Journal of Fluency Disorders 37 (2012) 314–324

Contents lists available at SciVerse ScienceDirect

Journal of Fluency Disorders

Past tense marking in the spontaneous speech of preschool children who do and do not stutter☆

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ARTICLE INFO

Article history:
Received 12 March 2011
Received in revised form 18 April 2012
Accepted 18 April 2012
Available online 26 April 2012

Keywords:
Stuttering
Verbs
Past tense
Language
Syntax

ABSTRACT

Purpose: The aim of this study was to identify whether different patterns of errors exist in irregular past-tense verbs in children who stutter (CWS) and children who do not stutter (CWNS).
Method: Spontaneous language samples of thirty-one age- and gender-matched pairs of children (total $N = 62$) between the ages of 24 months and 59 months were analyzed.
Results: Results indicated that children who do and do not stutter over-regularize irregular past-tense verbs (i.e., saying runned for ran) with comparable frequency. However, two nonsignificant trends which suggest possible intra-group differences were noted. First, irregular past tense verbs represented a greater portion of total verbs for CWS than for CWNS. Second, CWS appeared to double-mark (i.e., say ranned for ran) more often than CWNS. Results are discussed in light of theories about the acquisition of the irregular past-tense and about differences in language skills between CWS and CWNS.

Educational objectives: After reading this article, the reader will be able to: (a) summarize previous findings about connections between stuttering and language in CWS and CWNS; (b) describe similarities and differences between irregular past-tense verb use and errors in CWS and CWNS; (c) discuss possible connections between the declarative–procedural model and stuttering.

1. Introduction: language profiles of CWS and CWNS

The literature that has examined potential differences in language ability or use by children who stutter (CWS) and do not (CWNS) is not completely consistent in the identification of differences across areas of linguistic skill (see Bloodstein & Bernstein Ratner, 2008; Hall, Higgins, et al., 2007, for recent reviews). Analyses of standardized test data have shown lower, but still average-range, performance by CWS (e.g., Anderson & Conture, 2000; Anderson, Pellowski, & Conture, 2005; Bernstein Ratner & Silverman, 2000; Miles & Bernstein Ratner, 2001; Murray & Reed, 1977; Ryan, 2000; Silverman & Bernstein

☆ This research was supported in part by a grant from the National Institutes on Deafness and Other Communication Disorders (DC00559) awarded to the fourth author.
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http://dx.doi.org/10.1016/j.jfludis.2012.04.003

Ratner, 2002), or no difference in performance (Rommel, Häge, Kalehne, & Johanssen, 2000; Watkins & Johnson, 2004). Analyses of spontaneous language samples have shown less syntactic complexity among CWS (Silverman & Williams, 1968; St. Louis & Hinzman, 1988), or no difference between groups (Kadi-Hanifi & Howell, 1992). A separate set of investigations has found CWS to have "dissociations" between standardized test scores that exceed those seen in CWNS (Anderson et al., 2005; Coulter, Anderson, & Conture, 2009).

Experimental studies of people who stutter across the lifespan tend to show a variety of differences more consistently, including different lexical, semantic and syntactic priming effects (Anderson & Conture, 2004; Byrd, Conture, & Ohde, 2007; Hartfield & Conture, 2006; Melnick, Conture, & Ohde, 2003; Pellowski & Conture, 2005; Savage & Howell, 2008), and different neural responses during speech production (Beal et al., 2011) and to stimuli containing semantic and syntactic violations (Cuadrado & Weber-Fox, 2003; Weber-Fox & Hampton, 2008).

Research that has specifically targeted verbs, which carry the bulk of morphosyntactic information in a sentence (Gleitman, Cassidy, Nappa, Papafragou, & Trueswell, 2005), seems to more consistently find differences between the language of CWS and CWNS. These differences appear in the frequency of verb use in general, use of specific kinds of verbs, and in indices of organization of verbs in the mental lexicon. For example, CWS have been shown to use fewer verbs per utterance than do CWNS (St. Louis, Hinzman, & Hull, 1985). CWS have also been shown to use significantly fewer verbs overall and fewer different verbs than CWNS (Wagovich & Bernstein Ratner, 2007) and to use fewer copular verbs (Pawlowska, Brown, Redden, & Weber-Fox, 2008; Wagovich & Bernstein Ratner, 2007). With regard to lexical organization, CWS have benefited more on noun-naming tasks from priming with verbs, while CWNS benefit more from priming with other nouns (Hartfield & Conture, 2006). In spontaneous speech, verb phrase initiations appear to attract more stuttering events than do other sentence constituents (Bernstein, 1981).

