Lindamood-Bell Learning Processes

What claims does the company make/what does the programme target?

The Lindamood-Bell programmes are targeted to help students who are struggling to read or comprehend, including individuals with general learning challenges, dyslexia, or autism, as well as adult learners. Specific difficulties addressed include reading words on the page, recognizing sight words, reading fluency, spelling, understanding, remembering, inferring, following directions, and critical thinking (Lindamood-Bell Learning Processes, 2015).

The response approach is derived from a dual-coding theory of reading, which postulates that both verbal and visual information is used to represent information (Pavio, 1979); therefore, by inducing mental imagery and using multisensory instruction, this approach can theoretically improve reading comprehension (Lindamood-Bell Learning Processes, 2015). There are three specific sensory-cognitive functions described as underlying reading and comprehension: phoneme awareness (the ability to perceive sounds within words), symbol imagery, and concept imagery. The explicit learning goals of Lindamood-Bell include establishing an imagery--language connection, developing symbol imagery, improving understanding, memory, and thought expression, and discovering and labeling the oral--motor components of phonemes, as well as the integration of the following processing skills: word attack, sight word recognition, contextual fluency, oral vocabulary, and comprehension (Lindamood-Bell Learning Processes, 2015).

Though assessment, evaluation, and expectations are individualized in the Lindamood-Bell programmes in order to account for differences in ability, the company stands on the idea that the cognitive processes necessary for reading are the same across individuals, and that these critical processes can be developed through concept imagery and symbol imagery. Expectations are made clear at the commencement of the instructional period and tracked with regular progress updates, however, Lindamood-Bell does not make guarantees of improvement, allowing for unforeseen factors impacting each child's response to the instruction (Lindamood-Bell Learning Processes, 2015).

Evidence for efficacy:

The Lindamood-Bell programmes are supported by a large body of published, peer--reviewed research indicating consistent significant improvements in phoneme awareness, phonological decoding, and single-- word reading skills as a result of training (Aaron et al., 2008; Alexander et al., 1991; Castiglioni-Spalten & Ehri, 2009; Eden et al., 2004; Johnson--Glenberg, 2000; Kennedy & Backman, 1993; Krafnick et al., 2011; Olson et al., 1997; Olulade, Napoliello, & Eden, 2013; Shaw & Disney, 2012; Torgeson et al., 1999; Torgesen et al., 2010; Truch, 1994; Vanderberg, Pierce, & Disney, 2011; Wise, Ring, & Olson, 1999; Wise, Ring, & Olson, 2000). Of the 27 studies reviewed here, implementing various components of the Lindamood-Bell programmes over various lengths of time in various age and diagnostic categories, none showed evidence against the capacity of these programmes to improve these particular reading--related skills-- however, it is important to note that many of these studies involve a potential conflict of interest due to the involvement of lead researchers from the Lindamood-Bell company.

Evidence of generalization to gains in reading comprehension is somewhat less robust, but still supported by a large body of overlapping research (Aaron et al., 2008; Kennedy & Backman, 1993; Krafnick et al., 2011; Murdaugh, Desphande, & Kana, 2015; Murdaugh, Maximo, & Kana, 2015; Shaw & Disney, 2012; Simos et al., 2002; Torgeson et al., 1999; Torgesen et al., 2010; Vanderberg, Pierce, & Disney, 2011; Wise, Ring, & Olson, 1999; Wise, Ring, & Olson, 2000). Only two studies reported no significant improvement in reading comprehension (Eden et al., 2004; Pokorni, Worthington, & Jamison, 2004).

Various neuroimaging techniques have also been used to investigate the effects of remedial reading training with the Lindamood--Bell programmes. Functional magnetic resonance imaging (fMRI) has associated improvements in reading skills in tutored dyslexics with signal increases in left hemisphere regions engaged by normal readers and compensatory activity in right perisylvian cortices (Eden et al., 2004), as well as signal change in V5/MT visual magnocellular areas (Olulade, Napoliello, & Eden, 2013), and in autistics with increased activity in visual and language

areas and compensatory right--hemisphere language area homologues (Murdaugh, Desphande, & Kana, 2015) and with widespread changes in resting state functional connectivity of reading networks (Murdaugh, Maximo, & Kana, 2015). One study using voxel--based morphometry identified changes in grey matter volume in reading--related areas known to be under--activated in dyslexia (Krafnick et al., 2011), and another using magnetic source imaging found increased activity in the left superior temporal gyrus – an area normally involved in phonological processing (Simos et al., 2002). While none of these studies provide evidence specifically for a particular effect of the Lindamood-Bell training techniques, and the Simos et al. (2002) study actually found indistinguishable effects of the LiPS programme and another training programme, they do provide a basis for neuroanatomical and functional explanations of the behavioural improvements observed after sufficient reading intervention.

