Critical Review:

Is the PROMPT approach an effective treatment for improving articulatory control and intelligibility in children with severe speech sound or motor speech disorders?

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This critical review examines the efficacy of the Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT) treatment approach for improving articulatory control and intelligibility in children with developmental motor speech disorders. Five articles were included in this review. Study designs included: two single subject designs, one mixed design, one case control study, and one single group pre-posttest design. Overall, the results of this review provide suggestive evidence that the PROMPT approach is an effective intervention for children with developmental speech sound and motor speech disorders. Recommendations for clinical practice and future research are discussed.

Introduction

Children with speech sound disorders and motor speech disorders, including dysarthria and apraxia of speech, are a heterogeneous group (Strand & McCauley, 2008). While dysarthria is characterized mainly by disrupted or distorted speech as a result of neurological impairment to underlying speech processes, apraxia is characterized by difficulties with motor planning and programming. Speech sound disorders are defined as a broad range of disorders in which challenges with the production of speech is the primary deficit (Strand & McCauley, 2008). Although the principle characteristics of these disorders may vary, Strand & McCauley indicate they share many overlapping characteristics, and children often present with varying profiles of impairment. It is therefore important when considering these disorders to plan treatment that is specific to each individual in terms of the relative contribution of phonologic, motor planning, and motor execution impairments (Strand & McCauley, 2008). To date there is relatively little literature examining the effectiveness of any one treatment approach for children with speech sound and motor speech disorders despite there being many treatment approaches used by clinicians (Morgan & Vogel, 2009; Namasivayam, Pukonen, Goshulak, Yu, Kadis, Kroll, Pang, & De Nil, 2013). Therefore, it's crucial to develop an evidence base for an intervention approach that has the flexibility to meet the individual needs of a variable group.

Prompts for restructuring oral muscular phonetic targets (PROMPT) is a treatment approach for speech sound and motor speech disorders that was developed in the 1970s (Hayden, 2004). The current PROMPT approach is based primarily on Hayden and Square's Motor Speech Hierarchy and uses a combination of tactile-kinesthetic cues, auditory, and verbal input to improve speech sound production (Hayden, 2004; Namasivayam et al., 2013). Treatment priorities are chosen on an individual basis according to the unique presentation of each child's speech impairments (Hayden, 2006). The focus of PROMPT is to embed treatment into naturalistic communication settings in order to build contextually relevant and age appropriate speech productions that individuals can use functionally (Hayden, 2006). PROMPT has been used in clinical practice for many years. However, there is still relatively little research that demonstrates it's effectiveness and much of the previous literature focuses on the efficacy of PROMPT for adult populations (e.g. apraxia and aphasia), which varies considerably from children with motor speech and speech sound disorders (Namasivayam et al., 2013). Therefore, it is important to examine and identify any gaps in the current evidence supporting the effectiveness of PROMPT intervention in improving speech intelligibility and articulatory control in children with speech sound and motor speech disorders.

Objectives

The primary objective of this paper is to critically evaluate the existing literature regarding the effectiveness of PROMPT intervention for children with speech sound and motor speech disorders. The secondary objective is to provide speech language pathologists, who may be interested in PROMPT intervention, with evidence based recommendations regarding its implementation.

Methods

Search Strategy

The following computerized databases were searched to obtain peer reviewed journal articles related to the topic

of interest: PubMed, PsycINFO, Cochrane library, and Google Scholar. Keywords included: [(PROMPT) AND (motor speech) OR (speech sound disorders) AND (children) OR (childhood) OR (developmental)].

Selection Criteria

The studies selected for inclusion in this critical review were required to use PROMPT intervention as the primary means of treatment for children with either speech sound disorders or developmental motor speech disorders (including dysarthria and apraxia). Papers outlining the effects of PROMPT intervention in children with Autism were excluded from this review. No limitations were placed on research design or outcome measures.

Data Collection

The literature search resulted in five articles that aligned with the selection criteria. Articles consisted of two single subject designs, one mixed design, one case control study, and one single group pre-posttest design.

Results

Single Subject Design

Ward, Strauss, & Leitao (2013) conducted a longitudinal single-subject study with a multiple baseline research design. Six children ages 3-11, with moderate-severe speech sound disorders associated with cerebral palsy underwent PROMPT treatment in order to determine the effectiveness of PROMPT at improving intelligibility as well as duration, velocity and distance of the jaw and lips. Results indicated that PROMPT intervention significantly improved intelligibility in 5/6 participants, and lip and jaw movement patterns in all participants.

