A PRELIMINARY STUDY OF THE EFFECTIVENESS OF THE CELLFIELD READING PROGRAMME.

This document reports a preliminary study of the effectiveness of the Cellfield treatment. The data were collected in 2008 in 4 Cellfield clinics with a total of 27 participants, and the data analyses were done by Professor Max Coltheart.

DESIGN

In this study, the two-week period of treatment was preceded by two pretreatment assessment sessions (pre-tests) and followed by two post-treatment assessment sessions (post-tests). The multiple pre-tests are meant to control for maturational, practice and retesting effects, and the multiple post-tests to look at whether any treatment effect that is seen persists even after treatment is withdrawn.

Pre-treatment assessments
Prior to treatment, the 27 children were administered 2 reading pre-tests, both pre-tests using the Woodcock Word Identification, Word Attack and Passage Comprehension subtests. These two pre-test sessions were separated by between 22 and 35 days.

Details of the Cellfield treatments
Cellfield treatment began almost immediately after the date of pre-test 2. The treatment period was approximately 2 weeks, with one hour of treatment once a day but only on weekdays. Thus there were 10 sessions of treatment.

The Cellfield Treatment is available in three levels of difficulty, ‘A-’, ‘A’ and ‘A+’. All have content comprising 5 common components, 4 of which involve language and the fifth being a non-language component called a ‘mosaic’.

Mosaics (10%) are so called because they look like black tiles arranged irregularly on a blank checker board. The task requires reconstructing a given Mosaic onto its blank checkerboard neighbour. The Mosaics progress in 4 x 4, 6x6, 8x8 and 10x10 configurations. This task provides regular break during sessions to keep children engaged and their executive function in ‘novelty’ mode. It is intended to enhance spatial skills, pattern recognition, sequencing, visual retention, rapid scanning, and eye/hand motor control.

There is an additional language component only for A- & A; Symbol/sound correspondence revision.

This Symbol/sound correspondence task is as follows: Five single vowels are presented aurally and visually, with an example word for each. The child is required to repeat each vowel. After all the vowels have been so presented, they are presented again aurally and visually in a different whole word. Each vowel in its corresponding word disappears leaving the rest of the word which stays on screen. The child is required to find the missing vowel from two lines of vowels moving opposite to each other on screen, then put it back into the gap in the word. This is repeated for nine vowel combinations and twenty single consonants. This symbol/sound correspondence revision exercises takes about 20% of Session 1 and Session 2 in treatments A- and A.

The four language components are Rhymes, Homophones, Embedded Text & Pidjin English[1]:

• Rhymes (30%) involve choosing the correct word out of four phonetically similar choices, with acoustically modified target words. The intention is to enhance phonological awareness and enhance auditory perception through acoustically modified target words. The task involves a strong orthographic to phonological emphasis and decoding of whole words.

• Homophones (20%) involve choosing the correct printed word out of a choice of two, given an aurally presented sentence using the correct word.

• Embedded text (15%) involves reconstructing and remembering phrases and sentences from a string of words and nonwords which have no spaces between them and are moving slowly in opposite directions. This task is intended to exercise phonological processing, attention control, ocular scanning and working memory.

• Pidjin English (25%) involves the reconstruction of words, phrases and sentences, which have had their orthographic representations altered in a consistent way, finding the original words within moving strings of words. This is considered to be Cellfield's most powerful inductive learning exercise. It involves high demands on phonological processing, working memory, visual closure, visual retention, ocular motor control and eye/hand coordination.

In each treatment session, the content is presented in 10 subsections, with the language content always presented in pairs with a mosaic at either end. Each treatment session is organized like a layered cake consisting of subsections of components as above. All language subsections are presented only in pairs to keep the subject engaged. The mosaics on either side of these pairs become a welcome respite from the unavoidable repetition and cognitive effort involved in the language tasks. There is an additional mosaic at the end in sessions 8, 9 and 10 for all treatments.

