Overt PAST on irregular verbs in child English due to secondary feature negligence

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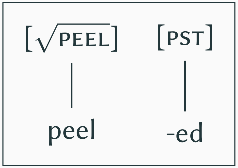
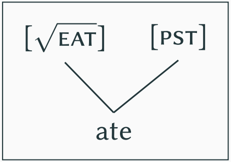
English past tense

(1) a. I **peel** an apple.
    b. I **peel-ed** an apple

(2) a. I **eat** an apple.
    b. I **ate** an apple



1-to-1 mapping



1-to-many mapping

Errors in child English past tense

(3)	a.	I **ate** an apple.	Target
	b.	I **eat-ed** an apple.	Distributive error
	c.	I **ate-d** an apple.	Redundant error
	d.	I **did**(n't) **ate** an apple.	Periphrastic error

Known as overregularization errors (3a, b) or overtensing/doubling errors (3c) (Kuczaj 1977, 1978, Stemberger 1982, 2007, Marcus et al. 1992, Maratsos 2000, Hattori 2003).

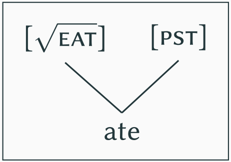
Undercompression: Realization of more material/exponents than must be realized in the adult language including redundant material (see e.g. Slobin 1973, MacWhinney 1985, Alexiadou et al. 2021, Guasti et al. 2023)

Questions

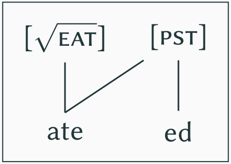
1. How do redundant errors fit with the idea that **children prefer a 1-to-1 mapping between form and meaning** (Slobin 1973, Brighton et al. 2005, van Hout 2008, Arnon 2009, Guasti et al. 2023, Martin et al. 2023).
2. What are the relative frequencies of different error types and why are they like they are?
3. What mistake are children making when they produce an error and what does this tell us about grammar?

This talk

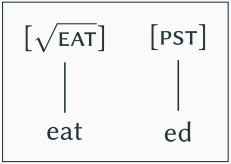
1. The 1-to-1 mapping preference (also) holds at the level of a single morpheme. Redundant and distributive errors have more 1-to-1 mappings than the target form.
2. Distributive errors are more frequent than redundant ones. They also have more 1-to-1 mappings than redundant errors.
3. In an error, children neglect secondary features when selecting a morpheme.[1]



target



redundant



distributive

[1] This presupposes a postsyntactic realizational morphology where stem variants like *ate* are treated as contextual allomorphs rather than as actual portmanteaux.

Roadmap

- Corpus study of past tense in child English
- Analysis of redundant and distributive errors
- Frequencies of redundant and distributive errors
- Analysis and frequencies of periphrastic errors
- Conclusion

Corpus study on past tense in child English

Corpus study

- on **all typically developing children** from **39 North American English** and **17 British English** corpora available through the ChiLDES database (MacWhinney 2000).
- We queried for past tense forms of **37 irregular verbs** within the 100 most frequent verbs in English ChiLDES, including distributive and redundant error forms in various orthographic variants.
- Hits were annotated for target (TAR) or error type (DIS, RED, PER_DO, PER_DID).[2]

[2] We excluded the homographs *cut, read, let, put, fit, hit* and by accident also *buy/bought*, and participles that are syncretic with the past tense (e.g. *brought*, *felt*, etc.).

Results: Counts of errors

(4) *Overall error counts*

Type	*N*	%	Example
TARGET	100,674	97.19	ate
NON-TARGET	2,916	2.81	
DISTRIBUTIVE	1,771	1.71	eat-ed
REDUNDANT	382	0.37	ate-d
PERIPHRASTIC[3]	416	0.40	
did	365	0.35	did(n't) ate
do	51	0.05	do(n't) ate
OTHER	347	0.33	

[3] Frequencies are based on all past tense contexts only a subset of which are also *do*-support contexts. Thus, the actual error frequency for periphrastic errors based on contexts where we expect *do*-periphrasis in the first place is likely much higher. An estimate based on all utterances with "did(n't)" and "did not" comes out at ca. 5 % error rate.

