Critical Review:
Does Fast ForWord Improve Language Outcomes in School-Age Children with Language Impairment?

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This critical review examines the effectiveness of Fast ForWord (FFW) as an intervention for school-age children with language impairment. Studies evaluated include one systematic meta-analysis, four randomized controlled trials, and two single subject 'n-of-1' studies. Overall, available research findings do not support the use of FFW with school-age children with language impairments as an effective intervention for language. Clinical implications and recommendations for future research are also discussed.

Introduction

Language impairment, or difficulty learning and using language, can occur in isolation or with other disorders. In isolation, specific language impairment occurs in 7% of school-age children, however, when comorbid with other disorders, occurs with a much greater prevalence (Tomblin, Records, & Zhang, 1996). This difficulty has been documented to manifest in social, academic, and vocational difficulties across the lifespan (Brinton, Spackman, Fukiki, & Ricks, 2007; Catts, Fey, Tomblin, & Zhang, 2002; Clegg, Hollis, Mawhood, & Rutter, 2005). There are several proposed mechanisms leading to this difficulty, one of which consists of a perceptual processing difficulty. Tallal et al. have proposed that children with language impairment are slower to process auditory information than typically developing peers, and are at a disadvantage when discriminating dynamic temporally cued spectral components such as formant transitions (Tallal, 1976).

Fast ForWord-Language (FFW) is a suite of computer activities for children aged 4-14 designed to improve cognitive skills that children need to improve language and reading (What Works Clearinghouse, 2006). The programs are based on Tallal's (1976) perceptual processing hypothesis. The developers of the FFW program assert that the program leads to neural reorganization that causes an increased ability to perceive fast-changing acoustic input. This improvement is said to lead to to subsequent gains of 1 to 1.5 years on standardized tests of language skills after 6 weeks of training (Merzenich, Jenkin, Johnson, Scheiner, Miller, & Tallal, 1996; Tallal et al, 1996).

Fast ForWord was launched commercially in 1997, and is now used in many schools and clinics internationally to treat language and reading skills (Strong et al, 2011). In a study by What Works Clearinghouse (2007), it was estimated that Fast ForWord has been used by over 570,000 children in more than 3,700 schools in the US. A critical review of existing literature investigating the effectiveness of FFW is necessary given its widespread use and claims of significant language gains.

Objectives

The primary objective of this paper was to critically evaluate existing literature regarding the effectiveness of FFW as a treatment for school age children with language impairment. The secondary objective was to provide evidence-based practice recommendations to speech-language pathologists and other professionals who are providing language intervention to school-age children with language impairment.

Methods

Search Strategy

Computerized databases, including PubMed, PsycINFO, and CINAHL were searched using the following search strategy: ((Fast ForWord) AND ((Language) AND (Language Impairment) OR (Language Disorder).
The search was limited to articles written in English.

Selection Criteria

Studies selected for inclusion in this critical review paper were required to investigate the impact of Fast ForWord on any language measures in school-age children with a language disorder or delay. The language outcomes needed to measure a specific area of language. Studies measuring phonological awareness and reading outcomes were only included if they also contained a measure of language. The populations included were either labeled as having a language delay, disorder, or impairment by a speech-language pathologist, or defined by performance at least 1.5 standard deviations below the mean on a standardized test of language skills.

Data Collection

Results of the literature search yielded the following types of articles: systematic meta analysis (1), randomized control trial (RCT) (4), and single-subject 'n-of-1' (2).

Results

Meta-Analysis

A meta-analysis provides a thorough examination of a number of valid studies and combines the results using accepted statistical methodology as if they were one large study. Meta-analysis is sometimes considered the top form of evidence because it includes critical appraisal of studies selected for analysis.

Strong, Torgerson, Torgerson, and Hulme (2011) conducted a systematic review and meta-analysis of evidence investigating the efficacy of Fast ForWord as a treatment for child oral language and reading. The included studies were all randomized control trials with sample sizes ranging from 60-454 participants. A series of eight meta-analyses were conducted comparing the FFW intervention group with a) untreated controls and b) active controls receiving an alternative treatment. Appropriate analysis of Cohen's *d* revealed no improvement for the FFW treatment group compared to controls. The authors concluded that there was no evidence from the review that the FFW program is effective as a treatment for child language difficulties.