Even in adults who stutter (AWS), research suggests that aspects of verb processing may be atypical when compared to findings from adults with typical fluency. Cuadrado and Weber-Fox (2003) found that AWS were less accurate in an online task to judge the grammaticality of visually presented sentences that contained verb agreement errors, and displayed atypical ERP responses. In a follow-up study using naturally spoken sentences, Weber-Fox and Hampton (2008) found that in AWS, verb agreement violations elicited biphasic ERP patterns characterized by a negativity (N400) typically elicited by semantic violations, and followed by a positive wave (P600), also known as a 'syntactic positive shift.' In contrast, the ERP patterns elicited in fluent adults were more specific, showing only an N400 for the semantic violation and only a P600 for the verb-agreement violation. Taken as a whole, these findings suggest subtle differences in the production and processing of verbs between CWS and CWNS.

Examination of past-tense inflection, a subtle feature of verb production, of CWS and CWNS might provide additional insight into potential differences in morphosyntactic organization between these two groups. One approach to understanding the mastery of past tense marking that could inform this question is provided by the declarative–procedural model (Ullman, 2004), which grew in part out of the dual-system model of past-tense formation (Pinker, 1991, in turn building on the work of Ervin, 1964).

The dual-system model posits that individuals retrieve irregular past-tense verbs directly from the lexicon (as frozen word representations), while they create regular past-tense verbs by performing morphosyntactic operations on the lexical entries for the root form. The declarative–procedural model builds on this concept by positing that different neural pathways are associated with lexical retrieval and with morphosyntactic operations, and that this distinction underlies a broader variety of linguistic operations. Specifically, the declarative–procedural model posits that lexical retrieval is served by temporal lobe regions and that morphosyntactic operations are served by frontal lobe regions and basal ganglia circuits.

The experimental work of Ullman et al. (e.g., Ullman & Gopnik, 1999) has provided evidence that the distinction between declarative/lexical memory and procedural/grammatical memory may play a role in distinguishing the language of individuals with specific language impairment (SLI) from those with typical language. Evidence for this distinction includes at least three findings. First, individuals with SLI do not regularize the past-tense forms of nonsense (nonce) verbs whose stems resemble irregular verbs (i.e. *crive* for *drive*) as frequently as individuals with typical language do; that is, they rarely produce "crived" when given the prompt, "Today he crives, yesterday he _____". Instead, they seem to attempt to form the past by referencing a similar-sounding irregular lexical item (*drove*). Thus, individuals with SLI produce nonce past-tense forms that resemble irregular forms (i.e., saying *crove* for the past-tense of *crive*) more frequently than individuals with typical language do. Thus, individuals with SLI are less likely than individuals with typical language to attempt to apply a morphosyntactic operation to a nonce verb, and more likely to treat it as a lexical item. Finally, the likelihood of individuals with SLI forming the past-tense form of a real regular verb correctly is in direct relationship with the number of regular-verb neighbors it has (other verbs sharing the same rime), a pattern not seen among individuals with typical language because, of course, mistakes in the regular past-tense are very rare beyond a certain age. That is, individuals with SLI appear to form the past tense based on lexical information, computing what is most "probable" based on their lexical knowledge, whereas individuals with typical language appear to form the past tense by applying morphological affixes directly without any interference from lexical knowledge. Theoretically, this may be because morphosyntactic operations, and the neural circuits underpinning them, are impaired in individuals with SLI, while lexical memory, and the neural circuits underpinning it, is relatively spared.

There are several reasons, following this model, to suspect that CWS might also rely excessively, if not as exclusively as individuals with SLI, on declarative memory circuits rather than procedural ones in performing morphosyntactic operations. First, there may be reason to posit some overlap of stuttering and SLI. Although CWS are not as a rule of thumb also children

with SLI, the presence of clear subsets of children with SLI with stuttering or other fluency disorders, and of CWS with frank language impairments, is clearly documented (Arndt & Healey, 2001). Additionally, CWS are generally found to have weaker syntactic skills on standardized tests and in experimental research than CWNS, although this does not reach the clinical level of concern associated with SLI (for discussion, see Ntourou, Conture, & Lipsey, 2011). Finally, significant impairment in nonword repetition appears to be present in both children with SLI and in CWS (Anderson, Wagovich, & Hall, 2006; Berman Hakim & Bernstein Ratner, 2004).

Second, as outlined above, Ullman (2004) has posited that the basal ganglia supports procedural memory and therefore plays a key role in applying morphosyntactic operations. The potential role of basal ganglia abnormalities in the motor component of stuttering has also been promisingly explored (Alm, 2004), leaving open the possibility of a role for these abnormalities to play in any subtle linguistic component, as well. Third, if it is the case that CWS rely more heavily on the lexicon than morphosyntactic operations for forming the past tense, this might explain several subtle differences between CWS and CWNS on lexical priming tasks and in verb use.

With regard to lexical priming tasks, if verbs in particular are over-represented in the lexicons of CWS because of double entries (stems and past-tense forms), this would explain the findings of Hartfield and Conture (2006) in their 3–5 year old children; CWS would be expected to benefit more from priming nouns with verbs, rather than other nouns, as is seen with CWNS. In addition, if CWS do have "double entries" for verbs, this may explain findings that CWS show less vocabulary diversity for verbs (Silverman & Bernstein Ratner, 2002[2]), and use fewer different verbs (Wagovich & Bernstein Ratner, 2007).

