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Increasing adolescents' depth of understanding of cross-curriculum words: an intervention study.

Abstract:

Background: There is some evidence that vocabulary intervention is effective for children, although further research is needed to confirm this within contexts of social disadvantage. Very little is known about the effectiveness of interventions to increase adolescent knowledge of cross-curriculum words.

Aims: This study evaluated the effectiveness of an intervention programme designed to develop adolescents' knowledge of cross-curriculum words.

Methods and Procedures: Participants were 35 adolescents aged between 12 and 14 years who were at risk of educational underachievement with low scores on a range of assessments. Participants received a ten-week intervention programme in small groups, targeting 10 cross-curriculum words (e.g. 'summarise'). This was evaluated using a bespoke outcome measure (the Word Knowledge Profile). The study involved an AABA design, with a repeated baseline, delayed intervention cohort and blind assessment. Intervention included both semantic and phonological information about the target words and involved the adolescents using the words in multiple contexts.

Outcomes and Results: Results were promising and participants' knowledge of the targeted words significantly increased following intervention. Progress was demonstrated on the Word Knowledge Profile on the item requiring participants to define the word (for the summer intervention group only). These increases in depth of knowledge were seen on taught words but not on matched non-taught words.

Conclusions and Implications: Cross-curriculum words are not consistently understood by adolescents at risk of low educational attainment within a low socioeconomic context. A 10 week intervention programme resulted in some increases to the depth of knowledge of targeted cross-curriculum words.

INTRODUCTION

Importance of cross-curriculum vocabulary learning

Vocabulary skills are important to classroom learning because of a) the complex and abstract words used in the curriculum content, b) the need to use words as tools to access learning and facilitate 'academic thinking', c) the role of vocabulary in processing new disciplinary concepts and ideas, and d) the vocabulary used by teachers during oral pedagogy in conveying information (Alexander 2006; Nagy and Townsend 2012). There is evidence for an association between vocabulary knowledge and academic attainment. Vocabulary assessment scores accounted for variation in academic attainment in mathematics and English upon leaving school (Spencer *et al.* 2016). Knowledge of cross-curriculum words accounted for considerable amount of variation in academic attainment on tests of reading, mathematics, social sciences and science in a cohort of 339 12-14 year old children (Townsend *et al.* 2012). Insufficient knowledge of cross-curriculum vocabulary has been associated with the attainment gap between different groups of students based on socioeconomic background (Gardner and Davies 2014).

Beck, McKeown and Kucan (2002) outline the importance of vocabulary knowledge for learning, in particular cross-curriculum vocabulary (also known as Tier 2 words or general academic words), which are abstract and occur in multiple contexts, for example *coincidence*,

industrious, *fortunate*, *introduce*. While more low-frequency subject-specific words may be specifically taught in the classroom (e.g. *peninsula*, *isotope*, *stanza*), these cross-curriculum words are used across topics in schools but may not be taught explicitly (Beck, McKeown and Kucan 2002; Justice *et al.* 2014). Vocabulary interventions should target these cross-curriculum words, given their potential impact on success within the classroom (Gregor 2009; Justice *et al*. 2014).

Principles of teaching cross-curriculum vocabulary

Evidence for the effectiveness of vocabulary intervention is well established during the preschool and primary school years (Best, Dockrell and Braisby 2006; Lubliner and Smetena 2005; Justice *et al*. 2014; Marulis and Neuman 2010; Steele and Mills 2011) with emerging evidence for secondary school aged children, particularly using whole-class approaches (Lesaux *et al.* 2010; Snow *et al*. 2009). These studies typically involve children acquiring relevant information about different aspects of a word (including semantic, phonological, morphological, grammatical and orthographic) in order to establish clear lexical representations (Stackhouse and Wells 2001). The rationale for this is that when children do not develop phonological (information about the sound structure of a word) and/or semantic knowledge (information about meaning, function and relationships with other words) about new words, inadequate representations of words are stored, resulting in impoverished vocabulary or difficulties with accessing and retrieving words in the lexicon quickly and accurately (McGregor et al., 2002).