Strong et al. (2011) clearly described their inclusion and search strategy and provided a detailed description of the participants, design and setting, intervention treatment, control treatment, and outcome measures of all studies that were included for review. The data was extracted by two reviewers who worked independently, and the review protocol was well documented.

Strong et al. (2011) present strong, top-level evidence in their meta-analytic review of well-designed randomized controlled trials. This review provides compelling evidence that the existing literature does not document effects of great enough magnitude to result in improved language outcomes in children with language impairment.

Randomized Controlled Trials

Randomized controlled trials (RCT) are carefully planned projects that study the effect of a therapy while including methodologies that reduce the potential for bias and allow for comparison between intervention groups and control groups. They may be susceptible to bias if a considerable proportion of outcome data are missing.

Gillam et al. (2008) conducted a mixed-model randomized controlled trial investigating the efficacy of FFW as an intervention for children with language impairment. Their study compared language outcomes of 216 children between ages 6 and 9 who had language impairments. Children were randomly assigned to one of four intervention groups: a) FFW, b) a computer assisted language intervention (CALI), c) academic enrichment (AE), or d) individual language intervention with a speech-language pathologist (ILI). All children received the same intervention schedule (1hr, 40 mins/week for 6 weeks).

The primary language outcome measure was a well-accepted standardized measure of expressive and receptive language skills. Gains were made for all conditions, however, appropriate ANOVA analysis revealed no difference in language gains between conditions. The investigators preserved randomization by performing an intent to treat analysis. Authors concluded that the FFW program was no more effective at improving general language skills than the comparison interventions.

Gillam et al's study presents a strong design in terms of randomization of participants and control of factors. Rigorous selection criteria are described in the study. As well, they provide a detailed description of the participant characteristics and randomization process, which used stratified randomization to help ensure that factors associated with socioeconic status were equally distributed across the treatment conditions. Methodology included good control of participants as children were screened for coexisting factors that might impact language (hearing loss, vision, oral-mechanism, autism, TBI, cerebral palsy), and only those displaying a language impairment independent of other factors were included.

This study used a strong experimental design as well as a large sample size. The authors performed several different analyses, which considered clinically significant changes, however, the use of standardized measures to assess language may not have been sensitive enough to capture improvements from the interventions. With some limitation in outcome measurement, but an overall well designed study with good validity, Gillam et al. present compelling evidence that FFW does not lead to gains any greater than traditional therapy with a speech-language pathologist.

Cohen et al. (2005) studied the effects of FFW versus control conditions on language skills of 77 children aged 6-10 with severe mixed receptive-expressive LI.

An appropriate series of ANOVAs revealed no additional benefit in primary language outcomes for the group who received FFW compared to control conditions. The authors suggested that the findings were not sufficient to confer additional therapeutic benefit for children with more severe forms of SLI who are already receiving therapy.

Beyond the inherently strong RCT design of this study, the investigators also achieved greater power by studying a set of children who presented with similar weaknesses. The authors carefully described the selection and randomization procedures as well as the number of children allocated to each treatment group. The outcome measures were taken by speech-language pathologists not otherwise involved in the study.

On the same note, the results of this study are also limited because they only studied children with severe mixed receptive-expressive language impairment. This population represents a small subset of children who typically receive treatment for language impairment. This also makes it difficult to tease apart any effects of severity of language impairment, or type of language impairment on the response to the intervention.

Cohen et al's well-designed (2005) study presents suggestive evidence that there is no difference in intervention outcomes when children with language impairment receive FFW compared to conventional speech-language pathology.

Pokorni, Worthington, and Jamison (2004) compared the efficacy of FFW with two control interventions that target language and phonological awareness. They compared performance of 54 children with language disorders and reading difficulty.

Three appropriate MANOVAs revealed no significant gains on the three subtests of the CELF-3 for any of the treatments.

