Paper 6. Controlled trial of three sensory stimulation programmes including the precursor to Move4words – 99 pupils from Year 8.

By Dr Elizabeth McClelland, Move4words Community Interest Company

This paper describes data which were presented at a seminar in Department of Physiology, University of Oxford by Elizabeth McClelland in February 2007.

Abstract:

The precursor programme to Move4words, then called Coordinated Movement (CM), had a significant impact on improving reading age for 25 Year 8 students (aged 12-13 years) compared to a matched group of 25 who did not experience any extra intervention and who had 20 hours more regular teaching.

Immediately after the interventions, the CM group reading age increased by 9 months more than the No Intervention (NI) group (effect size d = 0.272). The effect continued to increase after the end of the intervention and by six months after the end of the intervention the CM group reading age had increased by 18 months more than the no intervention group (effect size d = 0.469).

Two other sensory stimulation techniques also improved reading age more than no intervention, and again the impact continued to build after the end of the intervention for these other two techniques. Six months after the end of interventions, an auditory stimulation package had an effect size of 0.306, and a very slow movement programme similar to t'ai chi had an effect size of 0.324.

The project:

99 poor readers from a large Secondary School in the south of the UK, in an area of relative deprivation, took part in a trial of sensory stimulation programmes which could be delivered to large groups at the same time.

The project was an attempt to find a solution to the low literacy rates of the intake to the school where almost one in three pupils had reading ages between two to five years behind their actual age on entry to the school in Year 7, and therefore found it hard to follow lessons designed for more mature readers.

As in all schools, resources were limited and were insufficient to supply one-to-one help for all of the pupils who were in need of literacy support. So this project tested whole-group techniques where many children might be helped by one or two teachers.

The project was designed by a special needs teacher at the school. All programmes were delivered and monitored by the same teacher from that school, and she collected all the reading age data.*

The students were split into four groups of 25 (one of 24), equally matched on reading age. All groups contained students equally distributed amongst the school's houses, so each group experienced the same range of teaching as all other groups. Three groups were taken out of lessons in the Spring and Summer terms of their Year 8 (age 12 -13 years) and took part in one of three sensory stimulation programmes over a period of 12 weeks. The other group remained in lessons and is termed the "no intervention" or NI group.

The three interventions are as follows:
1. Coordinated Movements or CM: This is an early precursor to Move4words and was designed by Elizabeth McClelland. Coordinated Movements contained the basic

Footnote: *I would love to acknowledge her name, but I have been requested to keep her name, and that of the school, anonymous.

principles of Move4words, which are the following: training in a gradual progression of coordinated movement skills using arms and legs, both sitting and standing; movement timing at about one move per second and speed well controlled; training in a gradual progression of eye tracking skills in three dimensions; focused awareness of movement; relaxation. These sessions lasted 20 minutes each day.

2. Mixed Movements or MM: This was put together by my colleague, and consisted of extremely slow arm, leg and head movements similar to T'ai Chi, each taking several minutes to complete, mixed with rapid coordination of arms and legs. These sessions lasted 20 minutes each day.

3. The commercial Listening Program (classic version) or LP: Pupils sat and listened through individual headphones to adapted classical music with reduced frequency ranges, which is claimed to stimulate literacy development by the manufacturers. These sessions lasted 30 minutes each day.

Generally, the students tolerated the CM programme best, the very slow movements in MM were a challenge to many students with poor concentration levels, and many students did not like the classical music in LP and found it hard to sit still for 30 minutes.

Reading age was assessed at the start of Year 7 in September for all 100 students, immediately after the end of the programmes in July of their Year 8, and again 6 months after the end of the programmes in January of their Year 9.

Results:

