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Impact of occupational, physical, and speech and language therapy in preschoolers with hyperactive/inattentive symptoms: A naturalistic 2-year follow-up study

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Abstract

Objective—Impact of speech and language therapy (ST) and occupational/physical therapy (OT/PT) on language and motor skills was examined in hyperactive/inattentive children.

Methods—Preschoolers were divided into those receiving and not receiving ST or OT/PT.

Results—Children receiving ST showed no gains in language functioning relative to those not receiving ST. OT/PT yielded similar results for motor functions. Hours of a service did not predict improvement. However, children who received ST showed improvement in social skills.

Discussion—The apparent lack of benefit suggests the need for further investigation into efficacy of these treatments in hyperactive/inattentive preschool children.

Keywords

Speech and language therapy; Occupational therapy; Physical therapy; ADHD; Preschool children

Attention-deficit/hyperactivity disorder (ADHD) is a highly prevalent psychiatric disorder, affecting 5% of children (American Psychiatric Association, 2013). The core symptoms of ADHD – inattention, hyperactivity, and impulsivity – generally emerge at an early age, prior

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to the time of formal diagnosis, and impact multiple domains of functioning. For example, compared to their typically-developing peers, these children often have difficulties in social relationships and underachieve academically (DuPaul, McGoe, Eckert, & VanBrakle, 2001). In addition, children with ADHD demonstrate elevated rates of language (Helland, Posserud, Helland, Heimann & Lundervold, 2012) and motor impairments (Fliers et al., 2008) as compared to their typically-developing. Among children diagnosed with ADHD up to 45% have language difficulties and as many as one half have been reported to have motor difficulties (Gillberg & Kadesjö, 2003).

Psychopharmacological (MTA Cooperative Group, 2004) and psychosocial (Sonuga-Barke, Daley, Thompson, Laver-Brandbury, & Weeks, 2001) interventions have proven efficacious for mitigating both symptoms and impairments associated with ADHD. However, auxiliary services, delivered primarily through the education system, are often used to target coexisting motor and language delays, particularly in young children with symptoms of the disorder. Inattentive and hyperactive/impulsive preschoolers are far more likely to receive occupational therapy (OT), physical therapy (PT), and speech and language therapy (ST) than their typically developing peers (Marks et al., 2009). Moreover, a third of the children with ADHD utilized multiple services. As a result, the individual cost of services utilized by preschool children with ADHD was found to be two to six times that of preschool children without ADHD. To the degree that these interventions are beneficial, the effort and cost is warranted. Unfortunately, little research has examined the extent to which these services are helpful to this population.

Below we briefly review data evaluating the efficacy of OT, PT and ST in children, although few studies have focused specifically on children with either an ADHD diagnosis or who present with elevated levels of hyperactivity/impulsivity and/or inattention. Given that as many as 46% of children with language problems (Cohen et al. 1998) and 50% of children with motor problems (American Psychiatric Association, 2013) have ADHD, it is likely that many of the children in these study samples would have either met criteria for ADHD or been characterized by elevated levels of ADHD symptomatology. As such, the degree to which the presence/absence of ADHD symptoms accounts for some of the variability in results described below is unknown.

A recent review of articles published in OT journals (Case-Smith & Powell, 2008) found that few studies used experimental designs or involved the use of evidence-based practice (EBP). We have identified four studies that assessed the impact of OT on children's fine motor skills in children with motor difficulties. Evaluation of a school-based OT program revealed, as reported by teachers, significant improvements in written communication, but not fine motor skills (Bayona, McDougall, Tucker, Nichols, & Mandich, 2006). Case-Smith (2000) evaluated the helpfulness of OT in a group of preschoolers and found that their fine motor skills improved when interventions were focused on play and peer interactions, as opposed to interventions that focused on performance and skill levels. Finally, Case-Smith (2002) reported that OT (vs. no OT) improved letter legibility (14% vs. 5.8%), but not number legibility or writing speed in children ages 7 to 10 years. Notably, only one study of OT has specifically focused on school-age children with ADHD (Chu & Reynolds, 2007). A family-centered OT treatment yielded behavioral improvements in children with ADHD;