Examples of errors

Distributive

(5) a. it **falled** [: fell] [* +ed] in the briefcase . (Eve, 1;10, Brown)
b. he **runned** [: ran] . (Helen, 4;11, Gleason)

(6) a. I **fell** . [+ RES] (Eve, 1;07, Brown)
b. now the cat **ran** away . (Helen, 4;11, Gleason)

Redundant

(7) a. so elephant **wented** [: went] [*] and got a ride .
(Laura, 2;05, Braunwald)
b. he broke [*] [= actually says **broked**] it ?
(Fraser, 2;06, MPI-EVA)

(8) a. I just **went** through that park [?] . (Laura, 2;03, Braunwald)
b. I **broke** it . (Fraser, 2;00, MPI-EVA)

Examples of errors

Periphrastic

(9) a. I **did**n't **caught** it &-uh (.) one . (Sarah, 3;03, Brown)
b. it **does**n't **broke** . (Sarah, 3;07, Brown)
c. **did** we **saw** a lion at the zoo ? (Nina, 2;10, Suppes)
d. where **did** you **made** [*] these ? (Becky, 2;08, Manchester)
e. I **do made** [*] the shopping . (Becky, 2;09, Manchester)

(10) a. **did**n't **bite** it . (Sarah, 3;01, Brown)
b. I **did**n't **go** in the park . (Nina, 2;05, Suppes)
c. **did** I **rip** this ? (Becky, 2;04, Manchester)

Results: Distribution of errors

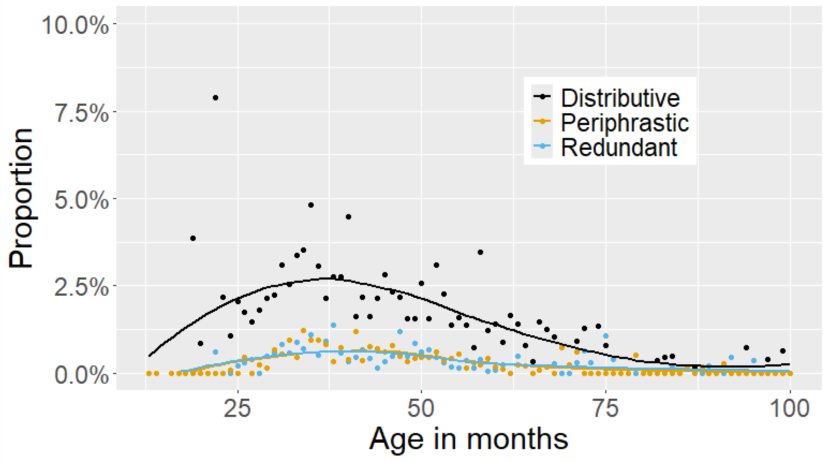


Figure 1: Error rates over age.

Interim summary

- Errors are produced alongside/after target forms.
- common U-shape: few errors made at young age, peak of errors at $\sim$40 months, errors slowly fade out after the peak.
- Different errors peak at the same time. There are no distinct phases for different error types.
- Distributive errors (*eat-ed*) are 4 times more frequent than redundant errors (*ate-d*).
- Within periphrastic errors, the *did ate* type is 7 times more frequent than the *do ate* type.

Analysis

Background

- We adopt a Distributed Morphology approach (Halle and Marantz 1993, 1994), where morphological forms are inserted into syntactic terminals subject to the Subset Principle (Kiparsky 1973, Halle 1997).
- Tense information and the verb root end up in the same complex head by some process (e.g. T-lowering, Generalized Head Movement).
- Irregular target forms are derived by biconditional allomorphy between past stem allomorph and past Ø-marker (rather than as a proper portmanteau).
- Allomorphy is implemented via secondary features (Carstairs 1987, Noyer 1997) on the special allomorph.

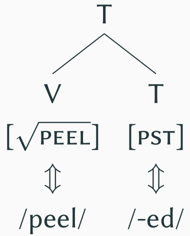
Vocabulary Insertion: Target regular

(11) *List of Vocabulary Items*

a. /peel/ ⇔ $[\sqrt{\text{PEEL}}]$

b. /-ed/ ⇔ [PST]

(12) *Vocabulary Insertion for a regular past tense*



Vocabulary Insertion: Target irregular

(13) *List of Vocabulary Items*

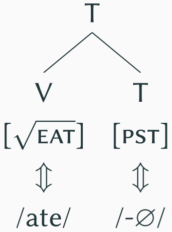
a. /eat/ $\Leftrightarrow$ $[\sqrt{\text{EAT}}]$

b. /ate/ $\Leftrightarrow$ $[\sqrt{\text{EAT}}]$ / $\_\_[\text{PST}]$

c. /-ed/ $\Leftrightarrow$ $[\text{PST}]$

d. /-∅/ $\Leftrightarrow$ $[\text{PST}]$ / $\_\_[\{\sqrt{\text{EAT}}, \sqrt{\text{BRING}}, \ldots\}]$ (cf. Embick 2003)

(14) *Vocabulary Insertion for an irregular past tense*



Analysis

Redundant and distributive errors

Children's errors

Secondary feature negligence (SFN)

Children occasionally fail to consider secondary features during Vocabulary Insertion.