Finally, as noted, there is evidence from neurocognitive studies of adults that decreased ease of semantic integration (larger amplitude N400) and syntactic repair processes (larger amplitude P600) are concurrently activated in AWS to a degree not observed in adults who do not stutter (Weber-Fox & Hampton, 2008). Specifically, among most typical individuals who do not stutter, hearing a semantically implausible utterance selectively activates a particular event-related brain potential (ERP), called the N400, thought to index ease of lexical integration (Kutas & Federmeier, 2011). ERPs reveal electrical activity in the brain time-locked to stimulus processing. Similarly, hearing a syntactically implausible utterance often selectively activates another kind of brain wave, called the P600, thought to index syntactic repair for recovering the meaning of the sentence (Gouvea, Phillips, Kazanina, & Poeppel, 2010). AWS, however, showed a pattern in which hearing either kind of implausible utterance activated both ERP components resulting in a biphasic pattern; that is, syntactic/procedural processing seemed to activate decreased ease of lexical integration and declarative knowledge for AWS, while semantic processing seemed to also activate syntactic repair post-lexical processes.

If the declarative–procedural model can be applied to CWS this way, then CWS might be expected to demonstrate different profiles of irregular past-tense verb formation than CWNS. Little other research has addressed the question of tense-marking in CWS before. Although Bajaj (2007) found no significant difference between CWS and CWNS on measures of tense-marking accuracy, his analysis included present tense third person marking and obligatory use of auxiliary "be" and "do", in addition to the past tense, perhaps blurring any observable difference in past-tense formation alone. Watkins, Yairi, and Ambrose (1999) compared the accuracy of a small list of morphemes between persistent and recovered CWS at ages 3 years, 4 years, and 5 years, and found no significant differences between the groups or between either group and normative expectations, although it is interesting to note, in light of the ideas presented here, that the only behavior without enough instances to analyze was use of regular past-tense (*-ed*) in the youngest group of persistent CWS.

Because this kind of analysis has not been frequently employed, other differences besides the one posited here might also be expected to arise. These could include CWS′ and CWNS′ relative frequency of use of regular and irregular forms, or differing frequencies of different kinds of over-regularization, such as double marking (*droved* for *drove*) or use of the incorrect irregular form (a vowel change such as *thunk* for *think* instead of a full stem change as in *thought*).

Finally, given hypotheses raised by the dual-system and declarative procedural models, do very young CWS and CWNS differ in their over-regularization of irregular past-tense verbs? Although over-regularizations are sporadically produced by speakers throughout the lifespan as speech errors, the most frequent age range for observing them is in children through age five (Hartshorne & Ullman, 2006). Thus, we examine this behavior in the youngest cohorts of CWS available for analysis. Are there other differences in past-tense usage? The hypothesis is that CWS will over-regularize less often than CWNS because they may rely more heavily on lexical retrieval than morphosyntactic operations, potentially due to hypothesized basal ganglia abnormalities.

2. Methods

2.1. Participants

Because past-tense errors are rare in spontaneous language data, even from young children, we sought to combine data from as many comparable subjects as possible. The study to be described here is the first, to our knowledge, to utilize data-sharing from multiple sites to answer a question about language abilities of children who stutter.

[2] Silverman now published as Wagovich.

Table 1
Participant characteristics across studies.

Study	No. of pairs	No. of male pairs	No. of female pairs	Age range	CWS′ time since onset	CWS′ severity	SES data
Bernstein Ratner and Silverman (2000)	14	12	2	28–48 mos.	Average: 2.53 mos; max. 4 mos.	Average stuttering frequency: 9.5%	Matched for years of maternal education
Hall et al. (2007a,b); Wagovich and Hall (2007); Wagovich et al. (2009)	5	3	2	25–44 mos.	Average: 5 mos; max. 8 mos.	Minimum stuttering frequency: 3%; mild-to-moderate rating	Not matched for years of maternal education; all mothers had completed at least secondary
Pawlowska et al. (2008)	12	7	5	49–59 mos.		Minimum stuttering frequency: 3%; mild-to-moderate rating	Most pairs matched within 4 years of maternal education

Data from sixty-two child participants were considered in this investigation. Data were derived by combining data from several previous investigations. Participating children include four samples, reported in (a) Bernstein Ratner and Silverman (2000) and Silverman and Bernstein Ratner (2002); (b) Pawlowska et al. (2008); (c) Wagovich, Hall, and Clifford, (2009) and Wagovich and Hall (2007); and (d) Hall, Wagovich, et al. (2007).

Pairs of children were matched by gender and by age (within 3 months), leading to 21 male and 10 female pairs of children. CWS were on average 41 months old, with an age range of 25–59 months. CWNS also had an average age of 41 months, with an age range of 27–59 months. Stuttering was the only speech or language issue noted for all participants. Twenty-five of the 31 pairs were matched for maternal education. For the remaining children, maternal educational status was unknown.