changes in motor functioning were not reported. These latter results should be interpreted cautiously because of the small sample size (n=20), lack of randomization, lack of a control condition, and possible rater bias in this unblinded study. Taken together, these studies suggest that OT may be helpful in some, but not all, aspects of motor functioning in children. However, adherence to evidence-based OT practices has been limited (Kielhofner, 2005) and the specific utility of OT as an intervention for motor problems in youth with elevated ADHD symptomatology remains unknown.

Research evaluating the efficacy of PT has almost exclusively focused on children with cerebral palsy and/or severe motor dysfunction (Harris & Roxborough, 2005), making it difficult to generalize findings to the majority of children with ADHD. One study reported that PT improved motor functioning in school-age children, with developmental coordination disorder and ADHD relative to those not receiving the service; half of the 14 treatment participants showed motor functioning in the normal range at the end of treatment, as assessed by the Movement Battery for Children (Watemberg, Waiserberg, Zuk & Lerman-Sagie, 2007). Thus, one small study provides data supporting the utility of PT in children with ADHD.

Another auxiliary service that inattentive/hyperactive children commonly receive is speech and language therapy (ST), but again, efficacy in this population has not been systematically evaluated. Like youth with ADHD, children with primary deficits in speech intelligibility and communicative competence are at risk for deficient social and academic skills which, over time, may compromise self-esteem and self-confidence (Felsenfeld, Broen & McGue, 1994). Thus, ST aims to improve speech and language skills and/or reduce the risk of negative outcomes associated with deficits in these areas. As compared to OT and PT, there is a far more substantial literature supporting the efficacy of ST (e.g., Almost & Rosenbaum, 1998; Thomas-Stonell, Oddson, Robertson & Rosenbaum, 2009). Almost and Rosenbaum (1998) examined the efficacy of community speech clinics and found that preschoolers with unintelligible speech showed improvement on measures of object identification, articulation, and consonant use when compared to preschool children who did not receive active treatment. Preschoolers who received a community-based speech therapy intervention showed improvement in communication skills, attention, play, socialization, confidence and behavior as rated by parents and clinicians. More specifically parents rated improvements in their child's ability to carry on conversations, socialize with their peers, participate in school, and in children's confidence and quality of life. Clinicians also reported improvements in socialization and independence (Thomas-Stonell et al., 2009).

Finally, two recent reviews support the efficacy of ST. Cirrin and Gilliam (2008) assessed the outcomes of speech and language intervention for school-age children by reviewing 21 published peer-reviewed articles that used measureable outcomes, randomized controlled designs, non-randomized comparison studies, and multiple-baseline single subject designs. They found that the majority of studies showed moderate-to-large effect sizes, suggesting good efficacy for ST. Similarly, Law and colleagues (2003) reviewed 25 studies that examined the efficacy of speech and language therapy with majority of studies focusing on children under the age of seven, with differing language difficulties. They concluded that ST is effective for improving phonology and vocabulary, but does not improve receptive

language. In addition, longer-term interventions (i.e., > 8 weeks) were more effective than more time-limited treatments. Taken together, these studies indicate that ST is beneficial for children with communication difficulties. Again, however, it is unclear whether such effects generalize to children with elevated levels of ADHD symptoms.