Why? — Ignoring secondary features reduces a 1-to-many mapping to a 1-to-1 mapping.

(15) a. *1-to-many mapping*

/ate/ — [$\sqrt{\text{EAT}}$]
/ate/ - - - / __[PST]

b. *1-to-1 mapping*

/ate/ — [$\sqrt{\text{EAT}}$]
/ __[PST]

Deriving a redundant error

(16) *List of Vocabulary Items*

a. /eat/ $\Leftrightarrow$ $[\sqrt{\text{EAT}}]$

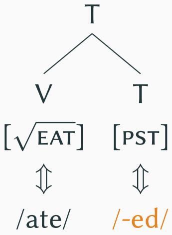
b. /ate/ $\Leftrightarrow$ $[\sqrt{\text{EAT}}]$ / __[PST]

c. /-ed/ $\Leftrightarrow$ [PST]

d. /-∅/ $\Leftrightarrow$ [PST] / __$[\{\sqrt{\text{EAT}}, \sqrt{\text{BRING}}, \ldots\}]$

The child neglects (16d)'s secondary features.

(17) *Vocabulary Insertion leading to redundant error*



Deriving a distributive error

(18) *List of Vocabulary Items*

a. /eat/ ⇔ [$\sqrt{\text{EAT}}$]

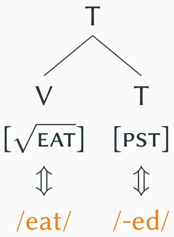
b. /ate/ ⇔ [$\sqrt{\text{EAT}}$] / __[PST]

c. /-ed/ ⇔ [PST]

d. /-∅/ ⇔ [PST] / __[{$\sqrt{\text{EAT}}$, $\sqrt{\text{BRING}}$, …}]

The child neglects (18b)'s and (18d)'s secondary features.

(19) *Vocabulary Insertion leading to distributive error*



A third possibility: Omission error

(20) *List of Vocabulary Items*

a. /eat/ ⇔ [$\sqrt{\text{EAT}}$]

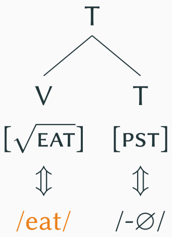
b. /ate/ ⇔ [$\sqrt{\text{EAT}}$] / __[PST]

c. /-ed/ ⇔ [PST]

d. /-∅/ ⇔ [PST] / __[{$\sqrt{\text{EAT}}$, $\sqrt{\text{BRING}}$, …}]

Third option: The child neglects (20b)'s secondary features.

(21) *Vocabulary Insertion leading to omission error*



Omission errors

- They are not systematically covered by our corpus search (and hard to query in general).
- There are a few chance hits (grouped among "other errors").
- They are indistinguishable from the rather frequent root infinitives (e.g. Harris and Wexler 1996, Legate and Yang 2007, Phillips 2010, a.o.), which may have other sources (absence of T, non-finite T, etc.; cf. Wexler 1998, Guasti 2002 for overview).

(22) *Examples of omission errors*

a. he **run [: ran]** away . (Helen, 4;11, Gleason)

b. and then he **come [: came]** [*] back . (Abe, 2;11, Kuczaj)

c. I **throw [: threw]** at [: it] so fast +... (NN, 4;09, Hall)

d. this girl **fall [: fell]** [*] down . (NN, 3;06, Ellis Weismer)

e. who **gave [= actually says give]** me that book ? (Eleanor, 2;00, MPI-Manchester)

Typology of (local) errors

(23)

$[_T$	$V_{[\sqrt{\text{EAT}}]}$	$T_{[\text{PST}]}$	]	Mistake		
	⇕	⇕		#	location	error type
a.	/ate/	/-∅/		0	—	target
b.	/ate/	/-ed/		1	T	redundant
c.	/eat/	/-ed/		2	V & T	distributive
d.	/eat/	/-∅/		1	V	omission

⇒ One mistake gives rise to three different error types depending on where and how often it is made.