Studies have also investigated principles for teaching academic vocabulary words including cross-curriculum words (see Nagy and Townsend 2012 for a review). Principles of rich vocabulary instruction (Beck, McKeown and Kucan 2002) are used to support in-depth knowledge of highly functional words. Principles include providing direct and explicit

definitions and attributes of words to be learned; promoting depth of processing, opportunities for repeated exposure and use of the target word, encouraging learning of words across contexts, and supporting children to use words in varied sentences (Stahl and Fairbanks 1986). New word learning must happen in relation to authentic contexts, with multiple opportunities to explore links with other words (Nagy and Townsend 2012). Teaching word learning strategies and word consciousness is also an important component of rich vocabulary interventions (Graves 2006). Learning a new cross-curriculum word is an incremental process, with new knowledge deepening with multiple exposures and multiple opportunities to use a word in new contexts (Lesaux *et al.* 2010).

There is a growing recognition that vocabulary interventions should promote the deep understanding of a relatively small number of words, their elements and semantically and morphologically related words in rich contexts (Lesaux *et al*. 2010: 45; Graves 2006). Depth of processing moves from: 1) association, where a new word is learned in relation to a definition or single context, to 2) comprehension in which a child demonstrates understanding in a sentence or utterance, or where a child puts definitional information to use, for example by finding an antonym; to 3) generation, in which the child produces a novel response to a word such as an original sentence, their own definition or applying the word to a new context (Stahl and Fairbanks 1986).

Interventions for adolescent vocabulary skills in contexts of socioeconomic disadvantage

In areas associated with social disadvantage the prevalence of language difficulties is higher in children attending pre-school and primary school (Department for Education (DfE) 2012; Law, McBean and Rush 2011) and secondary school (Spencer, Clegg and Stackhouse 2012) when compared to non-disadvantaged areas and vocabulary difficulties are a particular feature of this (Farkas and Beron 2004). In response, emerging evidence shows that older

children in contexts of social disadvantage can successfully learn new words through direct intervention (Joffe 2006; 2011). Snow, Lawrence and White's (2009) *Word Generation Project* in the USA embedded instruction of five words per week across the school curriculum with 6th – 8th grade students (aged 11-14 years) in a 24 week whole-school programme. Five schools implemented the programme, with pre- and post-test data available for 697 students. These data were compared to that from 319 students from three schools that did not implement the programme. The words targeted were 'all-purpose academic words' (Snow *et al*. 2009, p 326), defined as words that occur in a range of subjects and hence have maximum functionality across the curriculum. Adolescents in participating schools made accelerated progress in vocabulary knowledge with higher levels of educational attainment when compared to those in non-participating schools (Snow *et al*. 2009).

Similarly, Lesaux *et al*. (2010) delivered an 18 week vocabulary intervention programme in middle schools in the USA. Teachers delivered the intervention to 296 children aged 11-12 years in 13 treatment classrooms, and compared outcomes with 180 children in 8 control classrooms. Only 24% of participants spoke only English at home. The intervention targeted 75 cross-curriculum words in whole-class intervention sessions which focused on building depth of vocabulary knowledge via multiple meanings and morphological analysis. The study found significant gains on a researcher-designed measure of comprehension of targeted words and a morphological decomposition task for the intervention group but not the control group. There were no changes to standardised measures of reading vocabulary comprehension.

With both of these intervention studies, teachers delivered the content of the intervention in the classroom. This has a number of advantages. As all adolescents within the class are targeted, selection criteria and scheduling intervention sessions are not an issue. Furthermore, the intervention embeds vocabulary instruction within the whole school curriculum, allowing

for repeated and consistent exposure to the target words. However, some schools may be unable or unwilling to implement whole-school vocabulary programmes, particularly in low socioeconomic contexts where there is increased risk of low quality schooling (Lupton 2005).

Evaluating cross-curriculum vocabulary interventions

Despite an emphasis on rich vocabulary instruction and supporting deep knowledge of taught words, many intervention studies use outcome measures which access a relatively surface level of word processing. For example, changes to knowledge of targeted words are frequently assessed using multiple choice tasks, by asking participants to link targeted words to definitions (Snow *et al*. 2009) or synonyms (Lesaux *et al*. 2010). Such tasks are suited to being administered to large numbers of participants in short periods of time but they are limited in that performance is likely to be mediated by literacy skills and changes to depth of word knowledge cannot be measured over time. In contrast, Townsend and Collins (2009) used a bespoke outcome measure in their vocabulary intervention study with 37 children who were English language learners. Participants were asked if they had seen or heard the word before, and then asked if they thought they knew what the word meant and to provide a definition and an example of the word used in a sentence. This type of self-evaluation of word knowledge has been put forward as a means of examining the incremental nature of building word knowledge (Nagy and Scott 2000; McKeown and Beck 2004). Many vocabulary intervention studies use bespoke assessments featuring targeted words as outcome measures rather than standardised vocabulary assessments. This is because published vocabulary assessments measure knowledge of general words and so are unlikely to change following intervention focused on specific targeted words. Such assessments are also unable to show changes to depth of knowledge of words over time. In addition, standardised vocabulary assessment is most open to item bias on testing due to vocabulary reflecting