The limited data regarding the effectiveness of OT, PT and ST in hyperactive/inattentive preschoolers, coupled with the high frequency with which these children receive such services, suggest that further research is needed to determine the impact of these services on neurocognitive and behavioral functioning in this group of children. Thus, we will assess the direct effects OT/PT and ST on motor and language functioning, respectively, in preschoolers with elevated levels of ADHD symptoms. In addition, we will explore possible indirect effects of these interventions on the severity of ADHD symptoms and social functioning. Given compelling evidence from neuroimaging studies indicating a key role for motor system involvement in the pathophysiology of ADHD, including the basal ganglia (Qiu et al., 2009), supplementary motor cortex (Suskauer et al., 2008) and cerebellum (Mackie et al., 2007), it is possible that interventions targeting motor control may have a beneficial effect on inattentive and hyperactive/impulsive symptoms. Further, children with ADHD have less developed pragmatic language skills compared to their typically developing peers, and some of these pragmatic language difficulties mediate social skills (Staikova, Gomes, Tartter, McCabe, & Halperin, 2013). This raises the possibility that ST might improve social skills in preschool children with elevated levels of ADHD symptoms.

The present study was not designed to be a rigorous randomized controlled efficacy study of a particular service or intervention. Rather, data were retrieved from an ongoing longitudinal study of hyperactive/inattentive preschoolers to naturalistically explore the effectiveness of these treatments as implemented by educational system personnel. Our primary aim was to examine the impact of these auxiliary services on language and motor functioning in hyperactive/inattentive preschool children over a 2-year period. Secondary analyses investigated whether these services improved hyperactive/inattentive symptoms and social skills.

METHOD

Participants

As part of a longitudinal study examining factors associated with the persistence of ADHD symptoms in preschoolers, a community-based sample of 3- and 4-year-old children was recruited. Principals of local preschools were contacted and permission was requested to screen the school for 3- and 4-year-old children with attention and behavior problems. Direct referrals from schools and local practitioners were also accepted. Entry into the study was based on parent and teacher reports on the home and school version of the Attention-Deficit/Hyperactivity Disorder Rating Scale, Fourth Edition (ADHD-RS-IV; DuPaul, Power, Anastopoulos & Reid, 1998; McGoey, DuPaul, Haley & Shelton, 2007). Children who received 6 or more symptoms rated as Often or Very Often on the Hyperactivity/Impulsivity and/or Inattention subscale(s) after integrating parent and teacher reports (e.g., 5 symptoms from parent and 1 different symptom from the teacher) were considered hyperactive/inattentive. Exclusion criteria were: Full Scale IQ < 80, as measured by the

Wechsler Preschool and Primary Scale of Intelligence-Third Edition (WPPSI-III; Wechsler, 2002); evidence of a Pervasive Developmental Disorder, Post-traumatic Stress Disorder or a diagnosed neurological disorder; non-English-speaking parent or child; child not attending school; and treatment with systemic medication for a chronic medical condition (including ADHD). Among the 138 children who met criteria for the hyperactive/inattentive group in the longitudinal study, 22 children who began pharmacological treatment for a behavioral disorder after the baseline evaluation were excluded because such treatment would likely confound the results. Further, 25 children who did not attend both annual follow-up evaluations were excluded from these analyses. The final sample for this study consisted of 91 children (68 boys) ranging in age from 3.00 to 4.92 years ($M = 4.27$, $SD = .50$) who not only participated in the baseline evaluation (T1), but were also reevaluated two years later (T2). Mean age at T2 was 6.26 years ($SD = 0.33$) and the mean time between evaluations was 2.05 years ($SD = .16$).

The sample was racially and ethnically diverse, comprising 12 black (13%), 7 Asian (8%), 26 Hispanic (29%), 2 of mixed race (2%), and 44 (48%) white children. Socioeconomic status was assessed by the Occupational Prestige Scale (Nakao & Treas, 1994); the sample was largely middle class ($M = 64.48$, $SD = 16.85$) although a wide range was represented (range = 20–97).