Ward et al. (2013) used an ABCA design with baseline/no treatment (both A), treatment target one (B), and treatment target two (C) phases. Each phase of treatment (B and C) lasted 10 weeks and once weekly sessions were 45 minutes in length. Participants did not begin treatment until a stable baseline was established (5-8 weeks). Kinematic data of distance, velocity, and duration of articulator movements were collected at the end of each study phase and were compared to a reference group of 12 typically developing age and sex matched peers. Speech probes consisting of trained and untrained words based on both treatment priorities and untrained control words were completed at each baseline session, at the end of phases B and C, and at 12 weeks post treatment. Intelligibility data was collected at the single word level at the end of each study phase using appropriate standardized measures. Untrained listeners blind to the purpose of the study evaluated intelligibility. PROMPT intervention was administered by certified and experienced therapists who were not involved in the study in any other manner. PROMPT fidelity was evaluated by a PROMPT instructor blinded to the purpose of the study and fidelity to intervention was consistently above 78%. Statistical analyses of kinematic data was completed using t-tests and descriptive statistics. Friedman's ANOVA was used to test if PROMPT significantly affected distance, velocity, and duration post treatment. Given the single subject study design, statistical analyses of this nature are appropriate.

Ward et al. identified some limitations in their study. Authors explained that there were limits to the motion analysis system used to evaluate kinematic measures and analysis of lingual motion could not be completed. Two participants reached the lingual level in phase C and their lingual data was therefore unable to be analyzed. Additionally, Ward et al. reported that due to the speech impairments of these participants, kinematic intelligibility measures could not be collected and analyzed at the carrier phrase or sentence level. Therefore, generalization of results beyond the word level is cautioned. It is also important to note that the sample size was small. Single subject designs are often limited by the small sample sizes and therefore it is difficult to generalize these results to a larger population.

Despite these limitations, the study demonstrated several strengths including age and sex-matched reference participants, clearly defined baseline, blind evaluation, fidelity to PROMPT protocol, reliable outcome measures, and a clearly defined protocol. Based on the many strengths, this study provides highly suggestive evidence for the effectiveness of PROMPT intervention at improving intelligibility and articulatory control in children with severe speech sound disorders.

Grigos, Hayden, & Eigen (2010) outlined a single subject study examining the impact of PROMPT treatment on speech sound accuracy and articulator movement duration, displacement, and velocity in a 3 year-old child with a severe articulation impairment. Results indicated that PROMPT was effective for this child in improving phonemic accuracy and refining articulatory control.

The Grigos et al. study consisted of a baseline period (3 measures) followed by eight weeks (16 sessions, 45 minutes/session) of PROMPT treatment and one post treatment follow-up session. Untrained probe words were collected three times prior to the start of intervention, each week during treatment, and once at post session five months following treatment (which was delayed because of the participant living out of

state). Kinematic data was collected to track articulation accuracy, movement duration, displacement, and velocity at pre-treatement, after every second week of treatment, and post treatment. An age and sex matched participant was selected as a frame of reference for kinematic data and measures were gathered at the same intervals as the participant. Results were analyzed by blinded listeners using Percentage Consonants Correct (PCC) and Percentage Vowels Correct (PVC) (Shriberg & Kwiatkowski, 1982; Shriberg, 1983) of words recorded during kinematic data collection sessions, and acceptable inter-rater reliability was reported. Visual analysis was also completed to determine consonant and vowel accuracy. High inter-rater reliability was reported for these analyses. Appropriate t-tests were used to analyze the kinematic data for pre-treatment and weeks 2, 4, 6, and 8 but not the final post session.

Limitations of the Grigos et al. study include the lack of reliable long-term data, which precluded analysis of treatment gains and maintenance over the long-term. Generalization of findings in this study should also be cautioned due to the small sample size. PROMPT fidelity measures are not reported and the PROMPT instructor was not blind to the purpose of the study. Despite these limitations, this study demonstrates several strengths. Grigos et al. used an age and sex-matched reference participant in order to compare speech measures and kinematic findings. The participants and procedures of this study were thoroughly outlined for ease of replication. The baseline period was an adequate length to ensure stability, and therefore improvements can be interpreted as resulting from PROMPT intervention. Overall, the Grigos et al. study provides suggestive evidence that PROMPT is an effective method of improving articulatory accuracy and control for children with severe speech sound disorders.