The headline result is that the Coordinated Movements group (precursor to Move4words) improved the most of all the four groups and their group median reading age improved by 18 months more than the baseline No Intervention group over the 2 year 4 month period of the trial.
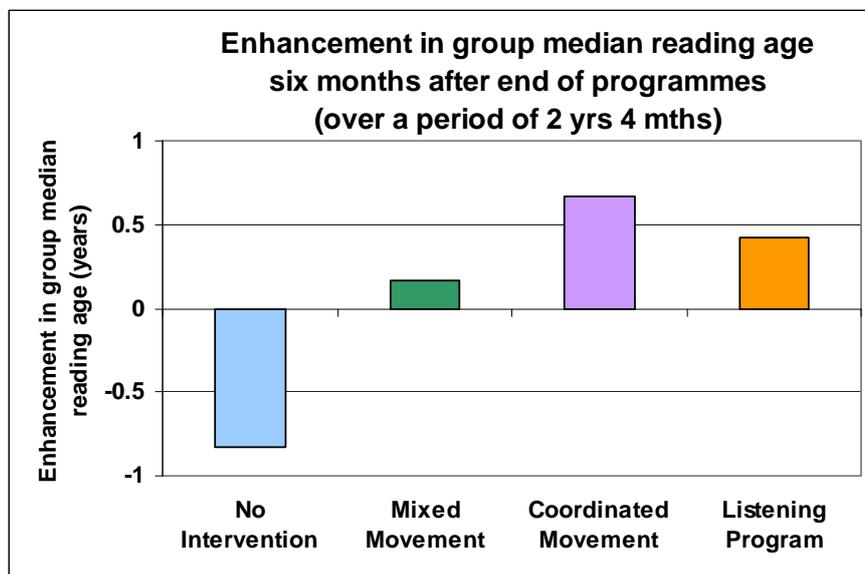

Figure 6.1: Changes in group median reading age between September in Year 7 and January in Year 9, a period of 2 years 4 months. A value of zero would indicate that the reading age increased by exactly 2 years 4 months.

Figure 6.1 shows these data. The reading age of the No Intervention group, who had approximately 20 hours more teaching over the intervention period than any of the other groups, increased by 1 year 6 months during the 2 year 4 month period of the trial. This means that they experienced a fall-back in reading age of 10 months in this time period. This is typical of pupils who are already behind in reading, they fall further behind their peers as time goes by.

In contrast, the Mixed Movements group experienced an enhancement in group median reading age of + 2 months, the Coordinated Movements group enhancement was + 8 months and the Listening Program group enhancement was + 5 months. This means that their reading age improved by this amount plus the 2 years 4 months of time elapsed.

Is this result statistically significant? And how can we tell?

This four-group design turns out to be much more complicated to analyse than a simple two group design such as used in paper 2 (one control group, one experimental group). After the experiment was completed, I came on the scene to analyse the data. I then found that scientists often try to avoid more than two groups of this size because of the statistical problem of analysis. It turns out that the size of the intervention effect in a four group experiment has to be FOUR times the size of the effect of the single intervention in a two-group study for the statistical tests to indicate that one or more intervention is significantly better than another.

So let's look at the details and get down to some statistics.

Detailed data analysis:

Firstly, let's look at the data. Table 6.1 shows the median** values at each stage of the trial. Figure 6.2 shows this in graphical form.

Group mean values in decimal years	Coordinated Movements Reading age in years (SD)	Mixed Movements Reading age in years (SD)	Listening Program Reading age in years (SD)	No Intervention Reading age in years (SD)
September Year 7	9	9.25	9	9.25
July Year 8	10.25	10.75	10.25	9.75
January Year 9	12	11.75	11.75	10.75

Table 6.1: Non-Parametric group median reading age values at the three stages of the trial.
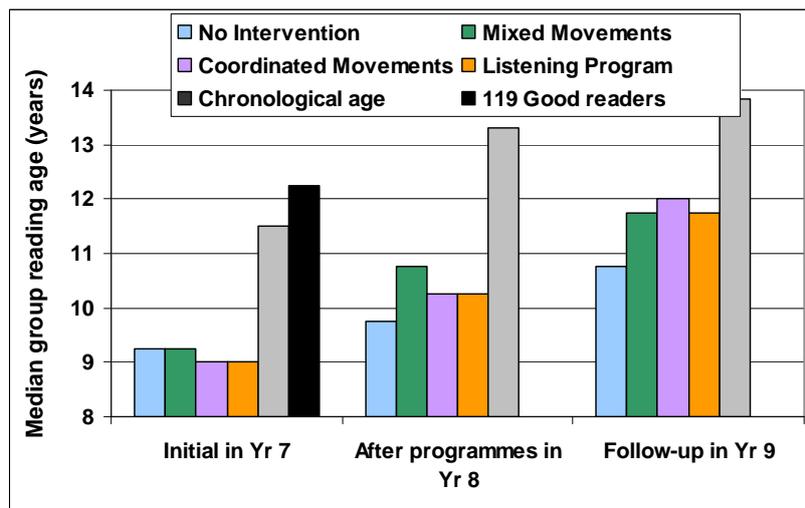

Figure 6.2: Group median reading age in September Year 7, July Year 8 and January Year 9 for the four matched groups. In addition, the chronological age of the groups is shown in grey, and in black is shown the median group reading age in September Year 7 of the rest of the students from this year who were not part of the trial.