individual experiences, the language of the home and familiarity with school curricula (Stockman 2000; Townsend and Collins 2009).

Research Aims

This study aimed to evaluate the effectiveness of an intervention programme designed to increase adolescents' depth of knowledge of cross-curriculum words. It addressed the following research question: Is an intervention programme effective in increasing adolescents' knowledge of cross-curriculum words within the context of high risk of educational underachievement and social disadvantage?

METHOD

Design

This study was a single-blind cross-over trial with random allocation to groups and blind assessment to group status. The study was carried out during one school year at a mainstream secondary school. In collaboration with the school, it was agreed that small-group intervention led by the research team (rather than teaching staff) was best suited for developing the intervention programme and for the priorities of the school at the time. This was due to a perceived lack of staff time, resulting from necessary responses to the recent Ofsted report (see below).

The study used a delayed intervention design, comprising an intervention group (Spring Group) and a waiting control group who went on to receive intervention (Summer Group). A repeated baseline of word knowledge was taken pre-intervention for both the Spring and Summer Groups. This allowed examination of the stability of knowledge of targeted and matched non-taught words over time, without intervention. A post-intervention assessment was carried out for both groups, and a delayed follow-up assessment of word knowledge was

also carried out approximately three months later for the Spring Group. Thus, there were four assessment time points across the study (see Table 1), with all participants being assessed pre-intervention, immediately before intervention, and immediately after intervention. The Spring Group was also assessed approximately three months after intervention ended to examine maintenance of progress.

Insert Table 1 around here.

Participants

Participants attended one mainstream secondary school in an urban area of social disadvantage. The school's catchment area was ranked in the bottom 5% of England's wards in terms of socioeconomic status, using the Indices of Deprivation (McLennan *et al*. 2011). These indices rank England's 32,482 super-ordinate areas in terms of seven domains (income, employment, health and disability, education training and skills, barriers to housing and services, crime, and environment). In 2013, 46% of students in this participating school achieved five or more A* to C grades including English and mathematics in their General Certificate of Secondary Education (GCSE) exams upon leaving secondary school. Many options after compulsory schooling have entry requirements including obtaining five or more GCSE grades at A*-C level including mathematics and English. This is an important benchmark for school evaluation data as schools with fewer than 40% of pupils achieving at this level are considered to be underperforming and in need of improvement. The school was judged as performing inadequately by the Office for Standards in Education, Children's Services and Skills (Ofsted) and was in the 'special measures' category during the project, meaning it was undergoing an intensive programme of school improvement.

Participant criteria were agreed in collaboration with staff at the school, as follows:

- In school years 8 or 9 (aged between 12 and 14 years).
- In low ability classes when curriculum subjects were ability-streamed.
- Not making expected progress in these low ability classes as determined by teacher informal assessment and judgement.
- No statements of special educational needs, indicating no identified significant learning needs.
- English is a first language or were bilingual but had attended all schooling in an English speaking context.
- Not receiving existing interventions or other support within the school.
- Not currently on the caseload of speech and language therapy services.

Parental and pupil consent was obtained for 44 participants. The Spring Group initially comprised 21 participants and the Summer Group 23 participants (this difference in number was due to timetabling differences across Year 8 and Year 9 participants). Nine participants left the study following the first assessment: three participants left the school, four participants were unable to take part because of timetabling clashes, and two were school non-attenders. This left 19 participants in the Spring Group, and 16 in the Summer Group. No participants chose to withdraw from the study partway through the intervention.

Demographic information for all participants is summarised in Table 2, along with the mean number of intervention sessions attended.

Insert Table 2 around here.