As part of a broader longitudinal study, the current study was conceived as a naturalistic follow-up to evaluate the impact of auxiliary services delivered in schools on behavioral, motor, language, and social outcomes. The decision of service allocation for participants was determined by personnel from each child's school district. An Individual Education Plan (IEP) was generated for each child if a particular service was deemed indicated. This naturalistic approach lends itself to addressing questions of service impact in a treatment-as-usual context. Due to the nature of such methods, the precise procedure(s) used by individual providers is not known, only that the approved service fell under the auspices of OT, PT or ST.

This study was approved by the Institutional Review Board of the university in which the research was conducted. Following a complete description of the study, a parent of each child provided written informed consent for participation.

Measures

At T1 and T2 children's language and motor development was assessed using subtests from the Language and Sensorimotor domains of the NEPSY (Korkman, Kirk & Fellman, 1998). Only subtests common to both time points (i.e., for 3- and 4-year-olds and 5- and 6-year-olds) were used. The NEPSY is a standardized neuropsychological test battery which yields age-standardized scores for specific subtests ($M = 10$; $SD = 3$). At both ages, the Language Domain includes Phonological Processing and Comprehension of Instructions subtests, which respectively assess word segment identification and the ability to process and respond to verbal instructions. The Sensorimotor Domain subtests, Imitating Hand Positions and Visuomotor Precision, measure finger dexterity and speeded hand-eye coordination, respectively. NEPSY subtests were administered by well-trained graduate students who were blind to the children's clinical status and treatment history. Test-retest reliability

estimates for the normative sample for the Phonological Processing and Comprehension of Instructions subtests range from $r = .83-.91$ and $r = .73-.89$, respectively. For Sensorimotor subtests, reliability estimates range from $r = .82 - .89$ for Imitating Hand Positions and $r = .68 - .81$ for Visuomotor Precision.

Severity of inattention and hyperactivity/impulsivity was assessed at T1 and T2 using the ADHD-RS-IV (DuPaul et al., 1998). The ADHD-RS-IV is an 18-item questionnaire, with items corresponding to the DSM-IV ADHD symptoms. Parents and teachers rated children's behavior on a 4-point scale (0 = Never/Rarely; 3 = Very Often). The nine inattentive and nine hyperactive/impulsive symptom ratings were summed to generate a dimensionalized severity measure for each construct for each informant at both time-points. The ADHD-RS-IV has been shown to be a reliable and valid measure of preschoolers' (McGoey, et al., 2007) and school-age children's (DuPaul et al., 1998) inattention and hyperactivity/impulsivity. In the present sample, coefficient alpha at each time point for each informant was high ranging from .86 (parent Inattention at T1) to .94 (teacher Hyperactivity at T2).

Children's social skills were assessed using the Behavior Assessment System for Children – Second Edition, Preschool (ages 2–5) and Child (ages 6–11) versions (BASC-2; Reynolds & Kamphaus, 2004). Scales were completed by parents and teachers at both time points, rating children's behavior on a 4-point scale (never to almost always). Coefficient alpha estimates for these scales in our sample ranged from .84 (parent T2) to .93 (teacher T2). Test-retest reliability ranged from .74 (parent T1) to .86 (teacher T2).

Procedure

Each year following the initial evaluation, parents were interviewed about services their child received during the past year using the Service for Children and Adolescents-Parent Interview (SCAPI; Jensen et al., 2004). Data collected using the SCAPi probed for whether or not the child had received OT, PT, and/or ST. The number and length of sessions were recorded for each service endorsed, and the number of hours of each service received over the 2-year period was calculated.

Data Analysis

Initially, the impact of service use on language and motor functioning was assessed using two separate 3-way Multivariate Analyses of Variance (MANOVA). For both MANOVAs ST (yes/no) and OT/PT (yes/no) served as the between-group variables, and Time (T1 vs. T2) served as the within-subjects variable. OT and PT were combined because no child received only PT, and both OT and PT are presumed to impact motor skills. One MANOVA focused on language functioning, with performance on the NEPSY Phonological Processing and Comprehension of Instructions subtests serving as dependent variables. Beneficial effects of ST on language function would be indicated by a significant ST x Time interaction characterized by greater improvement on the language subtests over time for those receiving ST. The second MANOVA assessed motor skills with performance on the Imitating Hand Positions and Visuomotor Precision subtests serving as the dependent variables. Beneficial effects of OT/PT would be indicated by a significant OT/PT x Time interaction such that

those receiving OT/PT demonstrated greater improvement over time on the two Sensorimotor subtests.

