

## **Critical Review: The effect of sign language on speech production in children with developmental disabilities**

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This critical review examines the effects that introducing manual sign to children with a developmental disability has on their oral language development. Study designs include: single participant withdrawal, single-participant multiple baseline, longitudinal case-study, and single participant alternating treatment. Overall, research to date shows no negative impact of sign language on the speech production of children with developmental disabilities and there is evidence suggestive of a positive effect of using manual sign as a means of facilitating speech production, with more methodologically sound research warranted.

### ***Introduction***

It is common for children with developmental disabilities to have severe speech and language impairments requiring interventions using augmentative and alternative communication, AAC (Schlosser & Sigafos, 2006). The use of AAC has been shown not only to improve functional communication in individuals, but can also be used to develop language skills, and thus need not be introduced only after traditional language intervention has failed (Ronski & Sevcik, 1996). In fact it has been suggested that the use of AAC can facilitate the production of speech in individuals with developmental disabilities (Ronski & Sevcik, 1997).

There exist many different AAC options and devices, and clinicians and families are faced with an often complex choice in deciding the appropriate AAC intervention. One common intervention is the use of manual signs, alone, or in addition to speech.

There have been several theories suggested as to why the use of manual signs would have a positive effect on language and speech production in children with developmental disabilities. Research has shown that children with Down syndrome produce fewer spoken words, but more gestures when compared to typically developing children (Stefanini, Caselli, & Volterra, 2007). Exploiting this gestural strength could bypass impaired motor and cognitive systems necessary for speech production, allowing the individual to establish basic communication through other means. It has also been posited that signs can provide a more consistent model than speech for children

with developmental disabilities (Millar, Light, & Schlosser, 2006). Gestural input can provide additional cues for learning referential linguistic concepts and can bypass auditory processing difficulties a child may have. Further, the signed language that is used with children with developmental disabilities is often less complex than spoken language. It could be easier for a child to extract the meaning from this morpho-syntactically simpler sign language than from speech (Kouri, 1988).

Despite the fact the use of signs is a well established and comparatively old AAC intervention, parents are often hesitant to introduce sign language as an AAC intervention. They often express concerns that sign may inhibit the speech production of their child, because the child will find signing easier than speech and won't be motivated to talk (Millar et al., 2006). The relationship between sign language and speech production in children with developmental disabilities is important to understand, so professionals can provide the most effective speech and language treatment to this population, as well as provide families and clients with information to help them make an informed and appropriate choice regarding AAC interventions.

### ***Objective***

The primary objective of this paper is to critically evaluate existing literature regarding the effect of manual signing on speech production in children with developmental disabilities. The secondary objective is to propose evidence based recommendations for

future research as well as clinical implications of the findings.

## ***Methods***

### Search Strategy

Research articles were found using a computerized database search, including Medline, PsycINFO, CINAHL, and ProQuest Education. The search was limited to articles written in English between 1980 and 2007. The following search strategies were used:

((Speech) OR (oral) OR (verbal)) AND (production) OR (express\*)) AND ((ASL) OR (AAC) OR (sign language) OR (manual sign)) AND ((mental retard\*) OR (develop\* delay) OR (develop\* disability) OR (cognitive impair\*) OR (down syndrome)) NOT ((hearing) AND (impairment) OR (loss) OR (disable\*)) OR (hard of hearing) OR (deaf))

Hand searches of references cited in articles identified through the search strategy were also completed to identify additional relevant articles.

### Selection Criteria

The studies selected for this critical review were required to investigate the use of interventions involving manual sign in children with developmental disabilities and include some evaluation of the effect of the intervention on expressive speech. Studies that included aided AAC interventions (e.g., voice output devices) were excluded. However no restrictions related to subject demographics or outcome measures were applied.

### Data Collection

The search identified seven studies that met the selection criteria outlined above. These studies included single participant withdrawal (1), single-participant multiple baseline (1), longitudinal case-study (1), single participant alternating treatment (4) designs. See Table 1 for a summary of results.

## ***Results***

Kouri (1988), conducted a study examining a child-directed treatment approach using Simultaneous Communication (speech + manual signs) in an ABAB withdrawal design. Five

children with developmental delays, between the ages of 2-5 attended individual treatment sessions twice a week for 8 months. During the sessions, the clinician provided child-oriented modeling of speech and sign (or speech alone during the baseline period) with no response demands placed on the child. Following the initial treatment phase, a withdrawal phase was instituted followed by a second treatment phase. The responses of the children were recorded and inter-observer reliability was on average 93.5%.