Eighteen children out of the 27 were assigned to treatments A- or A and had identical sessions 1 & 2. Their first language task was 'symbol/sound correspondence revision'. The 9 children who were assigned to treatment A+ were not given 'symbol/sound correspondence revision' but instead began with the more difficult 'embedded text', plus 'Pidjin English', which would not appear for the other 18 children until the third session. The remaining subsections of sessions 1 & 2 are identical for all treatments (mosaics, rhymes and homophones).

Sessions 3 to 10 at any treatment level retain the same 4 language components and mosaics. Of these, it is Pidjin English that changes between treatments and is the most difficult. A- Pidjin English starts in English with 2 letter words. The Pidjin English forms

[1] This is more appropriately termed "Pig Latin"

of these words is required to be found from a string of Pidjin English words moving in opposite directions. This is repeated several times in reverse direction, building up to bigger words and longer phrases. 'A' starts with Pidjin English and with two words, building up more quickly into sentences. A+ starts with Pidjin English phrases and ends up more quickly into long sentences, which require much more in the give time.

That difficulty is amplified with tighter time-out settings and more demanding motion graphics. It is usually the performance of a child in Pidjin English that compels a supervising practitioner to go down a level (or sometimes up). In this study, out of 9 children who started on A+, 3 were dropped back to A, and out of 10 children who started on A, 3 were dropped down to A-. One child who started on A- was raised to A.

Homophone homework, which is the same for all treatments, was completed by all, prior to doing the sessions containing the homework material. Pidjin English homework, which varies according to treatment level, was likewise completed by the appropriate children.

In summary, all children in the study were given the same 4 language components and mosaics in the way that was most difficult for each child but achievable. This included the largest component, ‘Rhymes’, which employed brain plasticity principles through acoustically modified target words, with four word choices. Pidjin English, the most demanding of many reading skills, was also performed at a high level, by virtue of an appropriate treatment level choice, with the assistance of a supervising practitioner and with homework that was given. The concurrent visual aspects[2] became equally difficult for all, but with some lessening in later sessions for A-.

Post-treatment

Very shortly after cessation of treatment the children were administered their first post test. Subsequently they received a second post-test, which occurred between 24 and 34 days after the first post-test. Treatment had ceased before the first post-test and so of course there was no treatment occurring between the immediate and the delayed post-test. Both post-tests used the Woodcock Word Identification, Word Attack and Passage Comprehension subtests.

[2] Usually, all children undergoing the Cellfield Intervention have an eye examination, which looks for ocular motility (OM) problems. To address OM problems, Cellfield requires children to wear remedial glasses. In this study, only 22 out of 27 children had initial eye examinations. Of these 22, 18 had OM problems. 18 of these children wore remedial glasses. Of the 18, only 9 children had post treatment eye examinations. Of that 9, 4 had successful OM outcomes, 2 were marginally successful, and 3 were unsuccessful.

RESULTS

Treatment effects.

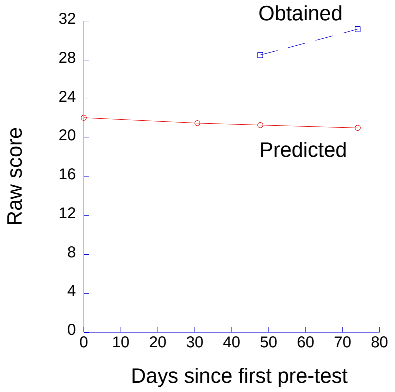
Woodcock Word Attack

This test consists of 45 nonwords to be read aloud, in order of difficulty, from *ree* to *byrcal*. Testing stops after 6 consecutive errors.

Raw score results:

	Pre-test 1	Pre-test 2	Post-test 1	Post-test 2
Obtained Raw Score	22.52	21.93	28.70	31.30
Mean days since Pre-test 1	0	30.74	47.70	74.11
Mean CA at test in months	135.1	136.1	136.7	137.6

These data were analysed using a regression technique. For each subject individually, an equation describing the relationship between test performance and time was calculated from the two pretest scores, and then used to predict the levels of performance at the times of the two post-tests if there is no effect of treatment. Figure 1 shows the predicted results, along with the obtained results.



