Executive Functions as Predictors of Classroom Listening Skills

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Purpose

The purpose of this study was to determine if **executive functions,** including **working memory**, are predictors of **spoken language processing skills** (or "listening skills") in the classroom, as measured by the Children's Auditory Performance Scale (CHAPS).

Background

- The *Children's Auditory Performance Scale* (CHAPS; Smoski, Brunt, & Tannahill, 1992) is a teacher-completed survey of a child's classroom "listening skills" in various conditions (e.g, in background noise, or when sustained attention is required).

- It is often used as a screening tool for auditory processing disorders; however, recent research has shown that the CHAPS is not a particularly strong predictor of performance on auditory processing tests (e.g., Competing Sentences and Low Pass Filtered Speech) (Wilson et al., 2011).

- Executive functions skills, such as working memory and the ability to initiate actions, plan, organize, inhibit, and self-monitor are believed to play an important part in classroom success (e.g., Alloway, Gathercole, Kirkwood and Elliott, 2009). Classroom listening skills measured by the CHAPS may be related to these cognitive skills. If so, measures of executive function should be related to the CHAPS.
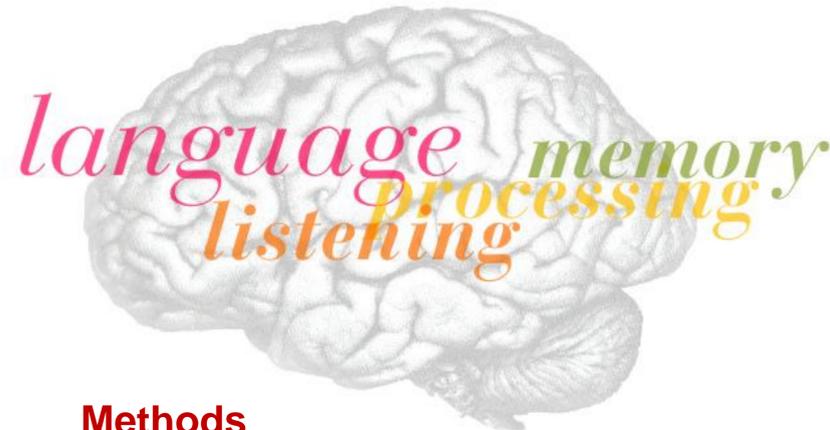
Methods

- Data were collected by file review from the clinical records of children and adolescents who were referred to our university clinic for a comprehensive auditory/language processing assessment . Only those children with both CHAPS and (Teacher) BRIEF records were included (n=57; average age = 10.08 yr). The study was approved by the Committee on the Protection of Human Subjects.

- Executive functions were measured by the *Behavior Rating Inventory of Executive Functions* – Teacher form (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000). The BRIEF is a norm-referenced tool considered to be a reliable and valid measure of executive functions in real-life settings (Baron, 2000).

- Classroom listening skills were measured by the CHAPS (Smoski et al., 1992).

- A stepwise linear regression was performed using SPSS for Windows 16.0. Alpha level set at .05. Independent (or predictor) variables were subscale scores (T-scores) from the Teacher forms of the BRIEF. The criterion variable (dependent variable) was the Total Condition score. Missing data were deleted pairwise. Descriptive statistics were also used to make comparisons and describe the data.

Results

- One tailed t-tests showed that **these subjects have significantly more executive dysfunction** than average (p<0005) (average Global Executive T-Score from the BRIEF = 63.59 (almost 1 standard deviation from the mean); their **language scores are significantly lower than average** (p<.0005) (average Core Language score on CELF-4 = 88.42).

- Pearson **correlations revealed that classroom listening skills, as measured by the CHAPS, were significantly correlated with all the executive functions** measured by the BRIEF (except Emotional Control; see table below).

Pearson Correlations Among Variables	BRIEF Inhibit	BRIEF Shift	BRIEF Emotional Control	BRIEF Initiate	BRIEF Working Memory	BRIEF Planning/ Organizin	BRIEF Organiza. Materials	BRIEF Monitor
BRIEF Inhibit	-							
BRIEF Shift	.398(**)	-						
BRIEF Emot. Control	.429(**)	.747(**)	-					
BRIEF Initiate	.548(**)	.551(**)	.431(**)	-				
BRIEF Working Memory	.517(**)	.506(**)	.339(**)	.824(**)	-			
BRIEF Planning/ Organizing	.663(**)	.592(**)	.410(**)	.772(**)	.792(**)	-		
BRIEF Organiza. Materials	.639(**)	.451(**)	.408(**)	.575(**)	.639(**)	.753(**)	-	
BRIEF Monitor	.882(**)	.532(**)	.504(**)	.707(**)	.653(**)	.771(**)	.621(**)	-
CHAPS Total	**-.265(*)**	**-.267(*)**	**-.064**	**-.348(**)**	**-.418(**)**	**-.389(**)**	**-.304(*)**	**-.314(***

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

- **Working Memory emerged as the only significant predictor of CHAPS scores** in the regression analysis: R^2 = .174, R^2 adj= .158, F (1, 51) = 10.7, p < .005 (using the stepwise method).* No other variables or combinations of variables were identified as being predictive of listening skills, as measured by the CHAPS. The significant predictor, however, only accounts for 17% of the variance in CHAPS scores, as indicated by the R Square value.

[*To ensure the results were not influenced by multicollinearity, the regression was run again using the composite BRIEF scores (Metacognitive Index and Behavioral Regulation Index.) Results were that the Metacognitive Index alone, which includes Working Memory, was a significant predictor for CHAPS scores. (p<.05).]

Summary and Discussion

- **The study shows that executive dysfunctions are correlated with classroom listening problems, as measured by the CHAPS. Working Memory, in particular, was highly correlated and was a significant predictor of CHAPS scores.**

- Wilson et al. (2011) found that CHAPS scores were not correlated with any of the 8 diagnostic auditory processing tests they investigated (low pass filtered speech, etc.). Our findings suggest that classroom listening skills, as measured by the CHAPS, may be related to executive dysfunction.

- On the other hand, while statistically significant, the Working Memory scores from the BRIEF did not explain a great deal of the variance in CHAPS scores (17%), but this is in line with other studies of cognitive influences on auditory processing (see Iliadou & Bamiou, 2012, for a review).

- Listening is a complex task, and cannot likely be easily explained by any one variable, such as language competence, auditory processing, working memory, or overall executive dysfunction.

- For children with apparent listening difficulties, comprehensive and multidisciplinary assessment is essential, and should include measures of executive functions (particularly working memory), in addition to language and auditory processing.

- The results further underscore the need for better professional consensus on the nature and definition of auditory processing and "listening skills."

Executive functions (EFs)

"allow us to organize our behavior over time and override immediate demands in favor of longer-term goals"
(Dawson & Guare, 2004, p.1).

BRIEF Behavior Regulation Index (BRI)
- Inhibiting impulses
- Shifting attention
- Maintaining emotional control

BRIEF Metacognitive Index (MI)
- Initiating actions
- Working memory
- Planning/organization
- Organization of materials
- Self monitoring

CHAPS Listening Conditions
- Noise
- Quiet
- Ideal Conditions
- With Multiple Inputs
- Auditory Memory Sequencing
- Auditory Attention Span

Total Condition Score
Total Average Condition Score

Study Limitations:
- Heterogeneous sample
- Young sample
- Relatively small sample

Future Research:
- Investigate the relative contributions of cognition, language, and auditory processing on listening skills.

- Investigate subscale scores on CHAPS in addition to Total scores.

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Disclosure: The authors are employed by Plattsburgh State University of New York.