Results of the study showed that the children were able to acquire signed and/or spoken language in the child-directed treatment setting. All the participants' productive vocabulary (signed and spoken) did increase following intervention. There was a great deal of variability between participants, with each showing a unique pattern of language growth. Some increased greatly in their use of sign, while others showed gains in terms of social communicative factors (e.g., eye contact and episodic interactions). Three of the five children demonstrated an increase in spoken words during the study when compared to their performance at baseline. Two of the children showed a decrease in spoken words; however the decrease in words was minor, given the low level of words spoken in the baseline. No statistical analysis are provided to show whether the differences seen pre and post intervention were significant, thus an increase from 8 words to 83 words and a decrease from 4 words to 0 words are equivalent changes, which limits the results of the study. Further, as mentioned in the article, the withdrawal design was not able to test the treatment effect, due to the irreversible nature of communication skills, meaning a decrease in performance during the withdrawal period would not be expected.

Kouri's case study (1989), outlines a longitudinal study of a 2 year old with Down Syndrome, similar to the intervention in Kouri (1988). Child-directed therapy was provided using speech and sign input and all responses were recorded and coded, with results presented in raw numbers and percentages. Over an eight month period, 232 new words were produced by the child. Initially, 56% of utterances were signed by the child, but by the end of the study, only 14% of utterances were signed. Kouri found that the majority of spoken words that the child produced were initially signed, and details a variety of transitional patterns from imitated

sign to spontaneous speech. Further, it was found the participant primarily produced words she had seen the clinician sign, with only 16% of her produced words not initially signed by the clinician. The author concluded that there was a contingent relationship suggested between the participant's signed and oral expression, and that the signing facilitated rather than impeded her oral expression. As with all case studies, the small sample and lack of experimental control are limitations, however the detail of the data collected and length of the study allow for a better picture of the long-term effects of signing on speech than some of the more controlled experimental designs.

DiCarlo, Stricklin, & Banajee (2001) examined the effect of manual signing on the communication of both delayed and normal toddlers in a preschool setting. Nine children with disabilities were included in the study which employed a multiple baseline design across two groups. The study examined the children in four activities, one which was a control throughout, and three where the teacher began to use total communication in her interactions with the children. The communications of the children were recorded and descriptive statistics of the group as a whole were provided. Analysis revealed that there was a minimal increase in the children's signing and their verbalizations. The children with disabilities were measured as having 20% verbalizations at baseline and 24% at intervention, while there was no change seen in verbalizations during the control activity. A major limitation of this study is the fact that the results are provided for the group, rather than examining the behaviour of the individual participants. It is not possible to determine whether or not the increase in verbalizations was evident across all the children or if some children showed a decrease in verbalizations while others showed a larger increase, resulting in the overall increase. A positive aspect of this study is the fact it examined performance in a more natural environment than the other studies, which took place in private therapy sessions.

Four of the studies used an alternating treatment design to compare two intervention approaches within a single-subject. The first of these, by Sisson & Barrett (1984), compared the use of total communication (speech and sign) to speech alone in training sentences to 3 children, ages 4-8, with developmental disabilities.

Following baseline testing, training took place twice a day, once using each experimental condition. In both experimental conditions children were taught equivalent sentences through the use of chaining (teaching one word to criterion and then adding a second word). In the total communication condition, children received signed and spoken prompts and were able to respond with speech and/or sign, while in the oral condition they received only spoken prompts and required spoken responses. The results showed that total communication facilitated 100% mastery for two of the three children while oral training yielded only small gains. The remaining child, who was the youngest, showed some gains in both conditions but less differentiated effects. The researchers suggested that the age of the child may have had an effect on his performance. No tests of statistical significance were performed on the data, but rather provided in graphs, which makes it difficult to determine the significance of the difference seen between the two conditions.

The remaining three alternating treatment designs were by one group of researchers and used a similar design for each study, while examining different questions. In Clarke, Remington, & Light (1986), the acquisition of signs that were and were not in the receptive vocabulary of the child were compared. Three children, ages 6-11, all with developmental disabilities, participated. In Clarke, Remington, & Light (1988), the acquisition of signs using total communication and sign alone training were compared. Four children, ages 5-9, with developmental disabilities, participated. Finally, in Remington & Clarke (1993), they compared the acquisition of signs using Differential Sign Training, and Extensive Sign Training. This study involved five children between the ages of 4 and 11. All three studies followed an alternating treatment design, in which the children, following baseline testing, participated in two daily sessions, one for each experimental design. The participants were taught single words from picture referents using behavioural reinforcements and the particular experimental condition until the children demonstrated acquisition of the word. After the treatment period, post-treatment testing was completed to assess the participants' acquisition of the signs. All three studies also included assessment of speech production, and so can be examined for the effects of sign on speech production.