Mixed Design

Dale & Hayden (2013) compared the effects of the full PROMPT approach and the PROMPT approach without tactile-kinesthetic-proprioceptive (TKP) cues in a single subject and mixed design (ABB and ACB) with four children ages 3;6-4;8 with childhood apraxia of speech. For the purposes of the present review, all participants received PROMPT therapy for 8 weeks (16 sessions) with one group receiving 8 sessions of PROMPT without TKP cues followed by 8 sessions of full PROMPT. Dale & Hayden (2013) indicated that using the PROMPT approach resulted in significant improvements in articulation, intelligibility, socialization, and untrained word probes regardless of treatment group. There was some evidence to suggest that the two children who were treated with the full PROMPT approach demonstrated greater improvement, however, this evidence was not significant.

Changes in focal oromotor control and sequencing, intelligibility, speech movements, and improvements in activity and participation were measured using appropriate standardized tests administered pre- and post-treatment by assessors blinded to the study purpose. Generalization was measured using untrained probe words administered three times at baseline, four times during treatment, once at the completion of treatment, and once three months post treatment. Intervention was carried out by a PROMPT certified instructor and fidelity to PROMPT treatment protocol was ensured by evaluating adherence to PROMPT twice during treatment. Significant changes in standardized scores were appropriately defined for each test according to non-overlapping confidence intervals or in terms of percent or SDs of change.

Dale & Hayden identified several limitations that caution generalization of findings in the study. The sample size (n=4) is very small, there was no formal means of evaluating significant change on the measure of speech movements, and finally the baseline was only three sessions in length. Short baselines may not be appropriate for someone with apraxia of speech given the inconsistent nature of the disorder. However, Dale & Hayden noted that there was little evidence of spontaneous improvement across the baseline period for any of the participants, indicating gains measured following intervention could be attributed to treatment rather than to spontaneous improvements. Additional strengths of this paper included the clear description of participants and research protocol, which could allow for near reproduction of the study. The use of a baseline period, untrained probe words, blinding of test administrators and evaluators, fidelity measures, and reliable and valid measurement tools all increase the overall reliability and validity of this study. Overall, the conclusions drawn from the Dale & Hayden paper provide suggestive evidence of the effectiveness of PROMPT intervention in children with developmental motor speech disorders.

Case Control Design

Kadis, Goshulak, Namasivayam, Pukonen, Kroll, De Nil, Pang, and Lerch (2013) described a case control study comparing cortical thickness from MRI scans and speech measures of 14 children ages 3;9-6:6 (M = 4;5, SD = 0.8) with idiopathic apraxia of speech (pre and post PROMPT treatment) to a control group of 14 typically developing peers (MRI data only). Following treatment with PROMPT, cortical thickness results indicated significant thinning of the posterior superior temporal gyrus, canonical Wernicke's area in those with apraxia of speech relative to controls. Of relevance to the present review, Kadis et al. also examined the

efficacy of PROMPT intervention in this study and reported significant gains on all speech measures. Kadis et al. concluded that PROMPT was a beneficial treatment approach for these children.

A thorough assessment was conducted, using appropriate standardized tests, pre and post-intervention to measure word level articulation, phonological deviations in speech, and neuromotor integrity of speech. Within-subjects t-tests were calculated for each measure, although no adjustments for multiple comparisons were reported. Statistical analysis was only conducted on 12/14 participants because two participants did not return for post treatment assessment, and no intention to treat analysis was performed.

There are several limitations of this study including a lack of detail regarding the targets selected for each participant. There is also no report of blinding of assessors and evaluators. Additionally, there was no report of fidelity measures. The baseline period consisted of gathering speech measures on only one occasion. Given the inconsistent nature of apraxic speech, this is an inadequate baseline length in which to draw conclusions about treatment effects. Finally, this study is limited by its small sample size and generalization of findings to a larger population should be made with caution. Given these limitations this study provides equivocal evidence for the effectiveness of PROMPT intervention.

Single Group Pre-Posttest Design

Namasivayam et al. (2013) used PROMPT as the treatment approach to examine the relationship between speech motor control and intelligibility, and changes in speech motor control, articulation and intelligibility pre and post treatment for 12 children ages 3;11-6;7 (M = 4;5, SD = 1.1) with moderate to profound speech sound disorders and red flags for motor speech involvement. Of relevance to the present review, significant post treatment improvements were noted in speech motor control and sentence-level intelligibility, but not articulation.