The vast majority of the research concerning Lindamood-Bell programmes has focused on individuals with dyslexia, learning disabilities, low literacy, language and reading deficits, and students deemed to be at--risk for dyslexia; within these populations, there is significant evidence of improvements in reading skills. As might be expected, most of these studies concern school--aged children between the ages of six and thirteen, but several have also identified these gains in both young adults and older adults (Eden et al., 2004; Shaw & Disney, 2012; Truch, 1994; Vanderberg, Pierce, & Disney, 2011) A smaller cohort of research-- largely case studies-- has approached individuals with alexia (Adair et al., 2000; Conway et al., 1998), aphasia (Kendall et al., 2006), and autism (Murdaugh, Deshpande, & Kana, 2015; Murdaugh, Maximo, & Kana, 2015), but this small sample does not in itself provide sufficiently robust evidence to support the efficacy of these programmes in those clinical populations.

The findings of one well--designed, large--scale, independent study characteristic of the evidence described above are briefly summarised below:

> *Individual Differences in Gains from Computer--Assisted Remedial Reading (Wise, Ring, & Olson, 2000)*: This study included 200 students between the ages of 7 and 11 with low reading achievement who spent about 28 training hours (over 6 months) in either a "phonological--analysis" condition (a Lindamood--Bell programme and related materials) or an "accurate--reading--in--context" condition for comparison. Though both programmes involved about 8 hours of small--group instruction and 20 hours of individualised computer--based practice, the 91 students in the accurate reading in context group focused on comprehension strategies, while the 109 students in the phonological analysis group covered articulatory concepts, phonological awareness, and explicit phonics. As might be expected, the phonological training resulted in greater gains in phonological skills and untimed word reading than the comprehension training, which resulted in greater gains in time--limited word reading. Both groups made significant gains in spelling and reading comprehension, but neither training condition was found to have a significant advantage on these general measures. At a 9--month follow--up, most of the returning students maintained or improved their levels, but not their rates, of training gains, but the differential advantages in word reading for either condition had disappeared. By the 2--year follow--up, most of the phonological skill advantages of the phonological analysis group had also disappeared, suggesting that this group had not used their significantly improved decoding skills as a "self--teaching mechanism" that could have led to greater growth in fluent word reading outside of the training period. It is possible that this effect might have been mitigated with more training hours or more integrated bridging practice. An important finding of this study is that lower--level readers gained significantly more from the phonological training than higher--level readers, and experienced significantly fewer voluntary drop--outs in the phonological training condition than the comprehension condition. This suggests that improved phonological skills positively supported greater differential growth in word reading for lower--level readers. It is also useful to note that this study did not include an untrained control group, making a reliable assessment of gains relative to "normal" reading age outside of pre--/post--test results impossible.

Evidence against efficacy:

Although the evidence for significant improvements in reading skills as a result of training in the Lindamood--Bell programmes is robust, many of the same studies reporting these gains also experimentally compared the Lindamood--Bell programmes to other types of reading programmes

and found no significant differences on overall language or reading skills (Aaron et al., 2008; Johnson--Glenberg, 2000; Kennedy & Backman, 1993; Pokorni, Worthington, & Jamison, 2004; Sadoski & Willson, 2006; Simos et al., 2002; Torgeson et al., 1999; Torgesen et al., 2010; Wise, Ring, & Olson, 1999; Wise, Ring, & Olson, 2000), despite advantages in phonological awareness and phonemic decoding. A few studies assessed such comparisons a t various post--intervention follow--ups, and reported similarly undifferentiated treatment effects after periods of one to two years (Torgesen et al., 2010; Wise, Ring, & Olson, 1999), even where significant differences had existed on immediate post--tests (Olson et al., 1997). This lack of unique training benefits was further extended with a neuroimaging perspective by Simos et al. (2002), who compared the effects of the LiPS programme with Phono--Graphix using magnetic source imaging, and found no significant differences in the activation profiles of the dyslexic participants in either programme. This is not to say that this type of phonological training is not effective-- rather that the particular type of reading skills training used may be less important than other factors, such as a thorough assessment of an individual learner's strengths and weaknesses.