Interim summary

- Distributive and redundant errors have a common source: Secondary feature negligence.
- SFN is a consequence of children's preference for a 1-to-1 mapping (on the level of the individual Vocabulary Item).
- This mistake even derives (attested) omission errors.

Prediction 1: Past stem realizes root in non-past contexts

(24) a. /eat/ $\Leftrightarrow$ [$\sqrt{\text{EAT}}$]

b. /ate/ $\Leftrightarrow$ [$\sqrt{\text{EAT}}$] / __[PST]

SFN makes /ate/ available for realization of the bare root.

Prediction 1: Past stem realizes root in non-past contexts

(24) a. /eat/ ⇔ [$\sqrt{\text{EAT}}$]
b. /ate/ ⇔ [$\sqrt{\text{EAT}}$] / __[PST]

SFN makes /ate/ available for realization of the bare root.

(25) a. Mummy can **found** [*] it . (Becky, 2;07, Manchester)
b. you can't **fell** [*] out hospital trains if you're poorly . (Helen, 4;05, MPI-EVA)
c. xxx will **came** out . (Charlie, 3;00, Gleason)
d. he won't **broke** . (Tow, 2;03, Post)
e. I'll **did** [*] it . (Helen, 4;00, MPI-EVA)
f. when I was two, you useta **threw** me? (Emily, 4;05, Weist)
g. we got to **saw** [: see] [*] those plants that look like seahorses (child 33, 4;06, Ellis-Weismer)

Prediction 2: /-∅/ as past marker on regular verbs

(26) c. /-ed/ $\Leftrightarrow$ [PST]

d. /-∅/ $\Leftrightarrow$ [PST] / __[{$\sqrt{\text{EAT}}$, $\sqrt{\text{BRING}}$, …}]

SFN allows /-∅/ to act as past marker on regular verbs.

Prediction 2: /-∅/ as past marker on regular verbs

(26) c. /-ed/ ⇔ [PST]

d. /-∅/ ⇔ [PST] / __[{$\sqrt{\text{EAT}}$, $\sqrt{\text{BRING}}$, ...}]

SFN allows /-∅/ to act as past marker on regular verbs.

(27) a. it droved [?] on (th)is different road an(d) it **stop** [* 0ed] . (Thomas, 3;05, Thomas)

b. he's [//] he **knock** [* 0ed] on it with [/] with a stick and was making loud [: noise] [*] . (child 93, 4;06, Ellis-Weismer)

c. when we were little babies like [//] we **like** [* 0ed] playing on the big climber . (child 116, 4;06, Ellis-Weismer)

d. last night (..) a man **lift** [* 0ed] me up an(d) pressed the button an(d) rubbish bin went up . (Thomas, 3;02, Thomas)

Analysis

Frequencies

Frequencies of local errors

Distributive errors (involving two SFN mistakes) are roughly 4.5 times more frequent than redundant ones (involving one SFN mistake).[4]

Let p (≤ 1) be the probability of a mistake being made, the probability of being made twice is p^2 ($< p$).

$\Rightarrow$ Distributive errors should be rarer than redundant ones!

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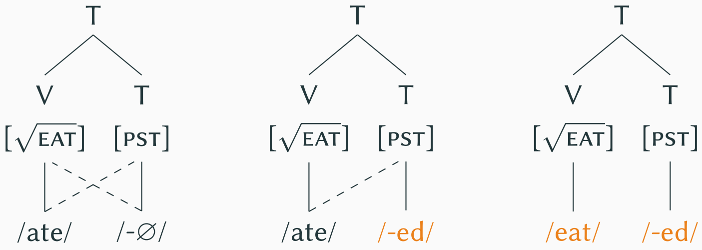
[4] Arnon (2009) found a similar distribution in child English plural errors, e.g. *foot-s*∼*feet-s* (3:1).
Driemel et al. (2023) found a similar distribution in child German and Dutch negative concord errors, e.g. *nicht ein*∼*nicht kein* (1.5:1) / *niet een*∼*niet geen* (7.5:1).

Consistency bias

Consistency bias

A type of mistake, if it occurs, tends to be made consistently within the domain of the complex head.

Why? — Generalizes the preference for 1-to-1 mappings from individual Vocabulary Items to whole words (i.e. complex heads).



