Phonological Processing of Young Children Who Stutter: Preliminary Behavioral/ERP Findings

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ABSTRACT

The purpose of this study was to extend Byrd, Conture, and Ohde's (in press) empirical assessment of behavioral effects of holistic/ incremental phonological priming on picture naming in children who stutter (CWS) and do not stutter (CWNS) by also employing electrophysiological (event-related potential, ERP) measures.

Participants were preschool-age CWS as well as age- and gender-matched CWNS split into two age groups, younger (39-50 months) and older (56-71 months).

Preliminary findings indicate that CWS rely more on holistic (word-like) compared to incremental (sound-like) processing and neutral primes than CWNS during picture naming.

Holistic processing is thought to be a less mature, efficient means of processing and as such may contribute to the difficulties CWS have establishing normally fluent speech-language production.

INTRODUCTION

Phonology and Childhood Stuttering

- Survey of 1184 SLPs revealed (across 46 USA states)
  - 33.5% of CWS had articulation disorders
  - 12.7% of CWS had phonological disorders (Blood, Ridenour, Qualls, & Hammer, 2003).
- Persistent CWS more delayed in phonology compared to spontaneously recovering CWS (Paden & Yairi, 1996; Paden, Yairi, and Ambrose,1999).
- CWS encode phonological information in a subtly different manner than CWNS (e.g., Melnick, Conture, & Ohde, 2003).

Incremental vs. Holistic Processing (Byrd, Conture & Ohde, in press)

- Both 3- year old CWS and CWNS were fastest with holistic (word-like) primes.
- However, by 5 years of age, CWNS are fastest when presented with incremental (sound-like) primes whereas CWS remained fastest with holistic primes.
- Therefore, CWS appear to be delayed in establishing more mature/advanced phonological encoding processes.

PURPOSE

The purpose of this study was to compare neural (i.e., ERP recordings) with behavioral correlates of picture-naming accuracy and latency associated with holistic and incremental phonological processing during a controlled picture-naming task.

METHOD

Participants

- 12 CWS and 12 CWNS were divided into two age groups; young (39-50 months) and old (56-71 months).
- To date, 3 of the 12 preschool CWS studied received speech-language treatment for their stuttering (between 3 to 12 months duration).

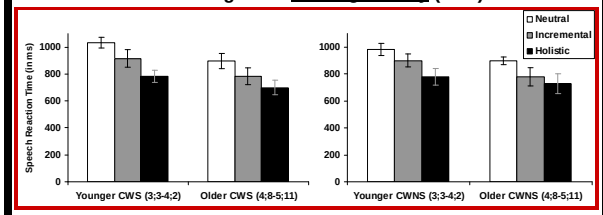
Measures

Picture-Naming Task (Byrd, Conture & Ohde, in press)

- Three prime conditions:
  1) Holistic: Almost the entire target word (e.g., "ed" prior to seeing the picture "bed").
  2) Incremental: Onset of target word (e.g., "buh" prior to seeing the picture "bed").
  3) Neutral: A pure tone beep.
- Speech reaction times (SRTs) - based on *fluent*, accurate productions.
- Naming errors - speech sound misarticulations, mislabelings, non-responses, and off-task behaviors, based on fluent responses.
- Event-related potentials (ERPs), during 700 ms epochs associated with *fluent*, accurate productions were obtained using 128-electrode geodesic sensor nets.

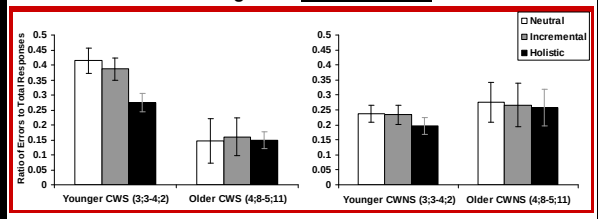
RESULTS

Figure 1: Naming latency (SRT)



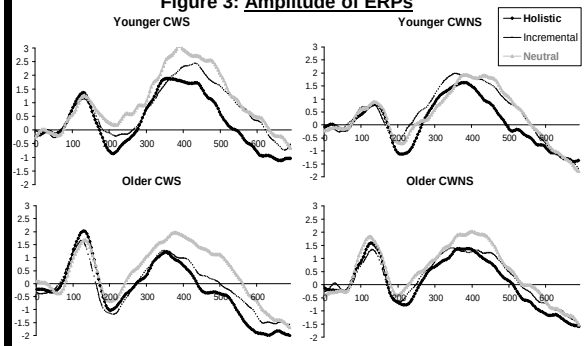
- Main effect of prime type for CWS ($p < .0001$) and CWNS ($p<.05$). No statistically significant interaction effects.

Figure 2: Naming Errors



- Main effect of prime type for CWS ($p<.01$), but not for CWNS.
- Prime type X Age interaction for CWS ($p<.01$), but not for CWNS. Younger CWS more accurate in holistic than neutral ($p<.01$) and incremental ($p<.05$).

Figure 3: Amplitude of ERPs



- *ERP amplitude for younger* children:
  - Differs very little between *incremental* and *neutral*.
  - Differs between holistic and *incremental* or holistic and *neutral*.
  - These differences appear stronger for younger CWS than younger CWNS, suggesting a less mature pattern for CWS.

RESULTS

DISCUSSION

There were four main findings, summarized below:

- ***First main finding*** : All children - whether CWS, CWNS, younger or older - named pictures faster given holistic compared to incremental and neutral primes.
- ***Implication***: Picture-naming speed of preschool children is facilitated by holistic priming, suggesting they process, in terms of naming speed, in a less well-developed ("holistic") way.
- ***Second main finding***: Younger CWS, were ***more accurate*** in holistic compared to incremental and neutral conditions than either older CWS or either age group CWNS.
- ***Implication***: Picture-naming accuracy of younger CWS is facilitated by holistic priming, suggesting they process, in terms of accuracy, in a less well developed ("holistic") way.

DISCUSSION

- ***Third main finding:*** Younger CWS, in particular, had ***lower ERP amplitudes*** in the holistic compared to the incremental and neutral conditions.
- ***Implication***: For younger children, especially younger CWS, less cognitive-linguistic effort is required given holistic primes, suggesting they phonologically process using this less mature strategy.
- ***Fourth main finding***: Older CWS, but not older CWNS, had ***lower ERP amplitudes*** during holistic *and* incremental compared to neutral primes. Older CWNS show greater ERP amplitudes in given *holistic* versus *incremental* primes.
- ***Implication***: Older CWS *continue* to holistically process but *begin* to incrementally process, suggesting a shift towards incremental processing, even though this shift occurs *later* than would be developmentally expected.

In contrast, older CWNS *begin* to *increase* cognitive-linguistic effort during holistic primes, suggesting they are further along in their shift *away* from holistic processing than older CWS.

CONCLUSION

Preliminary findings are consistent with Byrd et al. (in press) and suggest that preschool CWS phonologically encode differently than CWNS, using a less efficient, less mature means of phonological encoding than CWNS.

This method of phonological processing, which is not well matched to the increasing cognitive, linguistic, and motoric conversational requirements CWS face as they develop, may contribute to difficulties they have establishing reasonably fluent speech-language production.

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