Independent t-tests showed that the Spring and Summer groups did not differ significantly on age ($t(42)=-1.398$, $p=.169$) or the number of intervention sessions attended ($t(33) = 2.023$, $p=.051$). Table 2 also shows how many participants in each group had disruptive behaviour, as measured by the number of participants who needed referral to the school's behaviour

support team during at least one of the sessions (9 in the Spring Group and 4 in the Summer Group).

Participants completed an initial assessment session to profile their overall language skills (see Appendix 1). In addition, the research team had access to the results of the nationally used educational assessment *Cognitive Abilities Test* (CAT) which participants completed on entry into secondary school at 11 years of age. The CAT is used as a baseline from which to predict pupil performance in national examinations and to inform target setting. The verbal subtest (CATV) includes tests of receptive vocabulary, sentence completion, verbal classification, and verbal analogies which are presented in a written form. The quantitative subtest (CATQ) assesses reasoning ability with numbers, and the nonverbal subtest (CATNV) assesses the ability to think and reason with non-verbal material such as shapes and designs. Standardized scores are calculated with a mean of 100 and SD of 15. Table 3 shows that participants scored significantly below the normative mean on all language and CAT subtests. Spring and Summer intervention groups were matched on all measures of language; independent t-tests showed that the Spring Group and the Summer Group did not differ significantly on any of the assessment information.

Insert Table 3 around here.

Materials and measures

Cross-curriculum vocabulary selected for intervention

The intervention sessions targeted knowledge of 10 cross-curriculum words. These are abstract words that occur in multiple contexts, referred to as Tier 2 words according to the

tiered system of Beck, McKeown and Kucan (2002). The Academic Word List (Gardner and Davies 2014) was used to select words for inclusion in the study, in collaboration with teaching staff. The resulting list consisted of 10 highly functional, cross-curriculum words (all verbs) in use across the academic subjects taught in schools.

These 10 taught words were matched with 10 non-taught words, which were not taught during the intervention programme (See Appendix 2). Matching was based on:

- Number of syllables, stress pattern, and number of phonemes, using the Medical Research Council (MRC) Psycholinguistic Database (Wilson 1998). This database generates lists of words according to criteria input by the user.
- Measures of frequency from The British National Corpus (BNC) (2007). The BNC is a 100 million-word collection of samples of written and spoken language from a wide range of sources, designed to represent a wide cross-section of current British English.

Word Knowledge Profile

The bespoke outcome measure, the Word Knowledge Profile, examined depth of word knowledge of the ten taught words and the ten non-taught words. This was developed to capture change to depth of word knowledge over time, measuring participants' phonological and semantic knowledge about the target and control words. For each of the 20 words, participants were asked to: repeat the word, generate a rhyming word or non-word, rate their own knowledge of the word, provide a verbal definition of the word (resulting in the Word Meaning Score, divided into taught words and non-taught words), to use the word in a sentence, and relate the word to their own experiences by first saying where or when they might hear the word, and then being asked when they would perform the word, for example 'when might you consult something?'. Participants were also asked to spell six of the words:

interpret, convince, consult, generate, summarise and establish (due to time constraints it was not possible to ask participants to spell all of the words). Thus eight components were assessed for each word, in the order outlined above (see Appendix 4). For each word, each of the eight components were scored correct/incorrect. A copy of the Word Knowledge Profile sheet and examples of correct and incorrect responses are provided on the project website (Spencer 2016): https://adolescentvocabulary.wordpress.com/resources/how-to-evaluate-new-word-learning/.

Correlations between the standardised language assessments and the Word Knowledge Profile suggested that the measure had validity as a measure of vocabulary ability. For example, Pearson's product-moment correlation coefficient showed significant correlations between the baseline Total Word Meaning Score on the Word Knowledge Profile the BPVS, ($r = 0.571$, $p = <0.001$), CELF4UK Formulated Sentences ($r = 0.493$, $p = 0.001$) and CATV ($r = 0.511$, $p = <0.001$) but not with the spoonerisms task from the PhAB ($r = 0.209$, $p = 0.173$), the CATNV or CATQ ($r = 0.241$, $p = 0.128$; $r = 0.239$, $p = 0.119$) nor the CELF4UK Recalling Sentences ($r = 0.263$, $p = 0.084$).