Error frequencies (DIS & RED) by lexical item

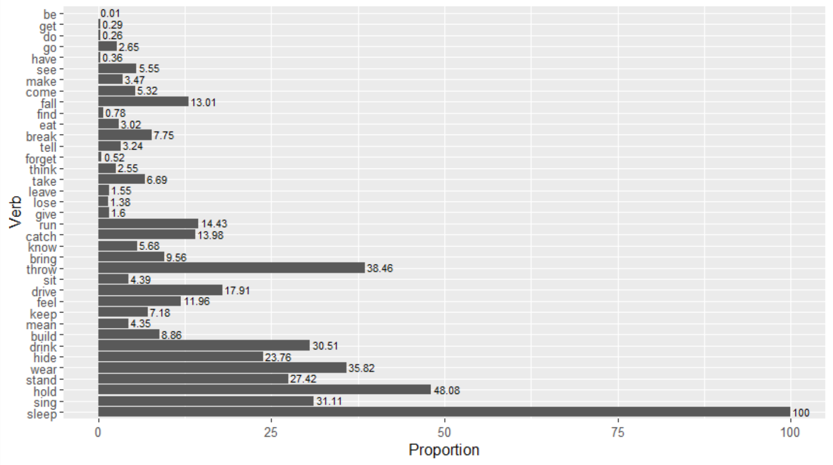
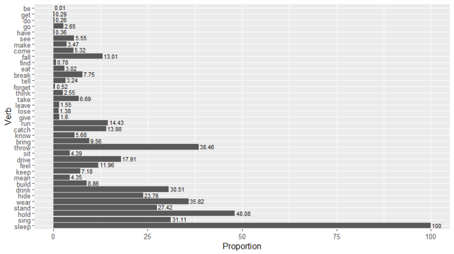


Figure 2: Proportion of distributive and redundant errors by verb ordered by frequency.

(Local) error frequencies by lexical item



The more frequent a verb the lower its error rate ($p < .001$).[5]

[5] Generalized linear mixed model with standardized log frequency as fixed effect, by-child and by-lemma varying intercepts: $\hat{\beta} = -1.3$, SE = 0.12, $z = -11.15$. Analyses performed using R (v.4.4.1, R Core Team 2021) and the lme4 package (Bates et al. 2015).

Frequencies by lexical item

- For each lexical item the likelihood of neglecting a secondary feature, negatively correlates with the stability of that feature's representation.
- More frequent items have more stable representations.
- SFN is more likely to happen with less frequent items than with more frequent ones.

⇒ More errors are made with less frequent lexical items (e.g. *sleep*) compared to more frequent ones (e.g. *be*).

Interim summary

The frequencies of errors depend on

1. the item-specific probability of a given type of mistake and
2. a Consistency bias favouring a consistent application of a mistake within a given complex head.

Analysis

Periphrastic errors

Periphrastic errors: Reminder

(28) a. I **did**n't **caught** it &-uh (.) one . (Sarah, 3;03, Brown)
b. **did** we **saw** a lion at the zoo ? (Nina, 2;10, Suppes)
c. where **did** you **made** [*] these ? (Becky, 2;08, Manchester)
d. it **does**n't **broke** . (Sarah, 3;07, Brown)
e. **does** it **fell** [*] into the water ? (Lara, 2;11, Lara)

(29) *Periphrastic error counts*

Type	*N*	%	Example
PERIPHRASTIC[6]	416	0.40	
did	365	0.35	did(n't) ate
do	51	0.05	do(n't) ate

Postsyntactic model of morphology → we need a theory of the syntax of *do*-support

Generalized Head Movement

We adopt Generalized Head Movement (GenHM, Arregi and Pietraszko 2021).

In a nutshell:

- There is a copy present of the complex head $[_{\mathrm{T}}\ \mathrm{V}_{[\sqrt{\mathrm{root}}]}\ \mathrm{T}_{[\textsc{tns}]}\ ]$ in both the position of *do* and the position of the lexical verb.
- Parts of the complex heads that don't originate in its current position are marked as "orphans" by an [O] feature.
- $\mathrm{V}_{[\sqrt{\mathrm{root}},\mathrm{O}]}$ is always realized by a form of *do*; $\mathrm{T}_{[\mathrm{O}]}$ undergoes an obliteration rule, leading to the absence of tense information on the lexical verb.