Clarke et al. (1986) found that signs corresponding to words for which the children showed receptive knowledge during baseline testing were acquired more quickly than those for which they had no receptive knowledge. The children received expressive speech posttests. It was reported only one of the three children developed her expressive speech as a result of sign training, improving from 66% to 98% on known words, and from 0% to 42% on unknown words. The results of the other two participants were not provided, so it is not known whether they showed no change or a decrease in verbalizations. The researchers suggest that receptive speech skills are what mediate expressive speech skills more than signing, indicated by the fact the one participant who improved expressive speech skills was the one who improved receptive knowledge of the unknown words.

Clarke et al. (1988) found that children acquired signs using both total communication and sign alone, but required fewer trials using total communication, a difference which was statistically significant. Two of the five children showed an improvement in their expressive speech in both conditions, but there were statistically significantly greater gains seen in the total communication condition than the sign-alone condition. The remaining three children showed no change in their expressive speech skills. It is important to note that the two children who showed improvement in their speech production were also the only two children who were able to reliably imitate speech in the baseline testing, which may be a possible explanation for their improvement compared to the other participants, and a more important factor in facilitating or inhibiting speech production than use of sign.

Finally, Remington & Clarke (1993) found three of the five children showed an increase in expressive speech, specifically in the Differential Sign Training condition, where prompts for the sign were given using a picture referent as a cue on only 50% of the trials (instead of 100% of the trials in the other condition). A fourth participant showed no expressive speech and a fifth child was not assessed for expressive speech because he showed no evidence of speech comprehension following training. Similarly, no pre-treatment testing of expressive speech was completed

because the words to be trained were unknown, thus the researchers assumed that words not receptively known could not be expressively produced. This is a reasonable assumption, however, completing pre-treatment testing would have allowed for more compelling evidence around the improvement of expressive speech post-treatment and could have confirmed their assumption.

## *Discussion*

### Appraisal of the results

The research evidence appears to indicate that the use of manual sign in children with developmental disabilities has no negative impact on their speech production and may show a positive effect on expressive speech. However, several issues with respect to the methodology, sample size, purpose and statistical analysis impact negatively on the strength of the evidence of the research available.

### Participants

A limitation of much research in the area of Speech-Language Pathology is the small sample size. Although there are seven studies reviewed, they total only 30 individual participants. It may in fact be fewer than 30 individuals as it appears both Kouri (1988 and 1989) and Clarke et al. (1986 and 1988) used the same participants in multiple studies. Small effects may be present but due to the small sample sizes not evident. Many of the studies comment on the variability of performance of the participants, and this is expected in a heterogeneous population such as the developmentally disabled. It is likely there are confounding variables affecting the abilities to improve oral expression outside of the use of sign language. This makes it difficult to generalize the results of the participants to other populations. Kouri (1988) suggests that a factor that may have had a strong influence on the children's progress was the involvement of the parents and their use of sign. Although this was not measured, it was suggested that if the parents signed to the children outside of the therapy sessions, this added exposure may have facilitated language acquisition.

### Method

Only three of the studies used child-centred intervention in a play or school context. The remaining four used highly structured behavioural therapy, on a limited number of non-functional vocabularies. Thus, the applicability of these studies is limited. A more natural environment and the inclusion of greater communicative functions or wider vocabulary could have provided more useful information about the clinical importance of this research. This also may have resulted in ceiling effects, which may under-represent the effects of manual sign intervention on expressive speech. The largest gains in verbal expression were reported in Kouri (1988) and Kouri (1989), in which data was collected in a natural play environment, so no ceiling effects were present. In the Clarke et al. (1986), Clarke et al. (1988), Remington & Clarke (1993), and Sisson & Barrett (1984), speech data was collected during naming tasks in which a limited number of words had been introduced using manual signs and verbal responses were limited to the words introduced. In these cases the absolute speech gains may seem more modest, but when considered relative to the experimental task, the improvement is more impressive.

The length of the intervention may also be under-representing the positive impact of sign language on oral production. In the studies taking place over longer periods of time (Kouri, 1988), (Kouri, 1989), again more significant gains in speech production are seen. In Kouri's (1989) case study, she shows that in the initial four months of the study, the child produced a greater number of signs, but the latter four months there was a predominance of speech over sign. Perhaps longer intervention times in other studies would have resulted in greater gains in speech production.