PROMPT intervention lasted for eight weeks (16 sessions, 45 minutes/session) and was carried out by a certified instructor, who was not involved in assessment for this study. One participant was reported to miss two sessions. Speech motor control and articulatory accuracy were measured pre and post treatment using appropriate standardized tests. Inter-rater reliability was reported to be high on analysis of these measures. Intelligibility was evaluated by blinded listeners, both pre and post intervention, at the word and sentence level using standardized measures. Paired two tailed t-tests were used to analyze change in each variable. Given the nature of this design, these are appropriate statistical analyses.

Results of this study should be evaluated with caution. The single group pretest posttest design is limiting as it does not provide a repeated baseline or control group. This means that any gains observed cannot be confidently attributed to treatment and may be due to some other unknown factor. For this reason Namasivayan et al. identified this study as not providing a direct evaluation of PROMPT efficacy. Therefore, it cannot be concluded with any certainty that gains in speech motor control and intelligibility are a result of PROMPT treatment. As a result, this study provides equivocal evidence in determining the effectiveness of PROMPT intervention.

Discussion

All of the studies demonstrated that participants made improvements in measures of either speech motor control, articulatory accuracy, or intelligibility following PROMPT treatment. However, some demonstrated more suggestive evidence than others. The use of stable baselines, using untrained probes, blinding, PROMPT fidelity measures, and control participants lead to highly suggestive evidence for the Ward et al. paper, and suggestive evidence for both the Dale & Hayden and Grigos et al. studies. While participants did improve following treatment, the Kadis et al. and Namasivayam et al. studies both provided equivocal evidence due to insufficient baseline periods, lack of control, and lack of fidelity measures. Overall results of these five studies indicate preliminary suggestive evidence of the effectiveness of PROMPT intervention for children with speech sound and motor speech disorders.

It is important to note the designs of the present studies are limited by the small sample sizes. It may be difficult to find enough participants meeting the criteria of a given disorder (such as speech sound or motor speech disorders) within a population to study. Therefore, true randomized control trials, though providing the best level of evidence, may not always be feasible. Generalization of results from small sample sizes should be cautioned. However, given that PROMPT is a highly controlled treatment protocol that follows a strict procedure, the results of findings across studies may afford more certain conclusions regarding the effectiveness of PROMPT. Within each study the same PROMPT procedures were followed including length of sessions, the goal selection process, and the structure of the sessions (focusing on functional treatment in natural communication settings such as play). Therefore, more

sound conclusions regarding the clinical relevance of PROMPT intervention can be made across studies.

Clinical Implications

Based on the findings of theses studies, there is suggestive evidence of the clinical effectiveness that the PROMPT treatment provides. However, there are some issues of relevance to the clinical implication of PROMPT in a typical government funded Ontario treatment setting. In both a preschool and school board setting in Ontario, children are generally only seen in blocks of 10 sessions (30-45 minutes/session) for Speech and Language services (Deloitte, 2010). In all studies reviewed, with the exception of the Ward et al. paper, PROMPT treatment was administered for 16 sessions (45 minutes/session) two times a week. In the Ward et al. study therapy was conducted once a week for 20 weeks. This raises a clinical issue about the effectiveness of PROMPT or rather of more intensive and frequent therapy. Edeal and Gildersleeve-Neumann (2011), explained that more frequent and intensive practice of speech results in a greater response to treatment in children with apraxia of speech. Therefore, when placing limits on the frequency of treatment, one may not observe the same gains clinically. While PROMPT does suggest clinical effectiveness, it is recommended that future research be conducted and incorporate:

1.1. A comparison of the effectiveness of PROMPT intervention delivered once a week vs. twice a week.
1.2. A comparison of PROMPT treatment with other treatment approaches for speech sound and motor speech disorders.
1.3. The effectiveness of PROMPT during shorter blocks of therapy (e.g. 10 weeks rather than 16).
1.4. Larger sample sizes.

In conclusion, the current research base provides suggestive evidence for the effectiveness of the PROMPT approach for improving articulation and intelligibility in children with speech sound and motor speech disorders. While the PROMPT approach does suggest clinical effectiveness, future research manipulating the frequency and intensity of treatment is recommended.

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