Given that the intensity of service provision differed markedly across participants, we investigated the relation between the amount of service received (in hours) and change in children's motor and language functioning over time. We conducted separate hierarchical linear regression analyses for language functioning and motor skill. For each analysis, Time 2 performance was regressed on Time 1 performance (entered at block 1) and the number of hours of service received (entered at block 2). The regression analyses exploring the relationship of hours of ST focused on language functioning, with Phonological Processing and Comprehension of Instructions subtests serving as outcome measures. Motor outcomes, Imitating Hand Positions and Visuomotor Precision, were assessed using the number of hours of OT and/or PT as predictor variables. A significant increase in variance accounted for by the model on the second block would indicate that more intensive therapy improved outcomes.

Secondary analyses focused on the severity of children's ADHD symptomatology and their social skills. Again we used 3-way MANOVAs and hierarchical regression analyses with the same categorical and dimensional treatment variables, respectively, as the primary analyses. Dimensionalized severity scores for parent-and teacher-rated Inattention and Hyperactivity/Impulsivity, as measured by the ADHD-RS-IV, served as the dependent measures for the analysis focusing on severity of ADHD symptoms. Raw scores of parent and teacher ratings of Social Skills as measured by the BASC-2 served as the dependent measures for the other MANOVA. For all analyses, effect size was measured using partial eta squared (η_p^2).

RESULTS

Among the 91 study participants, 45% ($n = 41$) received no services. Among those receiving services ($n = 50$), 35 children received OT, 39 received ST, and 17 received PT. No child received PT without at least one of the other two interventions, although 7 children received only OT and 12 children received only ST. For the analyses reported below, 27 (30%) received both ST and OT/PT, 12 (13%) received ST but not OT/PT, and 11 (12%) received OT/PT but not ST.

As shown in Table 1, there was considerable variability in the number of treatment sessions in which children participated, although, on average, those who received an intervention engaged in more than 100 treatment sessions. The majority of sessions were 30-minutes duration.

Primary Analyses

The 3-way MANOVA focusing on language-related subtests yielded no significant main effects for Intervention [ST: $F(2,80) = 1.50$, $p = .23$, $\eta^2 = .04$; OT/PT: $F(2,80) = .97$, $p = .39$, $\eta^2 = .02$]. In contrast, a significant main effect was observed for Time [$F(2,80) = 3.93$, $p = .02$, $\eta^2 = .09$] such that Phonological Processing improved significantly over time ($p < .05$), while performance on the Comprehension of Instructions subtest declined significantly over time ($p < .05$). Neither the ST x Time [$F(2,80) = 2.38$, $p = .10$, $\eta^2 = .06$] nor the OT/PT x

Time [$F(2,80) = 1.26, p = .29, \eta^2 = .03$] interaction reached statistical significance (see Figure 1).

The MANOVA focusing on motor subtests yielded significant main effects for OT/PT [$F(2,80) = 3.86, p = .03, \eta^2 = .09$] and Time [$F(2,80) = 4.97, p < .009, \eta^2 = .11$], but not for ST [$F(2,80) = .71, p = .49, \eta^2 = .02$]. Children receiving OT/PT, relative to those not receiving the intervention, performed more poorly on both Sensorimotor subtests irrespective of time (both $p < .01$). Performance of all children improved over time on the Imitating Hand Positions subtest ($p < .01$), but there was no significant time-related change on the Visuomotor Precision subtest ($p > .10$). Notably, there was no differential effect of either treatment; the OT/PT x Time [$F(2,80) = .89, p = .42, \eta^2 = .02$] and ST x Time [$F(2,80) = .52, p = .60, \eta^2 = .01$] interactions were not significant (see Figure 2).