As might be expected based on the inherently challenging nature of implementing carefully designed and controlled research in real--world educational settings, much of the research on the Lindamood-Bell programmes is susceptible to methodological shortcomings. While not necessarily grounds for exclusion from a comprehensive review of the available research--based evidence, these limitations do at least call for a careful examination of reported findings. The most frequently observed of these limitations are described below:

1. Lack of adequate control groups (see Alexander et al., 1991; McIntyre, Protz, & McQuarrie, 2008; Olson et al., 1997; Patel & Laud, 2010; Pokorni, Worthington, & Jamison, 2004; Shaw & Disney, 2012; Truch, 1994; Wise, Ring, & Olson, 2000; Vanderberg, Pierce, & Disney, 2011). This designation may be based on a lack of comparative treatment groups, of non-- treatment control groups, or of any control measure whatsoever. While some experiments are designed such that adequate comparisons are possible without control groups, generalisability regarding the interpretation of and confidence in results is limited in most cases. Having a comparative treatment group enables a more direct approach to the particular effects of the targeted intervention, but without a non-- treatment group, the susceptibility to expectancy effects or placebo effects increases and can impact overall findings.

2. Small experimental groups and case studies. Though some of the more robust studies included data from over 100 participants, some featured far fewer (see Alexander et al., 1991; Brennan & Robinson, 2009; Kennedy & Backman, 1993) and many were case studies (see Adair et al., 2000; Conway et al., 1998; Kendall et al., 2006). Though small--scale studies and case studies provide valuable insight into a particular phenomenon within a particular context, the generalisability of the results across populations is necessarily limited.

3. Inconsistent applications of the programmes. Given that there are five different titled programmes falling under the header of Lindamood--Bell Learning Processes, it is often difficult to differentiate the particular components implemented in the experiment and therefore difficult to draw conclusions regarding the efficacy of any particular program. The actual length of time spent in the intervention varied widely across studies, ranging from one 30--minute session per day for a few weeks to four hours per day across one or two years. These last concerns do not reflect on the viability of any individual study; they merely illustrate impediments to making generalised inferences from the multitude of studies available.

Conclusions:

With all of the above factors taken into consideration, there is a significant amount of published, peer- reviewed evidence supporting the efficacy of the Lindamood-Bell Learning Processes as remedial reading training, particularly with regard to demonstrated improvements in phonological skills. Gains in generalised reading and language skills have been consistently reported following experimental intervention, but there is no experimental evidence of unique benefits of these particular programmes when compared to other, equally-intensive training programmes.

What it involves:

Lindamood-Bell Learning Processes includes five distinct intervention programmes: Lindamood Phoneme Sequencing Program for Reading, Spelling, and Speech (LiPS; formerly known as the Auditory Discrimination in Depth Program), Visualizing and Verbalizing for Language Comprehension and Thinking, Seeing Stars: Symbol Imagery for Phonological and Orthographic Processing in Reading and Spelling, Talkies: Visualizing and Verbalizing for Oral Language Comprehension and Expression (the primer to Visualizing and Verbalizing), and On Cloud Nine Math. While each of these programmes is specifically designed to target a particular area of learning, the overall approach of Lindamood-Bell could be described as developing the skills and functions underlying reading and comprehension, including phoneme awareness, symbol imagery, and concept imagery (Lindamood-Bell Learning Processes, 2015).

In a Lindamood-Bell Learning Center, the first step is a two to four hour learning ability evaluation, in which an individual learner is assessed in terms of their unique strengths and weaknesses in reading, comprehension, and maths. Specific skills include sounding out words, word reading, paragraph reading, reading comprehension, oral language comprehension, spelling, vocabulary, math, and following directions. The evaluation also includes standardized academic and literacy tests, and is followed by a consultation to explain the results of each test and recommend instruction, if necessary (Lindamood-Bell Learning Processes, 2015).