The population in this study presents a limitation in that they studied only children with language impairment and a reading impairment. This population may differ from the larger population of children with language impairment. The sample size, which is of small to moderate size, with 16-20 children in each intervention group, may also not have been large enough to reveal the presence of a small treatment effect.

Although this study employed an intensive intervention period (3 hours per day), it was only completed for 20 days, and most children did not reach criteria for completion of the FFW intervention, nor the comparison interventions. The incomplete intervention results may differ from results if the intervention were completed in the prescribed way.

Due to these limitations, Pokorni's 2004) study presents suggestive evidence that FFW is no more effective at improving language than comparison phonological awareness and language interventions.

Fey, Finestack, Gajewsji, Popescu, and Lewine (2010) investigated FFW as an adjuvant treatment to conventional narrative-based language intervention (NBLI), which targeted narrative comprehension, production, and grammatical output. Twenty-three children finishing kindergarten, grade one, and grade two with impaired language were randomly assigned to one of three intervention sequences (FFW/NBLI, NBLI/FFW, wait/NLBI), however some randomization was restricted due to scheduling of the intervention. This was outlined well in the study methodology. All children had a documented language impairment based on scores significantly below the mean on a standardized language test. Participant selection protocol is explained clearly in the study, and did not include participants with factors that might contribute to a language impairment, such as hearing loss or neurological factors.

All three intervention groups displayed improvements on the measures of narrative ability, however, planned *t*-tests were revealed no differences in improvements made between the intervention groups.

Although this study presents a persuasive randomized, controlled design, there are several factors that limit the interpretation of the evidence.

The authors reported mortality in all groups and no intention to treat analyses were performed. Only participants who completed at least 50% of the intervention sessions were included in the analysis. This type of analysis increases the likelihood of bias being responsible for results. Fey et al.'s study is also limited by having a small sample size. Further, due to poor attendance, many participants received a lower intensity of treatment than initially planned.

Though there are some evident limitations, Fey et al's study has a strong design and presents suggestive evidence that FFW is no more effective as a supplement to conventional interventions for children with spoken language impairments in comparison to other forms of therapy.

Single subject 'n-of-1'

Single-subject designs establish experimental control within one participant by taking repeated outcome

measures of an intervention across different time periods. In studies of this design, the greater the number of individuals studied, the greater the likelihood of generalization of the results.

Gillam, Crofford, Gale, and Hoffman (2001) compared language before, during, and after treatment for 4 children with LI, using a multiple-probe design. Two children received intervention with FFW and two children received a bundle of Laureate Learning Systems Software programs (LLS). LLS is another computerized language intervention software.

Appropriate visual inspection of the data revealed variability across baseline, treatment, and follow-up for all participants. Appropriate analysis of Cohen's *d* revealed improvements in MLU in 3 out of the 4 children. Overall, results indicated similar gains on formal language measures and MLU in FFW in comparison to the LLS intervention, and authors concluded that computer-based language intervention may be beneficial to children when presented as part of a language intervention program.

Single-subject designs present a high level of evidence, and Gillam et al's study consists of some good methodology, such as the inclusion of a language sample measure in addition to standardized test scores.

None of the children in either treatment condition reached the dismissal criterion after 20 days of training. This is a limitation of the study, as it is difficult to know whether further language gains may have been made if the children were able to receive the benefits of the full intervention package.

The authors reported blinding of the examiners and control for any concomitant impairments that may have influenced language.

Overall, due to some strengths and limitations in methodology, this study presents suggestive evidence regarding the efficacy of the FFW program as an intervention for children with language impairment.

Friel-Patti, DesBarres, and Thibodeau (2001) reported studies of five children with language impairment between 5 and 9 years of age who received FFW as an intervention. Appropriate pre and post comparisons revealed modest changes on standardized measures; however, no improvements in language sample measures.

Friel-Patti et al's (2001) investigation adds strong evidence on the efficacy of FFW for several reasons. The tools used to measure language improvements are a relative strength, as the authors used both a standardized measure as well as an analysis of a language sample. Combined, these two instruments measure individual elements of language, as well as a small sample of language use.

