A Comparison of Behavioral Measures of Processing Load in Children

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HEaring Across the Lifespan
June 2, 2016
Some Definitions

**Effort** is the deliberate allocation of resources to overcome obstacles when carrying out a task (Pichora-Fuller et al., in press).

**Listening effort** is a specific form of *mental* effort that occurs when a task involves listening (Pichora-Fuller et al., in press).

Can be quantified subjectively, behaviorally, or physiologically.

**Processing load** is the magnitude of mental effort applied during a task.

May vary based on task-imposed demands as well as the motivation and available resources of the listener.
Measuring Processing Load

- Speech response-times
  - McCreery & Stelmachowicz, 2013
  - Gustafson et al., 2014

- Dual-task paradigms
  - Picou & Rickets, 2014
  - Hicks & Tharpe, 2002

- Physiological measures
  - Mackersie & Cones, 2011
  - Zekveld et al., 2010

- Memory tasks
  - Amichetti et al., 2013
Expectations

Speech Response-Times

– Latency of word recall is larger when task demands are increased by increasing noise levels

Dual-Task Paradigms

– Primary Task performance (words correct) remains the same in single- and dual-task conditions
– Latency of the secondary task response (RT) increases from single- to dual-task conditions
  • RT is further delayed when task demands are increased by increasing noise levels
The purpose of this study was to compare two measures of processing load (Speech Response-Time and Dual-Task Paradigm) in school-age children to examine the effects of listening difficulty within each method.
Participants

37 children with normal hearing

Thresholds ≤15 dB HL from 250-8000 Hz
6.0 to 12.92 years of age (M = 8.92, SD = 2.22)

Dual-Task Paradigm

Primary Task: Recognition of Isophonemic AB word lists

+4, 0, -4 dB SNR in multi-talker babble (Boothroyd, 2008)

Secondary Task: Visual monitoring task
Measures of Processing Load

**Speech Response-Time**

**Vocal RT** using the primary task (word recognition)
- Time elapsed from onset of stimulus to onset of response

**Dual-Task Paradigm**

**Visual RT** using a dual-task paradigm
- Time elapsed from flash to button press
- Percent change  = 100 * dual task − single task
  
  single task
Results: Word Recognition

No difference in word recognition performance between single- and dual-task conditions (p=.445)

Performance significantly reduced with each increase in noise level (p<.001)
Results: Speech Response-Time

Vocal RT was longer in more difficult SNR conditions (p<.001).
Results: Dual-Task Paradigm

Visual RT was significantly longer in dual-task condition compared to single-task condition (p<.001).

No significant percent change in Visual RT as SNR became poorer (p=.893).
Conclusions

When demands on task completion were increased by worsening the SNR, children showed increases in processing load as measured by the Speech Response-Time method but not the Dual-Task Paradigm.
Discussion & Future Directions

• Correct vs Incorrect Responses
• Secondary Task Difficulty
  – Picou & Ricketts (2014)
    • Simple vs Semantic processing
  – Howard, Munro, & Plack (2010)
    • Memory-based
• Up next: children with hearing loss
Acknowledgements

• Faculty Investigators
  - Fred H. Bess
  - Stephen Camarata
  - Ben W. Y. Hornsby
  - Alexandra Key

• Previous & Current Lab Members
  - Nicholas Bennett
  - Angela Chen
  - Hilary Davis
  - Tonia Davis
  - Stone Dawson
  - Andy DeLong
  - Caralie Focht
  - Emily Fustos
  - Elizabeth Geller
  - Olivia Gutierrez
  - Amanda Headley
  - Dorita Jones
  - Ralph Leverett
  - Lindsey Rentmeester
  - Quela Royster
  - Rebecca Schoon
  - Sara Seckman
  - Amelia Shuster
  - Beth Suba
  - Krystal Werfel

• Project/Staff Funding
  - Institute of Education Sciences, U.S. Department of Education through grant R324A110266 (Bess, PI) to Vanderbilt University
  - Dan and Margaret Maddox Charitable Trust

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