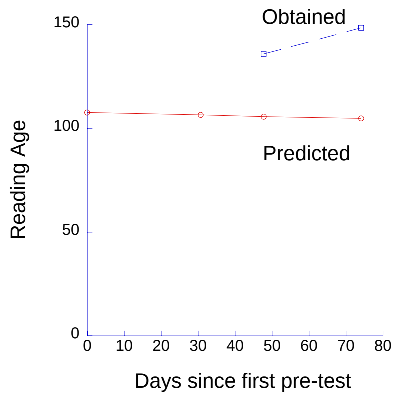
Performance at post-test 1 was significantly better than would be predicted if there was no effect of treatment ($t (26) = 8.65, p < .001$)). This was also the case for performance at post-test 2 ($t (26) = 8.13, p < .001$))

Although there was no treatment received after post-test 1, performance nevertheless continued to improve after post-test 1: this is shown by the fact that the difference between obtained and predicted scores was greater at post-test 2 than at post-test 1 (($t (26) = 3.91, p = .001$)

Reading Age results.

	Pre-test 1	Pre-test 2	Post-test 1	Post-test 2
Mean Reading Age	107.63	106.44	135.81	148.41
Mean days since Pre-test 1	0	30.74	47.70	74.11
Mean CA at test	135.1	136.1	136.7	137.6

The results predicted from the regression analysis and the obtained post-test scores are shown in Figure 2. Analyses of these Reading Age data produced the same results as the analyses of the raw score data.



Performance at post-test 1 was significantly better than would be predicted if there was no effect of treatment (t (26) = 5.84, p < .001)). This was also the case for performance at post-test 2 (t (26) = 6.68, p < .001))

Although there was no treatment received after post-test 1, performance nevertheless continued to improve after post-test 1: this is shown by the fact that the difference between obtained and predicted scores was greater at post-test 2 than at post-test 1 ((t (26) = 4.37, p < .001)

The children were reading well below their chronological age level before treatment, at their chronological age level immediately after treatment, and about 11 months above their chronological age level about a month after the end of the treatment.

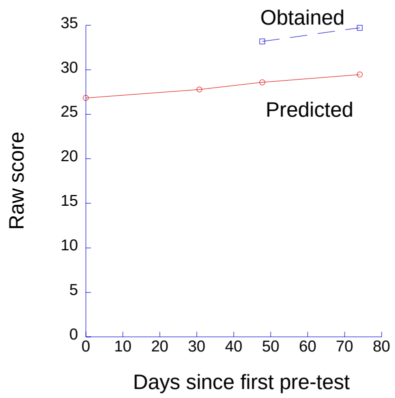
Woodcock Passage Comprehension

This test contains 68 items. For each items, the subject silently reads a passage of text with one word missing, and then has to supply a word that fits the context. Testing is discontinued after 6 consecutive items are failed.

Raw score results

	Pre-test 1	Pre-test 2	Post-test 1	Post-test 2
Obtained Raw Score	26.85	27.78	33.19	34.70
Mean days since Pre-test 1	0	30.74	47.70	74.11

The results predicted from the regression analysis and the obtained post-test scores are shown in Figure 3.



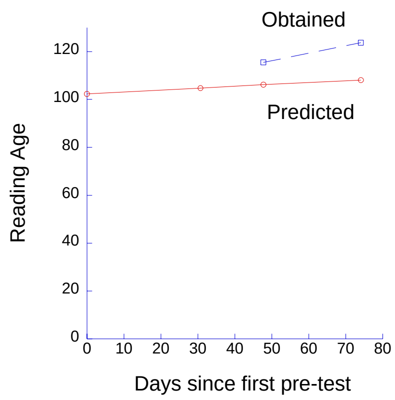
Performance at post-test 1 was significantly better than would be predicted if there was no effect of treatment (t (26) = 4.46, p < .001)). This was also the case for performance at post-test 2 (t (26) = 3.19, p = .004))

The difference between obtained and predicted scores was no smaller at post-test 2 than at post-test 1 ((t (26) = .73, p = .47), indicating that none of the beneficial effect of treatment was lost in the first month or so following cessation of treatment. Unlike the results with Word Attack, though, additional improvement due to treatment did not occur in the post-treatment phase.