Of limitation to the evidence, was that only 2 of the 5 children achieved the criterion for dismissal set by Scientific Learning Corporation. These two children were also the only subjects who showed clinically significant change on standardized measures of language. It is difficult to know whether the clinically significant change was associated with completion of the program, or with other subject-specific factors that may have assisted the individuals in reaching completion of the program. It is also, therefore, difficult to assume that the program had no effect on the three individuals who did not complete the program, as they did not receive the full intervention.

In sum, Friel-Patti et al's (2001) study presents suggestive evidence that FFW does not result in improved language among children with language impairment.

Discussion

Together, the results of the studies reviewed present suggestive evidence that FFW does not result in improvements in language outcomes.

There are several limitations of the studies reviewed that warrant further discussion. Children with language impairment represent a heterogeneous population, of which different subsets are being compared in order to appraise the cumulative evidence from these studies. For example, Cohen et al (2010) studied children with severe mixed receptive-expressive SLI, whereas other studies did not specify the severity nor whether the language impairment was receptive or expressive. It would be useful to know whether children demonstrated delays in one or both modalities in order to more carefully appraise any changes in language. Further, the differences between children with specific language impairment and language impairment with possible comorbidities may have implications for the results of this intervention.

Similarly, the FFW intervention is designed to address a receptive component of language, however it claims to lead to expressive language gains. It is not clear in what language areas the children should demonstrate gains, and the studies reviewed investigated both modalities of language. Further research is warranted to determine whether gains from FFW are made in one or both modalities, in order to determine whether this

intervention may be more beneficial to a specific set of students with LI. Of further note, Cohen et al's (2005) participants presented with more marked difficulties than children who had participated in previous FFW efficacy studies. Differences in the severity of language impairment should be a consideration when comparing results of the intervention.

Several studies reported that children were unable to meet criterion for completion of the FFW intervention. This calls into question whether the studies represent a fair evaluation of the intervention program. Gillam (2001) reported that none of the children reached dismissal criterion. This may imply that the participants of the study were not well suited for the intervention, or that the intervention may not be suitable for these students. If students were unable to complete an intervention designed for their population, it is of question how beneficial the design of this intervention is.

Finally, the current evidence involves comparing across different frequencies and durations of intervention. For example, Cohen et al (2005) and Gillam et al (2008) implemented treatment for 6 weeks, while Pokorni et al.'s intervention duration was only 20 days. Further research offering similar intervention models is necessary to more confidently compare the results of different FFW interventions.

It is important to consider the feasibility of the intervention when applying results to a clinical context. Most of the studies applied intervention for several hours per day, several days per week. For instance, Fey's (2010) study implemented FFW for 100 minutes in five sessions per week. It is of question whether this frequency of intervention is feasible to be provided by a SLP in a school setting. Many of the studies implemented a summer-camp style program. FFW may be more appropriate to be implemented in that context in order to deliver it with proper frequency and duration.

The idea that the intervention may require less direct intervention time from an SLP is worth investigating. Although the studies described supervision by SLPs during the intervention period, it appears that the supervision involved mostly reinforcement and redirection to the tasks, rather than direct intervention and feedback. In Cohen's (2005) study, the computer intervention was delivered in the home, by the parents with some consultation from the researchers. Although no greater benefits of FFW were revealed, participants did make language gains following computer intervention in several of the studies. Delivering a computer intervention in the home may be of benefit to certain children who enjoy the game and receive additional therapy at school. Future research is necessary to determine whether any gains made from FFW should be attributed to maturation and time, or to the FFW intervention. It could then be determined whether specific profiles of language-impaired children might benefit from FFW as an additional, at-home therapy.

Conclusion and Clinical Implications

This critical review suggests that Fast ForWord does not result in improved language outcomes in school-age children with language impairments. The current evidence, therefore, does not support a recommendation for the use of FFW as a primary intervention method for children with language impairments. The studies reviewed investigated FFW in different settings and as an adjunct to traditional therapy. The studies investigated FFW as an intervention with a varied set of children with language impairment, ranging in severity and abilities.

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