#### Purpose

None of the studies had the primary goal of examining the effect of sign language on expressive speech, and as a result there are significant limitations to the research with respect to the objective of this critical review. Since the purpose of the studies was not to examine oral expression, aside from Clarke et al. (1988), there is no statistical analysis provided by the research with respect to speech production, other than descriptive statistics. Likewise, only two studies, Sisson & Barrett

(1984) and Kouri (1988), established experimental control between the intervention of manual sign and speech production, providing stronger evidence about the effect of sign language on verbal expression than the remaining studies, which failed to establish experimental control with respect to their intervention and expressive speech. Further, the studies involve total communication, the use of manual sign in addition to speech. With the inclusion of speech in the interventions, it is difficult to say conclusively that the manual sign is improving the speech production of the children, and not the oral aspect of total communication, although several studies mention participants had previously been unsuccessful in speech therapy (Kouri, 1989) (Sisson & Barrett, 1984). While these studies may have been well-designed and provide compelling evidence for their particular research question, with respect to the question of this critical review; the effect of sign language on speech production in children with developmental disabilities, the evidence they provide is less compelling.

#### *Conclusions*

A critical review of the present research has shown no evidence of manual sign having a negative impact on the development of speech in children with developmental disabilities. Furthermore, it suggests that using manual sign with these children can help facilitate oral language.

#### *Recommendations*

The current research indicates clinicians can consider introducing sign language without concern of impeding the development of oral production in children with developmental disabilities. Clinicians should consider the use of manual sign, alone or in conjunction with oral production, initially in intervention with children with developmental disabilities who have severe speech production deficits, rather than as a last resort once speech therapy has failed. In so doing, they provide a functional means of communication for these children, facilitating social interaction and communicative success. Further, it provides a language base through which receptive and expressive language

knowledge can be accessed and targeted in therapy.

Family members and caregivers should also be well informed by clinicians that introducing manual sign will not repress or impede the development of a child's speech, and may in fact facilitate increased speech in the child in the future while allowing a communicative channel for the child in the present.

Additionally, further research can be recommended to provide a clearer view of the relationship between sign language and speech production in this population. Research is needed, in which the primary objective is an examination of the effect of sign language on speech production, with rigorous data collection and appropriate statistical analyses, in order to confirm the current research. Secondly, research conducted over a longer period of time, in more natural contexts should be considered. This would avoid ceiling effects and allow adequate time for true gains in speech production to be seen. Finally, research should be undertaken to examine potential variables influencing expressive production, both spoken and signed, in this population, such as receptive language skills or parental involvement in treatment procedures. Such research will allow for stronger conclusions to be made and better inform clinical practice.

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**Table 1:** Studies involving sign intervention with documented speech production outcomes in children with developmental disabilities.

<b>Reference</b>	<b>Design</b>	<b>Goal of Study</b>	<b>Participants</b>	<b>Intervention</b>	<b>Reported Effects on Speech</b>
Clarke, Remington, & Light (1986)	Alternating treatments (comparison of known vs. unknown words)	Teach single words	3 children with MR, 6-11 years old	Daily training sessions using Total communication (manual sign + speech) with picture referents	Increase in 1 child, 2 children unknown
Clarke, Remington, & Light (1988)	Alternating treatments (comparison of total communication vs. sign alone)	Teach single words	4 children with MR, 5-9 years old	Daily training sessions using Total communication or sign alone with picture referents	Increase in 2 children
DiCarlo, Stricklin, & Banajee (2001)	Multiple baseline (teacher directed total communication intervention across classroom activities)	Teach single words	12 children with various diagnoses, 1-3 years old	Teacher modeling of Total communication in structured daily classroom activities	Increase (reported as group)
Kouri (1988)	Treatment withdrawal	Teach single words	5 children with various diagnoses, 2-4 years old	Twice weekly treatment of child oriented modeling of total communication	Increase in 3 children, decrease in 2 children
Kouri (1989)	Longitudinal case study	Teach single words	1 child with Down syndrome, 2;8 years old	Twice weekly treatment of child oriented modeling of total communication	Increase
Remington & Clarke (1993)	Alternating treatments (comparison of Differential Sign Training vs. Expressive Sign Training)	Teach single words	4 children with MR, 4-11 years old	Daily training sessions using total communication (differential or expressive conditions) using picture referents	Increase in 3 children, no change in 1 child
Sisson & Barrett (1984)	Alternating treatments (comparison of oral vs. total communication)	Teach 2+ word combinations	3 children with MR, 4-8 years old	Daily training sessions of sentences using chaining with oral or total communication using picture referents	Increase in 3 children

MR= Mental Retardation