Children in each study received additional language testing, including tests of expressive and receptive vocabulary (*Expressive One-Word Vocabulary Test*, Gardner, 2000; *Receptive One-Word Vocabulary Test*, Brownell, 2000; *Peabody Picture Vocabulary Test*, Dunn, Dunn, Robertson, & Eisenberg, 1981); and other tests administered to both CWS and CWNS in the individual studies. Given the original working hypotheses of the individual studies that contributed to this post hoc analysis, children with frank diagnoses of concomitant language impairment were excluded from these studies and our post hoc analyses. Brief subject details are provided in Table 1. For further details on the children whose language samples were analyzed in this study, consult the original study publications.

2.2. Sampling

Conversational language samples had been obtained from all children in a variety of quiet locations, including laboratory and home settings, with either toys or books available to facilitate conversation. The majority of samples were elicited with a parent as the child's conversational partner; depending on the source study, conversation in some cases was elicited by a clinician.

Conversations were video- and audio-recorded, then transcribed according to either *CHAT* (MacWhinney, 2000) or *SALT* (Miller & Iglesias, 2008) protocols. Full transcripts, on which reliability checks were made during the original studies, were available for analysis. SALT transcripts were converted to CHAT for unified lexical analyses.

2.3. Irregular past-tense errors

All utterances were inspected for verb use, and frequency counts of all lexical items were printed using the CLAN freq utility. Irregular past-tense verbs in each child's scored utterances were recorded in a spreadsheet. Past-tense forms of copular and auxiliary *be* (i.e., *was*, *were*) were excluded. Only the first use of each verb was recorded for each child's sample. The exception to this was if a child produced two different iterations of the same verb in a sample (such as using both "falled" and "fell"); in that case, each form was recorded once, because they represent different strategies of producing the target word. Double-marked forms such as *broked* were flagged for later analysis as they indicate a somewhat different kind of error than full over-regularization. Because there was a relatively small total number of past-tense forms in the 62 samples, and because some children did not use any irregular past-tense verbs, the groups' data were summed as total irregular-correct and total irregular-incorrect (including partially incorrect forms). A Fisher exact test was used to compare the four resulting data points.

An attempt was made to analyze errors in the groups' use of the regular past-tense, because the declarative–procedural model suggests there could be differences in this as well if CWS employ a different set of strategies in creating past tense forms. These errors, however, present real challenges for analysis. First, while errors in the irregular past-tense are generally obvious in a transcript, errors in the regular past-tense are not. If a child says "I eated" instead of "I ate", it is clear what has happened; namely, the child has applied a morphological rule where a simple lexical item should have been retrieved. If, however, the child says "I bake", it is not always clear that the child has failed to apply a morphological rule; the child

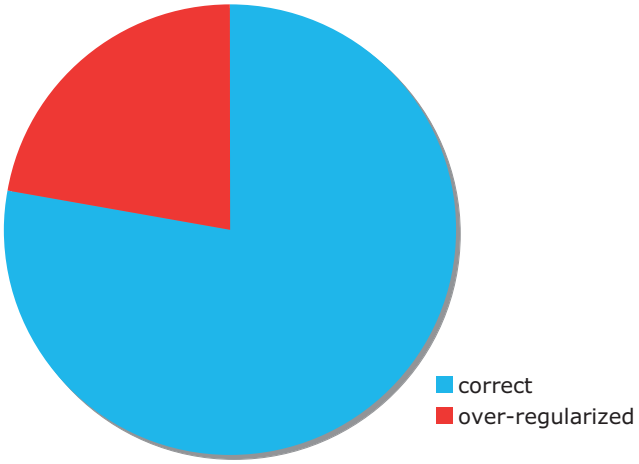

Fig. 1. CWS irregular past-tense correctness.

may instead have shifted the temporal context of the conversation. Contextual information often helps to resolve this issue, but it does not always do so clearly. Second, errors in the regular past tense in which *-ed* is not omitted but in which the child "over-irregularizes" (i.e., *I bade* for *I baked*, from an analogy with *make*/*made*), while potentially more obvious, are very low frequency and also potentially more likely to be coded by the transcriber as unintelligible words. For these reasons, the present study does not include analyses of regular past-tense errors.

Reliability was performed by having a second coder fully review 25% of all transcripts. Inter-rater agreement for coding of verb forms was 99%.

3. Results

3.1. Irregular past-tense errors

As a group, the CWS used 1280 total verbs, 24% of their 5353 total words. Of the verbs, 81 (6.3%) were irregular past-tense verbs. Of these irregular past-tense verbs, 62 (77%) were formed correctly and 19 (23%) were formed incorrectly.