Do-support in GenHM

(30) *List of Vocabulary Items*

a. /do/ ⇔ [V, O]

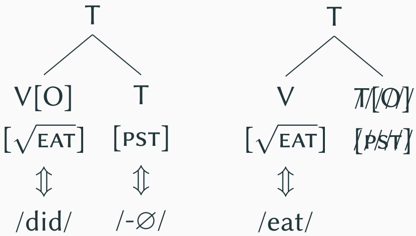
b. /did/ ⇔ [V, O] / __[PST]

c. /-∅/ ⇔ [PST] / __[{$\sqrt{\text{EAT}}$, $\sqrt{\text{DO}}$, ...}]

d. /eat/ ⇔ [$\sqrt{\text{EAT}}$]

e. /ate/ ⇔ [$\sqrt{\text{EAT}}$] / __[PST]

(31) *Target do-support derivation (with obliteration)*



Children's errors

Obliteration failure (OF)

Children occasionally fail to apply feature manipulating rules, i.e. they fail to obliterate $T_{[O]}$, which can then condition stem allomorphy on V.

Why? — This is undercompression, a failure to compress, i.e. make covert, underlying material that need not be pronounced in the adult language (see e.g. Alexiadou et al. 2021, Guasti et al. 2023).

Deriving a (did-type) periphrastic error

(32) *List of Vocabulary Items*

a. /do/ ⇔ [V, O]

b. /did/ ⇔ [V, O] / __[PST]

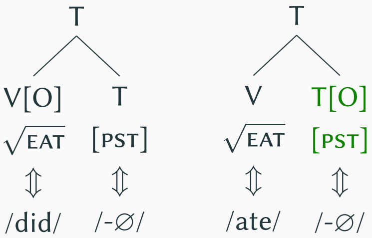
c. /-∅/ ⇔ [PST] / __[{$\sqrt{\text{EAT}}$, $\sqrt{\text{DO}}$, …}]

d. /eat/ ⇔ [$\sqrt{\text{EAT}}$]

e. /ate/ ⇔ [$\sqrt{\text{EAT}}$] / __[PST]

The child fails to obliterate T[O].

(33) *Vocabulary Insertion leading to did-type periphrastic error*



Combined mistakes and combined errors

Obliteration failure may be combined with secondary feature negligence thereby giving rise to combined errors.

(34) *Combined errors*

	[$\sqrt{\text{EAT}}^{[O]}$ ⇕	$T^{[PST]}$] ⇕	[$\sqrt{\text{EAT}}$ ⇕	$T^{[O,PST]}$] ⇕	OF	SFN	type	*N*
a.	/did/	/-∅/	/ate/	/-∅/	1	0	periphrastic	356
b.	/did/	/-∅/	/ate/	/-ed/	1	1	peri.-red.	1
c.	/did/	/-∅/	/eat/	/-ed/	1	2	peri.-dis.	8
d.	/did/	/-∅/	/eat/	/-∅/	1	1	target/peri.-omi.	n.a.
e.	/do/	/-∅/	/ate/	/-∅/	1	1	*do*-periphrastic	52
f.	/do/	/-ed/	/ate/	/-∅/	1	2		0
g.	/did/	/-ed/	/ate/	/-∅/	1	1		0

OF – Obliteration failure mistake; SFN – Secondary feature negligence mistake; peri.-red. – periphrastic redundant error; peri.-dis. – periphrastic distributive error; peri.-omi. – periphrastic omission error

Frequencies of periphrastic errors

Periphrastic errors seem as frequent as redundant errors, though they might actually occur at a much higher rate of ∼5 %.[7]

This is not surprising as a different type of mistake is involved (obliteration failure) which may have a different probability of occurrence.

[7] The frequencies are based on all past tense contexts only a subset of which are also *do*-support contexts. Thus, the actual error frequency for periphrastic errors based on contexts where we expect *do*-periphrasis in the first place is likely much higher. An estimate based on all utterances with “did(n’t)” and “did not” comes out at ca. 5 % error rate.

Frequencies of combined errors

(35) *Combined errors*

	example	OF	SFN	Loc. SFN	type	N
a.	*did ate*	1	0	—	periphrastic	356
b.	*did eated*	1	2	V, T[O]	peri.-dist.	8
c.	*did ated*	1	1	T[O]	peri.-red.	1

Periphrastic distributive errors (*did eated*, 8) are more frequent than periphrastic redundant errors (*did ated*, 1)

Both are far less frequent than plain periphrastic errors (*did ate*, 356) and generally vanishingly infrequent.

