequency VPCs, and not their constituent verbs, is shown in figure 2. This figure displays the rank plot for the verbs present in the VPCs, for both adults and children. The same scale factor used in figure 1 is applied to compensate for the lower number of VPC sentences in the children set. This time the match is extraordinary, spanning the whole vocabulary.

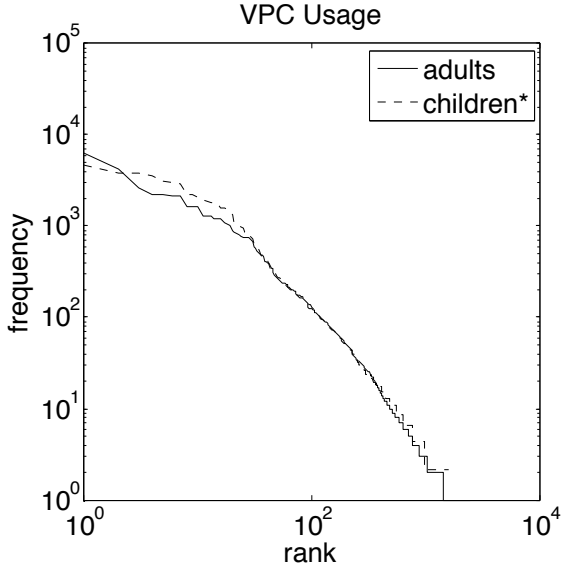

Figure 1: VPC Usage Frequency vs Ranking. The children frequency is scaled to match adult total VPC usage.

Ranks however, might not tell the whole story. It is important to verify if the same VPCs and verbs are present in the both vocabularies, and further if their orders in the ranks are similar. The two groups have very similar preferences for VPC usage, with a Kendall τ score of 0.63 which indicates that they are highly correlated, as Kendall τ ranges from -1 to 1. Furthermore they use a very similar set of verbs in VPCs, with a Kendall

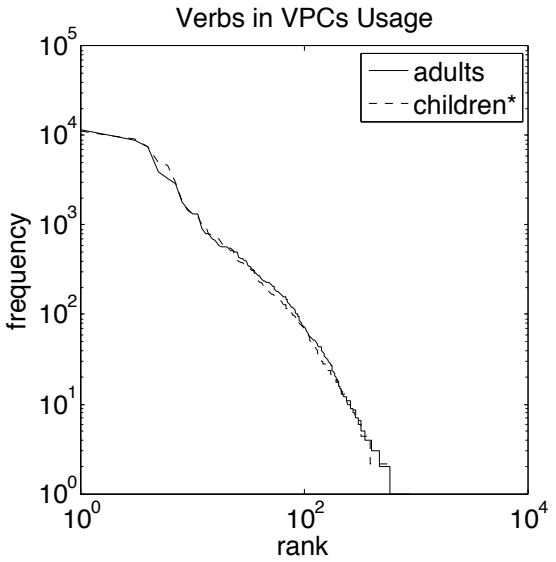

Figure 2: Verbs in VPCs Usage Frequency vs Ranking. The children frequency is scaled to match adult total VPC usage.

τ score of 0.84 pointing to a very strong correlation. We find less agreement between the orders of VPCs and verbs for both children and adults, indicating that the order of the verbs in the data is not predictive of the relative frequencies of VPCs. We examined (a) if children's VPC ranks followed their verb ranks, (b) if adults VPC ranks followed their verb ranks and (c) if children's VPC ranks followed adults' verb ranks. The resulting Kendall scores were around 0.2 for all three cases. Moreover, if the lower frequency VPCs are removed to avoid potential cases of noise, the Kendall τ score for VPCs by adults and children increases with the threshold, second line from the top in Figure 3, while it remains constant for all the other cases. As an example, the top 10 VPC types used by children and adults are listed in table 5. From these, 9 out of the 10 are the same differing only in the order in which they appear. Most of these combinations are listed in one of the dictionaries used for evaluation: 72% for adults and 75.87% for children. When a threshold of at least 5 counts is applied these values go up to 87.72% for adults and 79.82% for children, as would be expected. This indicates that besides any possible lack of coverage for child-directed VPCs in the lexicons or noise, it is in the lower frequency combinations that novel and domains specific non-standard usages can be found. Some

Rank	Chidren VPC	Children Freq	Adult VPC	Adult Freq	Child Rank
1	put on	2005	come on	6244	7
2	go in	1608	put on	4217	1
3	get out	1542	go on	2660	9
4	take off	1525	get out	2251	3
5	fall down	1329	take off	2249	4
6	put in	1284	put in	2177	6
7	come on	1001	sit down	2133	8
8	sit down	981	go in	1661	2
9	go on	933	come out	1654	10
10	come out	872	pick up	1650	18

Table 5: Top VPCs for Children and Adults

of the combinations not found in these dictionaries include *crawl in* and *creep up* by adults and *erase off* and *crash down* by children.