Figure 6.3 shows the fall-back in median reading age for each group immediately after the end of the interventions.

Between the initial reading test in September Year 7 and the test immediately after the interventions in July Year 8, the No Intervention group reading age improved by 6 months during the 1 year 10 month period, while the Coordinated Movements, Mixed Movements and Listening Program groups improved by 15, 18 and 15 months respectively.
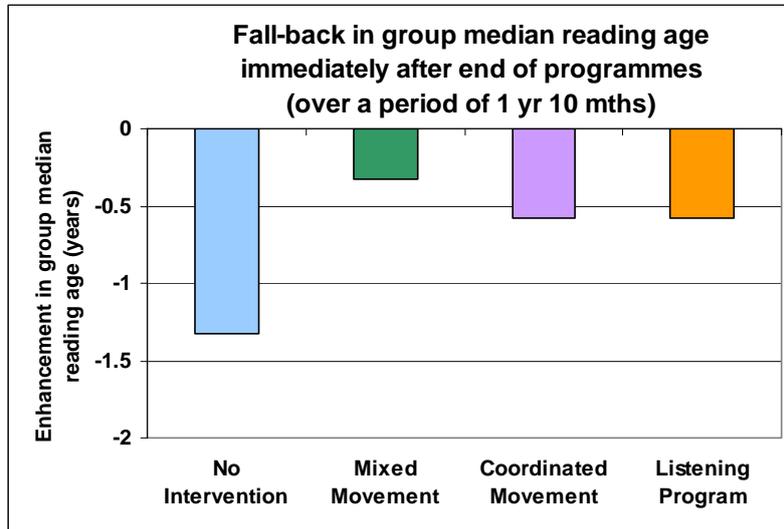

Figure 6.3: Changes in group median reading age between September in Year 7 and July in Year 8, a period of 1 year 10 months. A value of zero would indicate that the reading age increased by exactly 1 year 10 months. None of the groups improved this much during this time period, although all intervention groups improved more than the no intervention group.

The standard statistical approach to this data set is to put all the data at each stage of the experiment into a statistical test called the Kruskal-Wallis 4-way test to see whether any group has significantly different scores than another. Table 6.2 shows the results of this testing.

Kruskal-Wallis 4-group test	Z	df	Probability p (two-tailed)	Significantly different?
September Year 7	0.89	3	0.828	No
July Year 8	1.87	3	0.600	No
January Year 9	4.55	3	0.208	No

Table 6.2: Results of Kruskal-Wallis testing of four group trial at three different times. df indicates the degrees of freedom of the testing. The probability p needs to be less than 0.05 for us to be 95% confident that at least one group has a different group score than any other group.

The Kruskal-Wallis test suggests that no group stands out as significantly better than another at any stage of the trials. This is good news for the September Year 7 stage, where this test clearly shows that all groups are almost identical. Unfortunately, it suggests that there is no significant difference at any stage.

However, is this test too stringent because of the fact that there are four groups being compared (see above)? It may be so, because the group medians indicate that all three intervention groups were 12 to 18 months ahead of the no intervention group by January Year 9, while they all started out with equal scores in September Year 7.

We can re-assess the data, because the main aim of this paper is to compare the effect of the precursor Coordinated Movements programme with our other tests of Move4words.

| Mann-Whitney test CM vs NI	Z	df	Probability p (two-tailed)	Significantly different?
September Year 7	-0.28	49	0.778	No
July Year 8	1.15	49	0.250	No
January Year 9	2.02	48	0.043	Yes

Table 6.3: Results of Mann-Whitney testing comparing the group reading age scores of the Coordinated Movement group to those of the No Intervention group at three different times. The probability p needs to be less than 0.05 for us to be 95% confident that one group has a significantly different group score than the other group.

Table 6.3 shows a two-group test which compares the group reading age scores for the Coordinated Movements group with the No Intervention group, and ignores the other intervention groups. This test demonstrates that the Coordinated Movements group started at the same reading level as the No intervention group, but by 6 months after the end of the intervention, in January Year 9, the Coordinated Movements group were significantly better at reading (p = 0.043) than students who had not had the intervention but who had had approximately 20 hours more teaching. Is the size of this effect important for schools?

If we compare the reading age improvement of the two groups, the Coordinated Movements group median increased by 18 months more than the no intervention group over the whole trial. This certainly seems to be large enough to be an important effect for education, and to have a significant impact on the lives of these students. This effect was produced by a total of 20 hours of teacher contact time, which seems to be very cost-effective way of bringing about this level of improvement for 25 students.