Frequencies of combined errors

Consistency bias

A type of mistake, if it occurs, tends to be made consistently within the domain of the complex head.

Combined errors involve a combination of two different types of mistake: OF and SFN.

$\Rightarrow$ Consistency bias does not apply, thus $(p_{\text{OF}} \times p_{\text{SFN}}) \ll p_{\text{OF}}, p_{\text{SFN}}$

If both types of mistake occur combined, however, the Consistency bias favours errors where a SFN mistake is made throughout a complex head, as in a periphrastic distributive error.

Conclusion

- Both, redundant and distributive errors are a consequence of children ignoring secondary features of Vocabulary Items. This reflects their striving for 1-to-1 mappings.
- Distributive errors are more frequent than redundant errors due to a bias for making the same mistake throughout the entire complex head.
- Error rates are higher for less frequent verbs because the probablity of SFN (or OF) depends on the stability of representation of the involved element (SF, O) which is tied to its frequency.

Thanks

Thank you for your attention.

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Appendix A: Low error rates

Low error rates

Shouldn't low error rates simply be dismissed as 'noise'?

- Corpus-based spontaneous speech data has been argued to result in an underestimation of the error count (e.g. Maratsos 2000, Tomasello and Stahl 2004).
  $\Rightarrow$ Actual error rates may be expected to peak higher.
- Transcribers tend to correct errors (Pallaud 2002).
- Commission errors (including undercompression) in children's spontaneous speech are quite low in general (cf. Snyder 2007).
- They have informed models of grammar and of children's linguistic knowledge (see e.g. Pinker and Ullman 2002 for past tense; Sauerland et al. 2023 for antonyms; Rowland 2007, Rowland et al. 2005 for questions; Hein et al. 2022, Suh et al. 2013 for comparatives).

Appendix B: Proportion of error type within errors by verb

Redundant vs. distributive error proportion in all errors

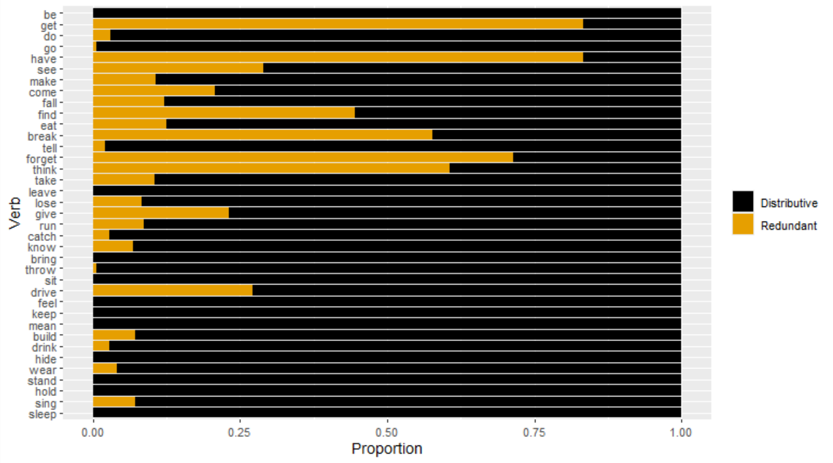
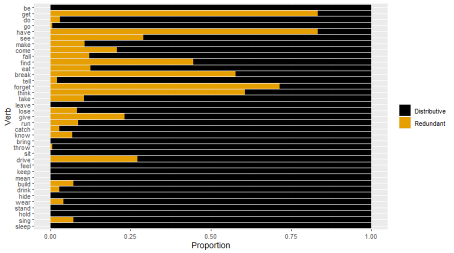


Figure 3: Proportion of distributive vs. redundant errors within all local errors by verb ordered by output frequency

Redundant vs. distributive error proportion in all errors



The more frequent a verb the higher the proportion of redundant errors within all errors ($p < .001$).[8]

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[8]Generalized linear mixed model with standardized log frequency as fixed effect, by-child and by-lemma varying intercepts: $\hat{\beta} = 1.0$, SE = 0.28, $z = 3.67$.

Redundant vs. distributive error proportion in all errors

Three ways one could think of this:

- This could simply be an artifact of the data.
- There might be an additional (possibly phonological) factor at play that skews the distribution towards redundant errors for the verbs in question.
- It might be possible that the consistency bias is not equally strong across all verbs but is relativized to each lexical verb such that it is weaker the more frequent a verb is.