As a group, the CWNS used 1611 verbs, 23% of their 7016 total words. Of the verbs, 74 (4.6%) were irregular past-tense verbs. Of these irregular past-tense verbs, 58 (78%) were formed correctly and 16 (22%) were formed incorrectly. A Fisher exact test comparing correct irregular past-tense forms and incorrect irregular past tense forms for both groups, as displayed in Figs. 1 and 2, fails to reach significance ($p = 1$). Fisher exact tests were used for analyses of past-tense verbs because the data fit into a contingency table (CWS vs. CWNS and correct vs. erred) and because sample sizes were small due to the low frequency of the behavior. A Fisher exact test was used instead of a chi-square test because of low cell values of the tested variables (Siegel, 1956).

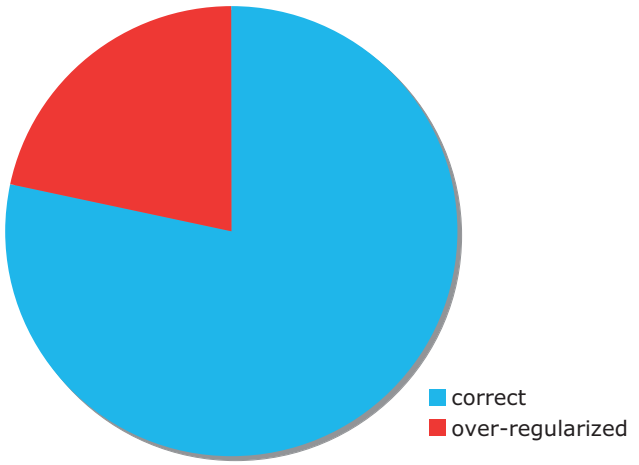

Fig. 2. CWNS irregular past-tense correctness.

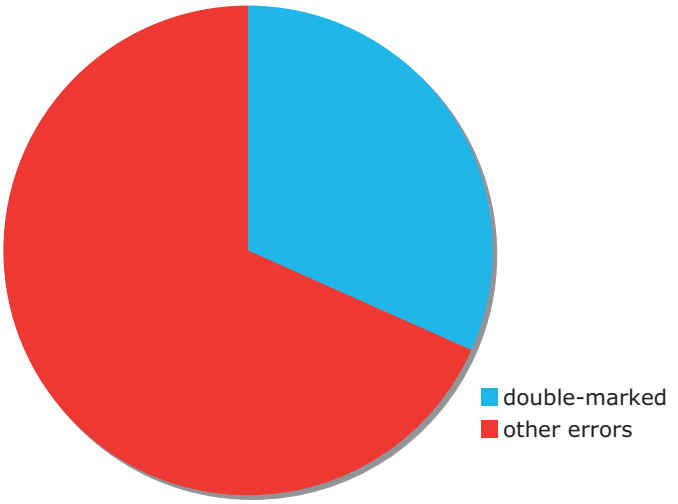

Fig. 3. CWS ratio of double-marked irregular past-tense to other irregular past-tense errors.

A trend of note within the incorrectly marked-forms is that CWS had more instances of double-marking of irregular past-tense forms, including instances with a stem change as well as a final morpheme (i.e., *broked*), and instances with two final morphemes (i.e., *falleded*). Of the 19 incorrectly formed irregular past tense forms in CWS′ transcripts, 6 (31.5%) were double-marked, with one instance each from three children and three from one child. Of the 16 incorrectly formed irregular past tense verbs in the CWNS′ transcripts, 1 (6.25%) was double-marked, meaning that only one CWNS made this sort of error. A Fisher exact test comparing the number of double-marking errors to all other errors (i.e., typical over-regularization) for the two groups, as displayed in Figs. 3 and 4, shows an observable trend, both for number of instances and number of children showing the behavior that does not reach significance ($p = 0.093$).

3.2. Irregular past-tense frequency of use

An additional finding of note in reviewing the data was that the two groups (CWS and CWNS) had a comparable number of occurrences of irregular past-tense forms, despite the fact that the CWS provided notably fewer verbs and words than the CWNS. Unique instances of correctly used irregular past-tense forms made up 4.9% of the verbs of CWS (63 out of 1280), but only 3.6% of the verbs of CWNS (58 out of 1611). A Fisher exact test comparing the number of correctly used irregular past-tense verbs with the number of all other verbs for each group, as displayed in Figs. 5 and 6, indicates that the difference approaches but does not reach significance ($p = 0.08$).

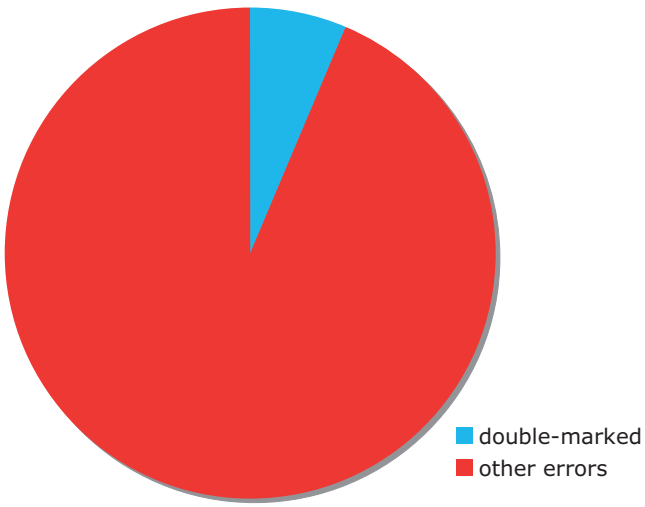

Fig. 4. CWNS ratio of double-marked irregular past-tense to other irregular past-tense errors.