Reading Age results

	Pre-test 1	Pre-test 2	Post-test 1	Post-test 2
Mean Reading Age	102.33	104.70	115.52	123.70
Mean days since Pre-test 1	0	30.74	47.70	74.11
Mean CA at test	135.1	136.1	136.7	137.6

The results predicted from the regression analysis and the obtained post-test scores are shown in Figure 4. Analyses of these Reading Age data produced the same results as the analyses of the raw score data.



Performance at post-test 1 was significantly better than would be predicted if there was no effect of treatment (t (26) = 4.11, p < .001)). This was also the case for performance at post-test 2 (t (26) = 2.80, p =. 01))

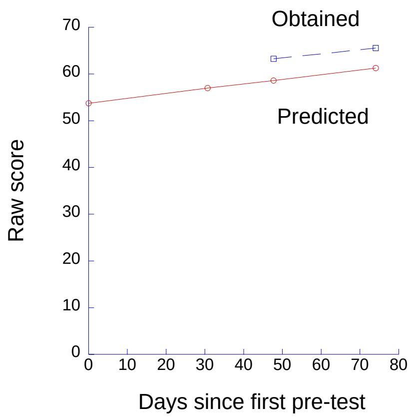
The difference between obtained and predicted scores was no smaller at post-test 2 than at post-test 1 ((t (26) = 1.61, p = .12), indicating that none of the beneficial effect of treatment was lost in the first month or so following cessation of treatment. Unlike the results with Word Attack, though, additional improvement due to treatment did not occur in the post-treatment phase.

Although the treatment did substantially improve Passage Comprehension performance, the children were still on average more than a year behind their chronological ages after having completed the treatment.

Woodcock Word Identification
This test consists of 106 words to read aloud, in order of difficulty, from go to shillelagh. 42 of these words are monosyllabic. Of these 42, 36% are irregular. Testing is discontinued after 6 consecutive errors

Raw score results

	Pre-test 1	Pre-test 2	Post-test 1	Post-test 2
Obtained Raw Score	54.15	57.33	63.41	65.78
Mean days since Pre-test 1	0	30.74	47.70	74.11



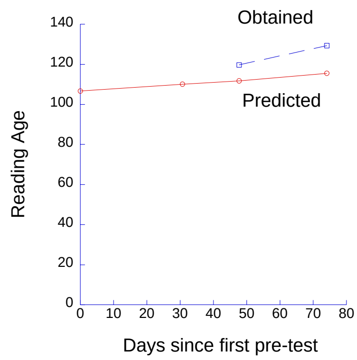
The results predicted from the regression analysis and the obtained post-test scores are shown in Figure 5.

Performance at post-test 1 was significantly better than would be predicted if there was no effect of treatment (t (26) = 4.72, p < .001)). This was also the case for performance at post-test 2 (t (26) = 4.72 p = <. 001))

The difference between obtained and predicted scores was no smaller at post-test 2 than at post-test 1 ((t (26) = .94, p = .36), indicating that none of the beneficial effect of treatment was lost in the first month or so following cessation of treatment. Unlike the results with Word Attack, though, additional improvement due to treatment did not occur in the post-treatment phase.

Reading Age results

	Pre-test 1	Pre-test 2	Post-test 1	Post-test 2
Mean Reading Age	106.67	110.07	119.74	129.33
Mean days since Pre-test 1	0	30.74	47.70	74.11
Mean CA at test	135.1	136.1	136.7	137.6



The results predicted from the regression analysis and the obtained post-test scores are shown in Figure 6. Analyses of these Reading Age data produced the same results as the analyses of the raw score data.

Performance at post-test 1 was significantly better than would be predicted if there was no effect of treatment (t (26) = 3.46, p = .002)). This was also the case for performance at post-test 2 (t (26) = 3.68, p =. 001))

The difference between obtained and predicted scores was no smaller at post-test 2 than at post-test 1 ((t (26) = 1.05, p = .30), indicating that none of the beneficial effect of treatment was lost in the first month or so following cessation of treatment. Unlike the results with Word Attack, though, additional improvement due to treatment did not occur in the post-treatment phase.