The instruction component of the clinic--based intervention is designed to be intensive, with one--on--one tutoring one to six hours per day, five days per week, for six to eight weeks (Lindamood-Bell Learning Processes, 2015). School--based interventions may vary in implementation, but are generally less intensive, with students working in homogenous ability groups of two to five students, five days per week, in sessions of 45 to 120 minutes. The specific tools and strategies utilized during these sessions are unique to each programme; the major steps of the main sensory--cognitive Lindamood-Bell programmes are outlined below:

1. Lindamood Phoneme Sequencing Program for Reading, Spelling, and Speech: Explicitly trains students “to link individual language sound sequences (the acoustic representation of phonemes) and, ultimately, graphemic sequences, to the sensorimotor, kinaesthetic experience of their corresponding articulatory positions and movements” (Adair et al., 2000).
    a. Setting the climate for learning
    b. Identifying and classifying consonants
    c. Identifying and classifying vowels
    d. Tracking simple syllables and words
    e. Basic spelling and reading
    f. Learning sight words and expectancies
    g. Tracking complex syllables and words
    h. Multisyllabic words
    i. Reading and writing in context
2. Visualizing and Verbalizing: “Based on the use of nonverbal sensory input, in the form of imaged gestalts, to develop oral and written language comprehension, establish vocabulary, and develop higher order thinking skills” (Murdaugh, Maximo, & Kana, 2015).
    a. Picture to picture imaging
    b. Word imaging

c. Fantasy imaging

d. Personal imaging

e. Single sentence imaging

f. Sentence by sentence imaging

g. Coloured square strategy

h. Picture summary

i. Word summary

j. Sentence by sentence imaging with interpretation

k. Multiple sentence imaging

l. Paragraph imaging

m. Paragraph by paragraph imaging

n. Whole page imaging

3. Seeing Stars: ”Used to teach phonological and orthographic awareness, sight words, and contextual reading through mental visualization of letters individually and in sequences, air writing, and similar multisensory techniques” (Sadowski & Willson, 2006).

    a. Imaging isolated letters

    b. Syllable cards

    c. Syllable boards

    d. Imaging syllables with and without a chain

    e. Imaging sight words

    f. Imaging spelling

    g. Multisyllable reading, spelling, and imagery

    h. Contextual integration

    i. Tracking complex syllables and words

    j. Multisyllabic words

    k. Reading and writing in context

4. Visualizing and Verbalizing: “Based on the use of nonverbal sensory input, in the form of imaged gestalts, to develop oral and written language comprehension, establish vocabulary, and develop higher order thinking skills” (Murdaugh, Maximo, & Kana, 2015).

    a. Picture to picture imaging

    b. Word imaging

    c. Fantasy imaging

    d. Personal imaging

    e. Single sentence imaging

    f. Sentence by sentence imaging

    g. Coloured square strategy

    h. Picture summary

i. Word summary

j. Sentence by sentence imaging with interpretation

k. Multiple sentence imaging

l. Paragraph imaging

m. Paragraph by paragraph imaging

n. Whole page imaging

5. Seeing Stars: ”Used to teach phonological and orthographic awareness, sight words, and contextual reading through mental visualization of letters individually and in sequences, air writing, and similar multisensory techniques” (Sadowski & Willson, 2006).

    a. Imaging isolated letters

    b. Syllable cards

    c. Syllable boards

    d. Imaging syllables with and without a chain

    e. Imaging sight words

    f. Imaging spelling

    g. Multisyllable reading, spelling, and imagery

    h. Contextual integration

    i. Tracking complex syllables and words

    j. Multisyllabic words

    k. Reading and writing in context

6. Visualizing and Verbalizing: “Based on the use of nonverbal sensory input, in the form of imaged gestalts, to develop oral and written language comprehension, establish vocabulary, and develop higher order thinking skills” (Murdaugh, Maximo, & Kana, 2015).

    a. Picture to picture imaging

    b. Word imaging

    c. Fantasy imaging

    d. Personal imaging

    e. Single sentence imaging

    f. Sentence by sentence imaging

    g. Coloured square strategy

    h. Picture summary

    i. Word summary

    j. Sentence by sentence imaging with interpretation

    k. Multiple sentence imaging

    l. Paragraph imaging

    m. Paragraph by paragraph imaging

    n. Whole page imaging

7. Seeing Stars: ”Used to teach phonological and orthographic awareness, sight words, and contextual reading through mental visualization of letters individually and in sequences, air writing, and similar multisensory techniques” (Sadowski & Willson, 2006).
    a. Imaging isolated letters
    b. Syllable cards
    c. Syllable boards
    d. Imaging syllables with and without a chain
    e. Imaging sight words
    f. Imaging spelling
    g. Multisyllable reading, spelling, and imagery
    h. Contextual integration