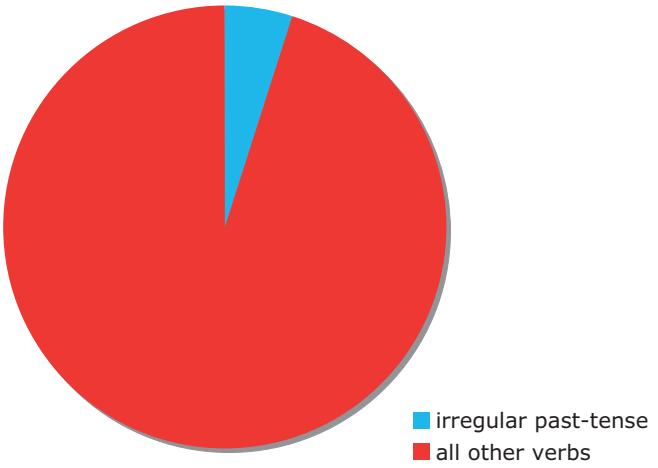

Fig. 5. CWS ratio of correctly used irregular past-tense verbs to all other verbs.

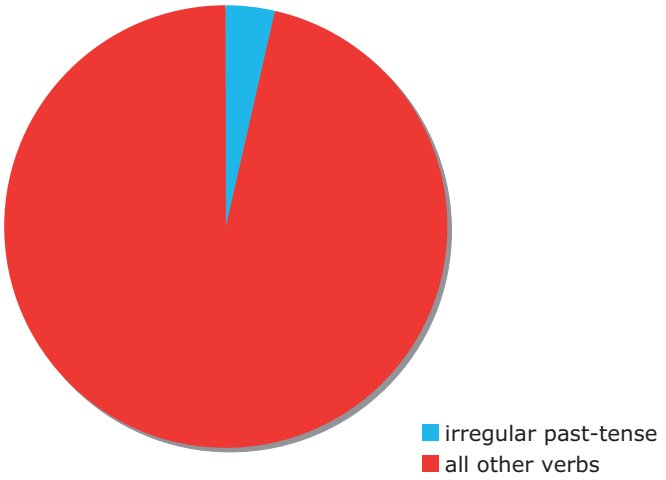

Fig. 6. CWNS ratio of correctly used irregular past-tense verbs to all other verbs.

4. Conclusions

4.1. Irregular past-tense errors and frequency of use

Contrary to our hypothesis, CWS do not over-regularize past-tense verbs less frequently than CWNS; there is no statistically significant difference in frequency between the groups in this regard. However, although results did not reach statistical significance, there was a slight trend for CWS to use double-marked irregular past-tense forms more frequently than CWNS. It is suspected that the lack of significance is the result of the extremely low frequency of the behavior, which limited the power of the analysis. Theoretically, double-marking suggests competition between two systems (declarative, lexical memory and procedural, grammatical operations) in placing morphemes. Although confirmation of our hypothesis that verb production is subtly impaired in CWS must await further confirmatory research, if such competition truly is more prevalent among CWS than CWNS, it seems plausible that the increased cognitive activity involved in deciding whether to place a morpheme or use lexical memory to form an irregular past-tense form could reduce overall cognitive efficiency, perhaps contributing to struggle in speech production. Thus, a hypothetical impairment in morphosyntactic skill during the earliest stages of grammatical development in children is not inconsistent with the onset or earliest manifestations of stuttering.

We utilized naturalistic data, which are subject to the children's ease and willingness to use certain past tense forms in conversation. One might predict that on an experimental protocol, such as that of Ullman and Gopnik (1999), which assesses individuals' performance on a set of real and nonce irregular and regular past-tense verbs, CWS might stutter more frequently on irregular past-tense forms and/or double-marked error forms than on regular past-tense forms and/or correct

forms. Unfortunately, the current set of corpora were not concurrently linked to media in such a way that we could conduct a reliable post hoc analysis of stuttering loci in this way.

In some ways, the relative (if marginal) prevalence of double-marking in the language of CWS compared to CWNS fits better into a potential overall language profile than a relative lack of over-regularization would. Lack of over-regularization is associated with SLI, and although there are reasons to wonder about a connection between the two disorders as discussed above, the language skills of CWS are clearly significantly above those of individuals with SLI. Unlike the potential for dysfunction in procedural memory seen in SLI, the trend seen in this corpus toward double-marking in CWS, if confirmed by future studies of larger corpora, experimental data, and work from languages other than English, is consistent with the hypothesis that both the declarative and procedural memory systems are functional, but improperly delegated to language tasks. This interpretation is further supported by the findings, in AWS, of decreased selectivity for P600 and N400 activation elicited by morphosyntactic errors (Weber-Fox & Hampton, 2008). Thus, our data, though only suggestive of production difficulties with morphosyntax in young CWS learning English, are quite consistent with very robust findings that AWS do not appear to process morphosyntactic errors in ways similar to processing seen in AWNS, and in fact show a small trend not to judge such errors as accurately as AWNS.