Although the treatment did substantially improve Word Identification performance, the children were still on average about eight months behind their chronological ages after having completed the treatment.

Treatment effects: Overall summary
There were three findings with respect to treatment effects:

(a) the treatment improved performance significantly on all three subtests;

(b) the average effect size varied across subtest. When the effect of treatment is assessed by subtracting predicted from obtained post-test 1 performance, there was a mean improvement of 30.2 months for Word Attack (standard deviation 26.9, range -2.6 to +86.2 months), 9.3 months improvement for Passage Comprehension (standard deviation 11.8, range -8.9 to +40.7 months), and 8 months improvement for Word Identification (standard deviation 12.0, range -4.4 to +47.8 months);

(c) after treatment has finished, there continue to be treatment-caused improvements for Word Attack but not for Passage Comprehension or Word Identification.

All of this was the case both when raw scores were analysed and when Reading Ages were analysed.

Woodcock results: factors affecting amount of improvement.
Here amount of improvement is measured by subtracting predicted from obtained post-test 1 performance. The two factors that could affect amount of improvement are the age of the subject and the ability of the subject as measured by pre-test 1 performance

Word attack
For the raw score data the partial correlation between amount of improvement and age with pre-test 1 performance controlled for was +. 181 (p = .376) and the partial correlation between amount of improvement and pre-test 1 performance with age controlled for was -.002 (p = .993).

For the Reading Age data the partial correlation between amount of improvement and age with pre-test 1 performance controlled for was +. 577 (p = .002) and the partial correlation between amount of improvement and pre-test 1 performance with age controlled for was -.248 (p = .222).

Passage comprehension.
For the raw score data the partial correlation between amount of improvement and age with pre-test 1 performance controlled for was +. 085 (p = .679) and the partial

correlation between amount of improvement and pre-test 1 performance with age controlled for was +. 257 (p = .205).

For the Reading Age data the partial correlation between amount of improvement and age with pre-test 1 performance controlled for was +. 466 (p = .016) and the partial correlation between amount of improvement and pre-test 1 performance with age controlled for was +. 523 (p = .006).

Word identification
For the raw score data the partial correlation between amount of improvement and age with pre-test 1 performance controlled for was +. 175 (p = .393) and the partial correlation between amount of improvement and pre-test 1 performance with age controlled for was +. 036 (p = .861).

For the Reading Age data the partial correlation between amount of improvement and age with pre-test 1 performance controlled for was +. 438 (p = .025) and the partial correlation between amount of improvement and pre-test 1 performance with age controlled for was +. 158 (p = .440).

Summary of improvement data

For raw score data, neither age nor initial level of performance predicted amount of improvement on any of the subtests.

For Reading Age data, it was true for all three subtests that the older the subject the greater the degree of improvement. In addition, for Passage Comprehension the better the pre-test 1 performance was the greater the improvement.

DISCUSSION
There is clear statistical evidence that the Cellfield treatment improved these children's ability to read: that is, their reading was significantly better after the treatment than it would have been if they had not received any treatment.

This particular design does not allow one to discover what specific aspects of the Cellfield treatment were responsible for the improved reading. If one wanted to do this, the design would need to include comparison groups using some other forms of treatment (perhaps even a treatment that would not be expected to have any effect, such as extra maths tuition) would be needed to show that the effect of the Cellfield treatment was due to the specific content of the treatment programme, rather than, say, doing structured training at any tasks for ten hours. This is not critical though if the concern is to determine whether paying for the Cellfield programme is a reasonable investment for parents.

A second potential limitation of the design is that the pre-test and post-test assessments were carried out by the clinicians themselves. This is appropriate for pilot/preliminary work, but it would of course be ideal if the assessments were done independently of the

Cellfield organization. There might also be something to be said for having the assessments done blind i.e. the assessor not knowing whether the assessment being done is preceding or following the treatment.

CONCLUSION

These results are encouraging and deserve to be followed up by a larger and more detailed study in which these limitations are avoided.