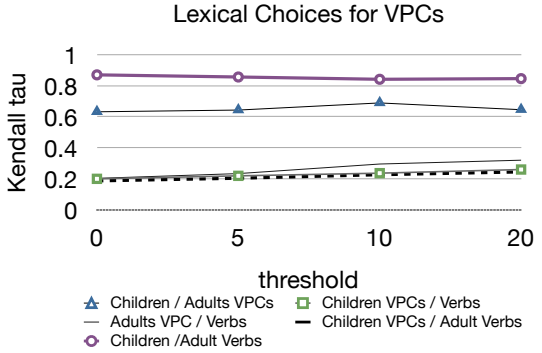

Figure 3: Kendall τ score per VPC frequency threshold

Finally, despite adults having a larger verb vocabulary used in VPCs than children, the two groups have similar ratios of verb per VPCs: 2.81 VPCs for children and 2.79 for adults, table 6. The top verbs used in VPCs types are also responsible for very frequent VPC tokens (e.g. *go, get, come, take, put, make and move*) accounting for 5.83% VPC types and 43.76% tokens for adults and 7.02% of the types and 47.81% of the tokens for children, confirming the discrepancy discussed earlier. These are very general verbs and some of the most frequent in the data, reported among the first to be learned (Goldberg, 1999a) which may facilitate their acquisition and use in VPCs.

Comparing VPC types used by children and by adults, this trend is confirmed: a large proportion (72.32%) of the VPC types that children use is also used by adults, Children $\cap$ Adult in table 6. When low frequency VPCs types are removed, this proportion increases (89.48%). Moreover, when the VPCs used only by the adults are considered, most of these (93.44%) occur with frequency lower than 5. This suggests that children tend to follow quite closely the combinations employed by adults, and the lower frequency cases may not yet be incorporated in their active vocabulary.

In terms of the distance between verb and particle, there is a strong preference in the data for joint combinations for both children and adults, table 7. For the split cases, the majority contains only one word between the verb and the particle. Children in particular display a slight dispreference for longer distances between verbs and particles, and over 97% of VPCs have at most 2 words between them.

Distance	Children Set	Adults Set
0	65.13%	64.14%
1	23.48%	22.15%
2	9.33%	10.90%
3	1.65%	2.15%
4	0.29%	0.47%
5	0.09%	0.16%

Table 7: Distance between verb and particle

5 Conclusions and future work

In this paper we presented an investigation of VPCs in child-produced and child-directed sentences in English to determine whether potential complexities in the nature of these combinations

	Children VPCs	Adult VPCs	Children ∩Adult VPCs	Children only VPCs	Adult only VPCs
VPCs	1579	2468	1142	437	1243
Verb in VPCs	561	884	401	160	483
Particle in VPCs	28	35	24	4	9
VPCs ≥ 5	504	766	451	53	278
Verb in VPCs ≥ 5	207	282	183	24	99
Particle in VPCs ≥ 5	18	20	17	1	3

Table 6: Number of VPC, Verb and Particle types by group, common usages

are reflected in their reduced usage by children. The combination of these results shows that, despite any additional difficulties, VPCs are as much a feature in children's data as in adults'. Children follow very closely adult usage in terms of the types and are sensitive to their frequencies, displaying similar distributions to adults. They also seem to use them in a similar manner in terms of particle placement. Therefore no correction for VPC complexity was found in this data.

Despite these striking similarities in many of the distributions, there are still some discrepancies between these two groups. In particular in the VPC ranks, children present a more uniform distribution for higher frequency VPCs when compared to adults. Moreover, there is a modest but significant dispreference for longer distances between verb and particle for children. Whether these reflect different strategies or efficiency considerations deserves to be further investigated.

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