The link between gesture and speech in children with Down syndrome

Research evidence suggests that, for typically developing children, spoken language and gesture develop alongside one another during early language development[1,2,3]. Once children have begun to demonstrate two-word speech, there is a gradual reduction in new gesture learning and frequency of gesture use with increasing spoken language acquisition[3]. Thus, though children do continue to use gesture, this becomes less frequent as children develop spoken language skills. The relationship between gesture and speech for children with Down syndrome is less clear. For many children with Down syndrome, speech and language skills are poor relative to their general cognitive abilities[4]. It may be expected then, that because of these speech and language difficulties, children with Down syndrome are more reliant on gesture to convey understanding. This was the focus of a recent paper by Silvia Stefanini and colleagues.

In this study, 15 children with Down syndrome (aged 3-8 years) were compared to 2 groups of typically developing children: a group matched for chronological age, and a second, younger group matched for mental age. The children were asked to name pictures, and the researchers recorded both spoken language production and gestural production during the task.

When children were compared on their spoken accuracy, children with Down syndrome produced fewer correct and more incorrect spoken responses than the typically developing children. Closer inspection of verbal responses highlights the speech articulation difficulties of the children with Down syndrome: many correct answers were phonologically altered and many incorrect answers were unintelligible productions.

Analysis of gestural production showed that all children used gesture, though the older typically developing children were less likely to do so than either of the other two groups, reflecting the decreasing use of gesture with increasing spoken language competence previously noted in typically developing groups. Children with Down syndrome gestured more frequently than the typically developing children and, in particular, were more likely to use iconic gestures. Iconic gestures are those that represent the meaning of the target picture, typically by performing the action of an object (e.g. moving fingers as though combing hair in response to “comb”). Typically developing children of the same mental-age as the children with Down syndrome also used iconic gestures, though these were often produced alongside the correct spoken answer. In this case, the gesture elaborated or added to the verbal response. In contrast, children with Down syndrome were more likely to use gesture without accompanying speech than typically developing children. Furthermore, the correct meaning of the target word could be expressed in gesture even when it was accompanied by incorrect speech. Thus, for this group, iconic gestures were often used as an aid to convey meaning. Including gestures which correctly conveyed the target meaning into the spoken accuracy data resulted in a significant increase in scores for children with Down syndrome, though accuracy was still poorer for this group than for the typically developing groups.

This paper suggests that children with Down syndrome use gestures to convey conceptual understanding. For this group, linguistic abilities are typically impaired relative to cognitive abilities. Difficulties with speech and language mean that, while gestures become a less important means of communication for typically developing children as spoken language increases, for many children with Down syndrome, gestures are more efficient vehicles for demonstrating understanding than verbal expression alone. For this group then, gesture and speech interact to convey meaning. Gestures are therefore a very important means by which children with Down syndrome communicate and interact with others.

Original research paper

FURTHER READING

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MEMORY

Music may improve verbal memory – Implications for children with Down syndrome

Working memory is the ability to keep information in your mind for a short time, focus on a task and remember what to do next. Within the working memory system, children with Down syndrome have a particular difficulty with verbal short-term memory[5]. They find it harder to remember verbal information than visuo-spatial information in short-term memory tests[5]. It is considered that the verbal short-term system, namely the phonological loop, is a major reason for the speech and language delays seen in children with Down syndrome[5]. Until
recently, it had not seemed likely that the adverse consequences of low working memory could be overcome\(^8\). However, significant and sometimes remarkable gains in verbal short-term memory have been found both using a parent-delivered intervention to improve digit span\(^9\), and using interactive and adaptive computerised memory training programmes\(^6,7\).

Also, in the last decade, researchers have begun to investigate in detail how experiences can affect brain structure and cognitive function\(^8\). One particular study compared the brain structures of a group of musicians and non-musicians, and they found that individuals with musical training tended to have an enlarged left temporal lobe when compared to individuals without musical training\(^9\). Indeed, studies of patients with brain damage have shown that the left temporal lobe primarily mediates verbal memory, and that visual memory is mainly processed by the right temporal region\(^10\).

Ho, Cheung and Chan found results which suggest that children with musical training demonstrated better verbal (but not visual) memory than those without such music training\(^11\). In their first experiment, ninety male participants aged 6-15 years were recruited from a school in Hong Kong. Forty-five of the participants had some level of musical training (MT) of between 1-5 years, and the rest had no musical training (NMT). The two groups were matched for age, education level and socioeconomic status. Results showed that participants in the MT group generally recalled more words than the NMT group. They also found that there were no significant differences in visual learning abilities between the MT and the NMT group. This suggests that musical training has no impact on visual memory.

Ho et al. also investigated the duration of music training to explore how this impacted on verbal and visual memory. They found that even when ruling out possible confounding factors (age and education level), there was a significant relationship between the duration of musical training and the participant’s verbal learning score \((r = 0.54, p < 0.001)\). A similar analysis was carried out between duration of music training and visual learning and visual memory and the relationship was low \((r = 0.22 \text{ and } 0.21 \text{ respectively})\). Ho et al. consider that these results are not just specific to a Chinese population, as a similar verbal memory advantage has been demonstrated in young adults with musical training in Canada\(^12\).

In their second experiment, Ho et al. conducted a longitudinal analysis which suggested a causal effect of music training on the improvement of verbal memory. They tracked and compared changes in verbal memory among a sub-group of children who began, continued, or finished musical training within a 1 year period. Prior analysis confirmed that there were no significant differences between the three groups on age, education level, general intelligence and verbal and visual memory abilities. Analysis showed that the verbal learning ability of the beginners group was significantly lower than those of the continued and discontinued training groups at the beginning of the study. One year later, the continued group demonstrated significant improvement in verbal memory, but the discontinued group however did not change. To summarise, children who had received one year of music training (regardless of their musical background), demonstrated lasting improvements in verbal learning and retention abilities. This study clearly suggests that musical experience affects the development of cognitive functions.

It is considered that speech and language development localises in the left hemisphere in the brain, whereas musical stimuli is generally processed in the right hemisphere\(^13\). However, some neurophysiological data suggests that music processing shifts from the right hemisphere to the left, as experience increases\(^14\).

This may go some way to explain why children with speech and language difficulties can respond well to language through music\(^15\). To summarise, musical training may improve verbal memory in typically developing children and this may have implications for planning new speech and language interventions for children with Down syndrome.

6. www.connm.com
7. http://www.masteringmemory.co.uk

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