The hierarchical linear regressions assessing the impact of service intensity (i.e., number of hours of service received) did not significantly predict changes in language or motor outcomes. After accounting for T1 scores, the number of hours of ST accounted for less than 1% of the variance in outcome as measured by the Phonological Processing and Comprehension of Instructions subtests. The number of hours of OT/PT accounted for a greater amount of variance in motor outcomes, as measured by the Imitating Hand Positions (6.7%) and Visuomotor Precision (6.5%), but these relations were not statistically significant (both $p > .10$).

Secondary Analyses

ADHD severity—The MANOVA focusing on ADHD symptom severity as measured by parent and teacher ratings yielded significant main effects for OT/PT [$F(4,61) = 2.89, p = .03, \eta^2 = .16$], but not ST [$F(4,61) = 1.53, p = .21, \eta^2 = .09$]. There was also a significant main effect of Time [$F(4,61) = 10.34, p < .001, \eta^2 = .40$]. There was no differential effect of treatment; the OT/PT x Time [$F(4,61) = .86, p = .49, \eta^2 = .05$] and ST x Time [$F(4,61) = 1.10, p = .36, \eta^2 = .07$] interactions were not significant. Further exploration of the significant OT/PT main effect indicated that irrespective of time, children receiving OT/PT were rated as more inattentive by parents ($p = .02$) and, to a lesser extent, teachers ($p = .07$) as compared to those not receiving OT/PT. Neither informant rated OT/PT recipients as more hyperactive than children not receiving the intervention ($p > .10$). Finally, severity of symptoms diminished over time irrespective of treatment, as measured by parent ($p = .002$) and teacher ($p = .03$) ratings of inattention, and parent ($p < .001$) but not teacher ($p = .09$) ratings of hyperactivity. None of the eight hierarchical regression analyses indicated a significant dimensional association between the amount of service received and change in Inattention or Hyperactivity/Impulsivity severity as rated by parents or teachers (all $p > .10$).

Social skills—The 3-way MANOVA examining social skills outcomes yielded a significant main effect for Time [$F(2,56) = 9.55, p < .001, \eta^2 = .25$]. Teacher ($p < .001$), but not parent ($p > .10$) ratings indicated significant improvement in social skills over time. The OT/PT [$F(2,56) = 1.84, p = .17, \eta^2 = .06$] and ST [$F(2,56) = .25, p = .78, \eta^2 = .01$] main effects were not significant. Notably, the ST x Time [$F(2,56) = 11.59, p = .001, \eta^2 = .30$] interaction was significant. Both parent ($p < .001$) and teacher ($p = .013$) ratings indicated

significant gains in social skills among those who received ST relative to those who did not receive ST (see Figure 3). The OT/PT x Time interaction [$F(2,56) = 3.14, p = .051, \eta^2 = .10$] approached significance. However, this latter interaction was due to the fact that the social skills of those receiving OT/PT were rated as getting somewhat worse by parents ($p = .02$), but not teachers ($p > .10$). Dimensional analyses did not reveal any significant associations between the amount of services received and social skills outcomes (all $p > .10$).

DISCUSSION

More than half of our sample of hyperactive/inattentive preschoolers received an auxiliary service in the form of OT, PT or ST, with a substantial proportion receiving more than one of these interventions. However, we could not find evidence for the effectiveness of these services for addressing motor or language abilities areas specifically targeted by the treatment. Specifically, children receiving OT/PT did not show differential improvement in motor skills and those receiving ST did not show evidence of differentially greater improvements on language-related measures. Neither of these interventions impacted the severity of ADHD symptoms; however, children who received ST demonstrated significant improvements in social skills as rated both by parents and teachers.