Another finding of note with regard to the irregular past-tense is that CWS appear to use these forms more frequently than CWNS. This may be in keeping with findings that the expressive language of CWS is characterized by lesser lexical diversity than that of CWNS (Silverman & Bernstein Ratner, 2002), since irregular past-tense forms are generally high-frequency words, presumed to be more easily retrieved from the mental lexicon.

However, CWS′ more frequent use of irregular past-tense verbs may also suggest a bias toward producing forms that can be pulled from lexical memory, rather than those that require morphological rule application. This is particularly intriguing since CWS have been noted to use another kind of verb with a different frequency than CWNS; namely, CWS have been shown to use copular forms less frequently than CWNS in Wagovich and Bernstein Ratner (2007) as well as in Pawlowska et al. (2008).[3]

This is perhaps surprising because, in the declarative–procedural model, both copulas and the irregular past-tense are posited to be "pulled" from lexical memory systems. One potential explanation is that copulas (*is*, *am*, *are*, *was*, *were*) are more "purely" held in lexical memory; they bear so little resemblance to their root "be" that there is little role for procedural memory systems to play in their production. Irregular past-tense forms, however, generally bear a set of relationships to their root forms; it is conceivable that, if a linguistic system is biased toward competition between the two memory systems, irregular past-tense verbs would be uniquely prone to production. Previous findings of simultaneous N400 and P600 activation for PWS (Weber-Fox & Hampton, 2008), combined with findings in this study of a trend toward more frequent double-marking of irregular past-tense forms and a strong association between performance on lexical standardized tests and syntactic complexity, suggest that the linguistic systems of CWS may in fact have such a bias.

It has been observed that over-regularization of past-tense forms can be influenced by phonological attributes of the verb stem:both typically developing children and children with SLI (Marshall & van der Lely, in press) appear to be more likely to over-regularize verb stems ending in vowels (e.g., *doed* vs. *hide*). Post hoc inspection of our data did not reveal distributional differences among the groups of children in the phonological characteristics of the root forms used in the conversational samples used in our analyses. In fact, the vast majority of errors were for words ending in stop consonants (e.g., *breaked*, *hitted*) and liquids (*falled*, *falded*; *telled*).

5. Limitations

The potential limitations of this study include the diverse sources of participants and the hand-scoring methods used. With regard to the first of these issues, efforts were made to assure rough comparability of participant backgrounds. For example, all participants were monolingual English speakers, and were roughly matched with regard to SES within each study that contributed samples for analysis. Additionally, participants from two of the three datasets had overlapping age ranges (i.e., 28–48 months and 25–44 months), whereas participants from the third dataset were slightly older (i.e., 49–59 months).

With regard to hand-scoring, efforts were made to assure the validity and reliability of past-tense verb counts. These included double-checking of data and inter-rater reliability scoring of 25% of the transcripts. Additionally, pairs were always scored at the same time, thus assuring that any learning or fatigue effects would not differentially affect the CWS or CWNS. However, there is inherent risk of some error in any hand-scored procedure. This method was chosen over automated methods because automated searches to count irregular past tense verbs would fail to catch some of the double-marked forms noted and would fail to distinguish between some forms with non-past tense meanings (i.e. "got" to mean "have", "did" as an auxiliary verb). Given these factors, the limitations of hand-scoring were felt to be fewer than the limitations of automated scoring.

[3] This pattern was also observed in a post hoc analysis of the present, larger dataset, which included the samples from the two aforementioned studies; developmental sentence scoring (DSS; Lee & Canter, 1971) was completed for all samples of the present study. A Fisher exact test with 292 copulas and 988 other verbs for CWS, and with 456 copulas and 1155 other verbs for CWNS shows this distribution to be significantly different at $p = 0.00085$.

6. Directions for future research

The findings of a subtle trend toward more frequent use of double-marking forms among CWS relative to CWNS suggest the potential value of future experimental work exploring past-tense marking in a more controlled fashion than language sampling allows. For example, sentence completion tasks eliciting irregular past-tense forms would allow differences in double-marking to be further explored. Additionally, verb-naming tasks that could elicit either an irregular past-tense or a regular past-tense form might provide additional insight into the differences in frequency of use of the two forms between CWS and CWNS. Analyses in both cases would need to control for the overall greater frequency of irregular past-tense forms as opposed to most of their regular past-tense synonyms. Ullman and Gopnik (1999) provide a protocol controlling for this factor. Ullman and Gopnik's (1999) protocol also provides guidance in controlling for the potential interactions between irregular verbs and their regular verb neighbors (i.e., *fly* with irregular past-tense *flew* has neighbors *cry* and *die* with regular past tense forms).