Figure 6.4: The distribution of reading ages for all four groups at the start of Year 7, before any intervention, and in January Year 9, six months after the intervention period. The distribution is clearly not "normal" (i.e. not a bell-curve) initially, so non-parametric statistics are required.

**Note about statistics used: In this paper I have used what are called non-parametric statistics. Standard statistics such as t-tests and ANOVA require that the data are distributed "normally", where most of the population have scores close to the central value of the range of scores and the scores fall on a "bell-curve". This is usually the case for a whole-class data-set. However, in this case, the students test scores were at the bottom end of the range for the whole class (see Figure 6.4) and the scores most definitely do not fall on a bell-curve.
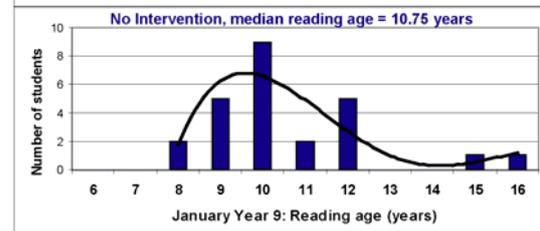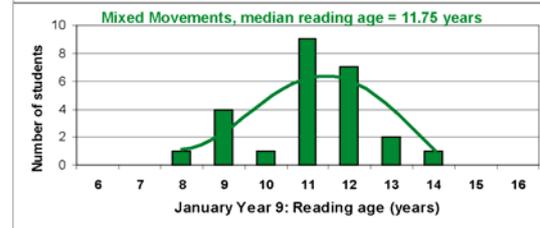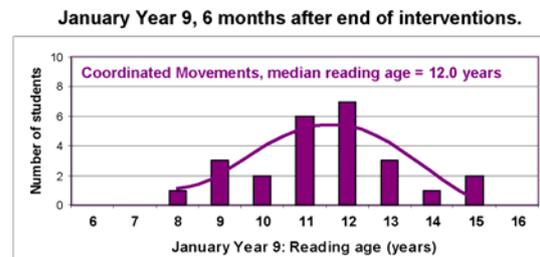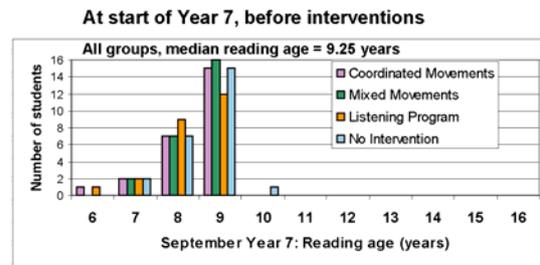
This means that instead of using averages, I have used medians, and I have not used t-tests or ANOVA but have used the non-parametric equivalent statistical tests of Mann-Whitney and Kruskal-Wallis.

Effect size:

To compare the results of this trial of the precursor movement technique, we need to estimate the "effect size" which is calculated from parametric statistics using the data in Table 6.4 and the following equation:

The effect size, Cohen's d = $\dfrac{\text{difference between both group scores after end of trial}}{\text{standard deviation of control group scores after end of trial}}$

- The effect size immediately after the end of the intervention period, between Coordinated Movements and No Intervention is d = 0.272.
- The effect size six months after the end of the intervention period, between Coordinated Movements and No Intervention is d = 0.469.

Cohen suggested that the effect size reflects a "small" effect when less than 0.2, relates to a "medium" effect when equal to 0.5 and is "large" when equal or greater than 0.8. He also pointed out that the relevance of these figures is dependent on the situation, and that an effect size of 0.2 would bring about a significant impact if used widely in education.

The effect size experienced by the students in the Coordinated Movements group is therefore "medium" and will be valuable for education.

Group mean values in decimal years	Coordinated Movements Reading age in years (SD)	Mixed Movements Reading age in years (SD)	Listening Program Reading age in years (SD)	No Intervention Reading age in years (SD)
September Year 7	8.87 (0.76)	8.99 (0.60)	8.74 (0.87)	8.95 (0.71)
July Year 8	10.74 (1.51)	10.58 (1.24)	10.35 (1.45)	10.33 (1.67)
January Year 9	11.89 (1.65)	11.50 (1.45)	11.60 (1.87)	11.03 (1.82)

Table 6.4: Parametric group average reading age values at the three stages of the trial. Standard deviation values (SD) are given in brackets.

Conclusions:

The Coordinated Movements technique had significantly more impact on reading than regular teaching with no extra intervention and the effect continued to build after the end of the intervention, doubling in the six months after the intervention finished.