The lack of an effect of these services on ADHD symptom severity may not be surprising, as these interventions are not designed to target or remediate inattention, impulsivity and/or hyperactivity. However, the lack of treatment-related improvements in motor and language functioning is noteworthy. OT/PT might be expected to improve motor skills. Notably, children who received these services had poorer motor functioning as compared to those who did not receive services, suggesting that our measures were sensitive to their deficits. However, the receipt of services did not diminish the gap between the groups. Similarly, ST might be expected to yield improvements in language functioning, but did not in the present study. Notably, these findings were consistent irrespective of whether the analyses were categorical (i.e., whether or not the service was ever received) or dimensional analyses (i.e., amount of intervention received). Our inability to detect evidence for effectiveness within these domains raises questions regarding the utility of these pull-out services for youngsters with hyperactive/inattentive symptoms and suggests the need for further research.

Overall, the lack of apparent effectiveness for these interventions in hyperactive/ inattentive children is concerning in light of the vast resources, both temporal and monetary, that goes into their delivery. One possible explanation for the findings could be that children who receive interventions are more impaired than their counterparts who do not receive services, and that a two-year period of time is not sufficient to measure lasting improvement. Furthermore, although these children did not make the expected treatment-related gains during the study period, it is possible that these interventions prevented deterioration and that the schism between those receiving and not receiving services would have been wider in the absence of intervention(s). Additionally, it is possible that the benefits of these interventions might be more apparent when children get older, at which point those who received interventions may catch-up to their counterparts. A randomized controlled trial with provisions for follow-up assessments would be necessary to address these caveats.

It is notable that the one area in which services seemed to have a positive impact was social skills ratings. More specifically, hyperactive/ inattentive children who received ST showed improvement in parent-rated social skills, while children who did not receive services showed a decrement. As rated by teachers, social skills improved over time irrespective of service group, but those receiving ST demonstrated incrementally greater improvement. Similar findings were reported by Almost and Rosenbaum (1998) following speech and language therapy. ST may benefit social skills through modeling and reinforcement of appropriate social behaviors, such as encouraging others and taking turns during the service session. In addition ST is often conducted in small groups of two to three children, which allows the facilitator to monitor and foster appropriate social conduct. Finally, because communication is such an important factor in social development, it is possible that improvements in speech and language that were not detected by the NEPSY subtests may have had a positive impact on social skills. While the number of analyses conducted in this study raises the possibility that the finding of ST-related enhanced social skills represents a Type I error, the fact that similar findings were independently generated by parent and teacher reports allows for greater confidence that the finding is valid. In addition, different teachers at the two rating periods, reduce the methods bias associated with parent reports. Further investigation is necessary to determine the veracity of this finding, and if correct, the mechanism(s) of action by which social skills are enhanced.

It is important to note that this naturalistic follow-up study, which was not designed to evaluate intervention efficacy, has several limitations. First, assignment to treatment was not randomly determined. As suggested by the differences between those who did and did not receive services, substantial selection biases likely influenced who received auxiliary services. A randomized controlled trial is necessary before any firm conclusions regarding the efficacy of these interventions in children with ADHD can be made. Second, because the larger study was not designed to assess the impact of OT, PT and ST, the neuropsychological outcome measures may not have had the optimal sensitivity to more precisely evaluate the benefits of the interventions on the targeted behavior. Third, although we were able to acquire data regarding the type and amount of treatment each child received, we were not privy to detailed treatment plans, limiting our knowledge of specific techniques employed by the service providers. An additional limitation was lack of power to examine PT services in more depth; there were not enough children who received PT and none received that intervention alone. Considering the fact that extant research into the efficacy of PT is limited primarily to children with cerebral palsy and other severe motor problems, these data suggest a real need for better controlled studies in children with hyperactive/inattentive symptoms or those with a diagnosis of ADHD. Further, caution must be used when generalizing these findings to children diagnosed with ADHD. Although the majority of children in this study did go on to meet criteria for ADHD, many did not meet full criteria when they entered the study as preschoolers (O'Neill et al. 2014). Lastly, parental report of services use may not be reliable.