Prices:

1. Learning Center on Campus:
    a. US$80 per student per instructional hour
    b. US$315 per testing
2. One programme (two--day workshop) for up to 15 teachers:
    a. Virtual: NZ$11,000, additional per person fees
    b. Onsite: NZ$14,700, additional per person fees
3. Two programmes (four days total of workshops) for up to 15 teachers:
    a. Virtual: NZ$22,000, minus 5% multi--programme discount, additional per person fees
    b. Onsite: NZ$30,000, minus 5% multi--programme discount, additional per person fees
4. Follow--up coaching (three days onsite plus five off--site support sessions):
    a. One programme: NZ$16,000
    b. Two programmes: NZ$23,000
5. Robot remote coaching (via ipad): 40 hours minimum per month, NZ$160 per hour

6. Virtual School Partnership-- examples (customizable based on number of schools and teachers):
    a. Intensive support, one school: US$162,000 (four days of workshops for up to 25 teachers, four weeks of onsite support, 200 Robot hours, and 40 hours of instructional support per teacher for up to 5 teachers)
    b. Moderate support, one school: US$135,000 (four days of workshops for up to 25 teachers, two weeks of onsite support, 150 Robot hours, and 30 hours of instructional support per teacher for up to 5 teachers)
    c. Ongoing support, one school: US$118,000 (four days of workshops for up to 25 teachers, one week of onsite support, 100 Robot hours, and 20 hours of instructional support per teacher for up to 5 teachers)
7. Comprehensive School Partnership-- examples (similar structure as Virtual School Partnership, but all services provided onsite by dedicated project direct and team):
    a. One semester, one school: US$182,000

b. Two semesters, one school: US$303,000

References:

Aaron, P. G., Joshi, R. M., Gooden, R., & Bentum, K. E. (2008). Diagnosis and treatment of reading disabilities based on the component model of reading. *Journal of Learning Disabilities, 41*(1), 67--84. doi: 10.1177/0022219407310838

Adair, J. C., Nadeau, S. E., Conway, T. W., Gonzalez--Rothi, L. J., Heilman, P. C., Green, I. A., & Heilman, K. M. (2000). Alterations in the functional anatomy of reading induced by rehabilitation of an alexic patient. *Neuropsychiatry, Neuropsychology, and Behavioral Neurology, 13*(4), 303--311.

Alexander, A. W., Andersen, H. G., Heilman, P. C., Voeller, K. K. S., & Torgesen, J. K. (1991). Phonological awareness training and remediation of analytic decoding deficits in a group of severe dyslexics. *Annals of Dyslexia, 41*, 193-- 206.

Bell, N. (1991). Gestalt imagery: A critical factor in language comprehension. *Annals of Dyslexia, 41*.

Brennan, S., & Robinson, G. L. (1998). 4 approaches to comprehension instruction for students with literacy problems at the high school level. *Australian Journal of Learning Disabilities, 3*(4), 12--19. doi: 10.1080/19404159809546573

Castiglioni--Spalten, M. L., & Ehri, L. C. (2009). Phonemic awareness instruction: Contribution of articulatory segmentation to novice beginners' reading and spelling. *Scientific Studies of Reading, 7*(1), 25--52. doi:10.1207/ S1532799XSSR0701_03

Conway, T. W., Heilman, P. C., Rothi, L. J. G., Alexander, A. W., Adair, J. C., Crosson, B. A., & Heilman, K. M. (1998). Treatment of a case of phonological alexia with agraphia using the Auditory Discrimination in Depth (ADD) program. *Journal of the International Neuropsychological Society, 4*, 608--620.

Eden, G. F., Jones, K. M., Cappell, K., Gareau, L., Wood, F. B., Zeffiro, T. A., . . . Flowers, D. L. (2004). Neural changes following remediation in adult developmental dyslexia. *Neuron, 44*, 411--422.

Eden, G. F., & Moats, L. (2002). The role of neuroscience in the remediation of students with dyslexia. *Nature: Neuroscience Supplement, 5*, 1080--1084.

Website/for more information see:

http://lindamoodbell.com/