Languages other than English, which is morphosyntactically impoverished, would also be particularly valuable for exploring irregular verb-marking in CWS. German, for example, has many more verbs which take an irregular past-tense form than does English, and Romance languages have several verbs which take irregular forms in the present tense as well as the past tense.

Whether in English or another language, any grammatical rule that has exceptions creating an "irregular" category can test the notion that CWS, like children with SLI, appear to be more likely to use lexical memory rather than morphological operations, or appear to apply both strategies to the same form more frequently than CWNS. One example in English is the case of irregular plurals (*one foot*, *many feet*, etc.). An attempt was made to observe differences in use of the irregular plural in the transcripts discussed here; the number of instances, however, was too few for analysis.

The original working hypotheses of the studies that contributed data to the current post hoc analysis necessitated that children with frank concomitant diagnoses of SLI or other language disorder be excluded from the sample. However, it should be noted that concomitant diagnoses of language impairment appear to be common in children who stutter (Arndt & Healey, 2001). Similarly, children who make frequent morphosyntactic errors in English (which has relatively sparse morphosyntax) would be more likely to carry such a diagnosis, and perform poorly on some of the screening instruments used in the individual contributing studies.

To our knowledge, this is the first effort to combine individual study samples of CWS across research laboratories to explore a low-incidence phenomenon in children's spontaneous language. The CHILDES Project (MacWhinney & Snow, 1985) was established exactly for this type of purpose, and has already been exploited to find patterns of children's language skill development that would not be possible in smaller, individual studies (see the CHILDES Project bibliography, 2010; Marcus et al., 1992, which examined the same behaviors studied in the current report with typically developing children). Given the long history of research in stuttering that has utilized spontaneous language samples from CWS and AWS in order to determine relative language skill and the influences of sentence formulation factors on the frequency and loci of stuttering behaviors, a more formal data archiving initiative in the field of fluency may be timely. Howell et al. have initiated such a venture (Howell, Davis, & Bartrip, 2009); larger scale initiatives containing data from multiple labs would further extend the utility of such data "banks", as would development of conventions for transcription and subject assessment/description to assure fidelity across contributions. The data from the current study were transcribed using two different conventions (SALT vs. CLAN); although both systems share inport/export "translations", a single platform, and unified conventions for data collection and transcription would facilitate future work.

In sum, this study found subtle differences in the usage frequency and error patterns of the irregular past tense in CWS and CWNS. Specifically, there was a slight trend for CWS to use irregular past-tense forms more frequently than CWNS, and there was also a trend for CWS to double-mark these forms more frequently than CWNS. These findings, in turn, can also be seen as supporting the possibility of atypical simultaneous use of declarative and procedural memory systems for morphosyntactic operations in CWS, even though not all the children learning English included in our study showed these patterns.

CONTINUING EDUCATION

Past tense marking in the spontaneous speech of preschool children who do and do not stutter

QUESTIONS

1. Past research into differences in verb usage between CWS and CWNS
   a. suggests CWS use more verbs than CWNS
   b. *suggests CWS use fewer verbs than CWNS
   c. suggests CWS use verb tense more accurately than CWNS
   d. suggests CWS use verb tense less accurately than CWNS
   e. suggests CWS use subject–verb agreement differently from CWNS

2. The declarative–procedural model states, roughly, that
   a. *lexical knowledge is held in declarative memory, and morpho-syntactic performance is served by procedural memory
   b. syntactic performance is held in declarative memory, and lexical knowledge is served by procedural memory
   c. lexical knowledge is served by declarative and procedural memory together
   d. syntactic performance is served by declarative and procedural memory together
   e. people with typical language and people with SLI probably use the two memory systems comparably
3. The results of this study show that
   a. *CWS make irregular past-tense errors more often than CWNS
   b. CWS make irregular past-tense errors less often than CWNS
   c. CWS make irregular past-tense errors as often as CWNS
   d. CWS and CWNS both produce irregular past-tense errors more than 30% of the time
   e. CWS make errors on different kinds of irregular past-tense verbs than CWNS
4. The findings of this study showed that double-marking
   a. occurred equally often in the errors of CWS and CWNS
   b. tended to occur more often in the errors of CWNS than CWS
   c. did not occur in any language sample from a CWNS
   d. *tended to occur more often in the errors of CWS than CWNS
   e. occurred in half of the CWS's language samples
5. According to the article, double-marking may be significant because it may
   a. be easier for a clinician to observe than a typical error in the irregular past-tense
   b. indicate greater syntactic knowledge than a typical error of the irregular past-tense
   c. co-occur with other forms of repetition in speech and language
   d. *represent the application of both declarative and procedural memory systems where one or the other would typically suffice
   e. indicate less syntactic knowledge than a typical error of the irregular past-tense

Acknowledgments

Research by Pawlowska et al. (2008) supported by a grant from the National Institutes on Deafness and other Communication Disorders (DC00559).

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