Auxiliary service delivery is enormously costly, which places a tremendous financial burden on the educational system (Marks et al., 2009). To justify the financial burden on the community there needs to be evidence that services are helpful to young children with inattentive/hyperactive symptoms. Additionally there is an opportunity cost associated as

most children are taken out of the classroom to receive these services. If children are pulled out from their education programs for services, they may miss valuable classroom instruction or fall behind in their assignments. Children who receive multiple services, implemented multiple times a week, can spend many hours outside of the classroom. The benefit of being pulled out of the classroom needs to be weighed against the costs of missed classroom instruction. Finally, the time that children are engaged in potentially ineffective interventions may limit them from engaging in more therapeutically beneficial interventions. This is especially important if there is a critical developmental window during which these services are the most helpful for hyperactive/ inattentive children.

Overall, these data raise questions about the effectiveness of OT and PT, as delivered in the community to preschoolers with hyperactive/inattentive symptoms. The receipt of ST, in contrast, showed benefits in parent- and teacher-reported social skills. Although these services are not specifically designed as therapeutic interventions for symptoms of ADHD, there is no question that many, if not most, hyperactive/inattentive preschool children receive at least one of these interventions. Our failure to detect benefits, coupled with the paucity of available scientific research, suggests a need for further investigation into the utility of these commonly-used auxiliary services. With such data in hand, evidence-based policy decisions can be more readily framed.

Implications for Practice

Although auxiliary services for preschool children with hyperactivity/impulsivity need further exploration, current evidence does not indicate differential improvement of ST and OT/PT in targeting improvements in language and motor functioning, respectively, in this population of children. Therefore, clinicians need to be prudent in making recommendations of these auxiliary services and take into account the limitations of the intervention(s) in addition to the economic and time burden prior to approval/implementation. Notably, ADHD symptoms are potential impediments to the benefits of auxiliary services and should potentially be addressed in order to optimize the value of these services. Given that preschoolers who received ST in the present study showed improved social skills, hyperactive/inattentive preschool children who also have impoverished social interactions may represent a subgroup of individuals uniquely positioned to benefit from ST. Lastly, clinicians are encouraged to use objective, clinically sensitive benchmarks to determine if the prescribed services are yielding beneficial results.

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Figure 1.

The effect of speech and language therapy (ST) on language measures. Overall MANOVA ST x Time interaction $F(2,80) = 2.38, p = .10, \eta^2 = .06$.

Note. ST = Speech and Language Therapy, + = service received, - = service not received

Figure 2.

The effect of occupational/physical therapy (OT/PT) on motor measures. Overall MANOVA OT/PT x Time interaction [$F(2,80) = 1.26, p = .29, \eta^2 = .03$].

Note. OT = Occupational Therapy; PT = Physical Therapy, + = service received, - = service not received

A. Parent Ratings of Social Skills

B. Teacher Ratings of Social Skills

Figure 3.

The effect of speech and language therapy (ST) on social skills as rated by A) Parents and B) Teachers. Overall MANOVA: ST x Time interaction, $F(2,56) = 11.59$, $p = .001$ $\eta^2 = .30$.

Note. ST = Speech and Language Therapy

Table 1

Amount of Services Received

Service	Number of sessions		Duration of Sessions (min.)	
	Mean (SD)	Range	Mean (SD)	Range
OT	126.47 (60.94)	22–260	32.27 (7.61)	30–60
PT	117.60 (67.46)	34–260	33.75 (10.25)	30–60
ST	154.02 (115.58)	7–622	32.81 (7.35)	30–60

Note. ST = Speech and Language Therapy; OT = Occupational Therapy; PT = Physical Therapy