Can deaf children’s working memory span be increased?

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Working Memory (WM)² is the ability to keep information in mind while working on the information at the same time. For example, when we add mentally, we need to think of the numbers we are adding, carry out the addition, and keep the result in mind all at the same time. WM is measured in spans, which indicate the amount of information that we can operate on and recall at the same time in the WM tests. WM is important for learning in school and some, but not all, deaf children have lower WM spans than hearing children. We also reported that profoundly deaf children have an average span that is 0.31 points smaller than the span of hearing children of comparable age and cognitive ability. Remember this value when you read about the results of a training programme designed to improve deaf children’s performance in WM assessments.

It was previously thought that WM is a fixed ability and cannot be improved through practice, but in the last ten years different programmes have succeeded in improving children’s WM. This article is about a teaching programme designed to increase deaf children’s WM span. The programme was developed with the support of the National Deaf Children’s Society (NDCS); BATOD contributed to this research by inviting teachers to participate through the magazine.

In order to assess the effectiveness of the programme, we compared the children who participated in the programme with a baseline group. In the first year of our research, teachers obtained permission for 80 children to be assessed in three WM tasks so that we could have a baseline of how well deaf children do in these tasks. The children were assessed twice with an approximate interval of six months between the assessments. In the second year, the teachers implemented with 73 children a programme designed to increase their WM span. The children were assessed before they started the programme (the pre-test) and again approximately six months

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² See the BATOD Magazine, September 2011 for more information about WM.
after they had been included in the programme (the post-test); so the interval between pre- and post-test was comparable for the baseline and the intervention groups.

What did the children do during the intervention?

WM performance is closely related to the children’s ability to control their own attention and to the way in which they rehearse the information in order to memorise it. Because attention control and planning require that the children think about how they will carry out the task, these abilities are called meta-cognitive skills. Some training programmes have successfully used meta-cognitive skills (e.g. Kloo & Perner, 2003). WM also depends on automatic processes and other training programmes have focused on improving automatic attention in order to improve WM (e.g. Kingberg, Fernell, Olesen, Johnson, Gustafsson, Dahlström et al., 2005). Our intervention combined games designed to improve both types of ability. All the games were played using a computer.

The meta-cognitive component involved teacher-led games, in which the teacher or teaching assistant supported the child by demonstrating rehearsal activities and rehearsing with the child in the first trials in each game. There were screens that reminded the child that rehearsal is important. The automatic attention component involved computer games that were played on our website; there were no prompts to help the child rehearse. For this reason, we suggested to the teachers that the children should start on the web games after they had learned some strategies that they could use when playing games on their own.

The full programme includes three teacher-led and three computer games with seven levels of difficulty. The children should move on to the next level of difficulty as soon as possible, so that they are always challenged, but not too soon so that they don’t get discouraged. You can find out more about the programme by visiting our website; our research team can help you and your school if you need training to start using the programme.

http://www.education.ox.ac.uk/research/child-learning/resources-2/

Figure 1 illustrates a teacher-led game in which the children are asked to count the number of ducks on a screen, then count the number of monkeys on the next screen, then type the number of ducks and monkeys in the keyboard. There are distracters on the screen and the children must focus their attention on the target animals. The teacher should guide the children’s rehearsal until they start rehearsing spontaneously.
Did it work?

The first result we should mention is that the children loved the games. That is important, if they are going to participate willingly. The second result refers to the comparison between the baseline and the intervention group. Because children already differ at pre-test, we control for the differences statistically when we examine their WM scores at post-test. When these controls were included, the mean span for the children in the baseline group in the post-test was 4.87 and the mean for the intervention group was 5.14. The intervention group had an advantage of 0.27 points in comparison to the baseline group. If you remember that the difference between profoundly deaf children and hearing children is 0.31 in this same scale, you can see that this improvement is quite important. During the six months of the intervention, the group that had practice in working memory gained substantially and would no longer be very different from a group of hearing children.

Amount of practice matters

Some teachers started working immediately after their children were pre-tested but others could not do so. When the children were post-tested, they had different amounts of experience in the games. We monitored how much experience the children had with the web games because, in order to play the game, the child had to use her/his identification number and password when accessing the website. Our computer automatically recorded that the child was playing a game. At the end of the programme, we knew how many web games the child had played.
There was a huge variation in the number of games that the children played. Some of the children did not play any web games and only participated in teacher-led activities. The mean number of games played by the children was between 16 and 17, but some children played more than 80 games. We analysed how this difference in practice influenced the children’s results at post-test. Figure 2 shows the children’s WM post-test scores by the number of games that they played.

The graph refers to the intervention group only because the baseline group did not play any games. The graph shows quite clearly that the children’s performance was directly related to the number of games that they played: the more games they played, the better their performance when they were retested.

This is good news for those deaf children whose WM span is lower than expected for their age. Teachers can help them develop this important cognitive skill and they can enjoy computer games that promote their WM.