Intervention programme

A ten-week programme was designed, consisting of once weekly one hour-long word learning intervention session carried out in small groups of 3-5 participants within the school setting. Each session targeted the knowledge and use of one word. The intervention programme incorporated principles of word-learning that have been successfully applied in other studies, as outlined in Appendix 3 (Beck, McKeown and Kucan 2002; Graves 2006; Justice *et al*. 2014; Lesaux *et al*. 2010; Marulis and Neuman 2010; Nagy and Scott 2000; Snow, Lawrence and White 2009; Stahl and Fairbanks 1986). The intervention was guided by principles of rich instruction to increase depth of knowledge of the targeted words, with an emphasis of providing multiple opportunities to use the words in multiple contexts, engaging

the participants in personalising word meaning and in applying strategies for learning new words, including morphological analysis. All session plans are freely available on a project website (Spencer 2016): https://adolescentvocabulary.wordpress.com/example-word-learning-session-plans/.

Each session followed a broadly similar structure, providing multiple opportunities to activate components of the speech processing system (Stackhouse and Wells 2001). In every session each participant was supported to think about what the target word means, what it sounds like, to say the word aloud, to use it in a sentence and to write it down during a concept mapping activity. Participants were supported to use suffixes and prefixes to build derivatives of the word. Each session included an experiential activity (e.g. where they evaluated, summarised, interpreted etc) and a main topic activity which gave them lots of opportunities to use the word in multiple contexts. Each week, participants were given a challenge card which reminded them to look out for the target word across the week and to use it if possible. The next session began with participants reporting back on this challenge.

Procedure

The study received ethical approval from the Research Ethics Committee, Human Communication Sciences, at the University of Sheffield.

1. Assessment Procedure

Each participant was seen individually for assessment in a quiet room within the school. Assessments were digitally recorded for later analysis and transcription. Two researchers (both qualified speech and language therapists) administered assessments at the first assessment point. The first assessment session lasted one hour and included the battery of language assessments outlined in Appendix 1 as well as the Word Knowledge profile.

Participants could request breaks at any time during the assessment session. The Word Knowledge Profile took between 10 and 20 minutes to complete for each participant. Post-intervention Word Knowledge Profiles were carried out by qualified speech and language therapists (not the researchers) and trained speech and language therapy students who were blind to both the group status of the participants (i.e. those who had received intervention versus the waiting control) and to the treatment status of the words (taught words versus non-taught words). At each assessment point, two members of the research team marked 25% of the Word Knowledge Profiles using written transcripts resulting in a 92-96% rate of agreement overall. Any disagreements were discussed and a decision was made on the correct response.

2. Intervention Procedure

Intervention sessions were delivered to small groups of 3-5 participants within the school setting. Due to timetabling, participants received intervention with peers from the same school year group. Random allocation was achieved by dividing participants into school year groups, each participant was assigned a random number and then the anonymised numbers were divided into two groups using Windows Excel. Within intervention groups, participants were assigned to a small peer group for intervention sessions according to their school weekly timetable, so that core subjects were not missed.

The first session took the form of a group discussion in order to engage all participants in the learning process by exploring the concept of word-learning and its importance. Following the first discussion session, the Spring Group received nine weekly one-hour intervention sessions. Due to timetabling constraints, the Summer Group received eight intervention sessions, thus receiving intervention for eight words. The mean number of sessions which participants actually attended was 7.06 (SD 1.2, range 4-9); Spring Group attended a mean of

7.42 sessions (SD 1.1, range 5-9) while the Summer Group attended a mean of 6.63 sessions (SD 1.2, range 4-8).

Intervention was delivered by two of the research team (SS and HL), both qualified and experienced speech and language therapists. Treatment fidelity was ensured by designing a lesson plan for each of the ten sessions. The researchers developed the intervention programme together and met weekly to discuss implementation and ensure consistency across groups.

Analysis

All quantitative data was inputted into SPSS 19 (IBM 2010) for analysis. A series of paired-sample t-tests were conducted to evaluate the impact of intervention on different items of the Word Knowledge Profile, as has been done in previous language intervention studies with adolescents (e.g. Ebbels *et al*. 2014). Bonferroni corrections were used to avoid type I error. Repeated measures ANOVA was not suitable because the intervention was delivered in small groups and therefore participants' progress may have been affected by peers' progress.

RESULTS

Knowledge of cross-curriculum words at baseline

For the whole cohort, at baseline 1) repetition of words was a relative strength, with a mean of 19/20 (95%) correct (range 14-20); 2) participants were able to describe the meaning of a mean of 5.2/20 (26%) words (range 0-12), as indicated by the Total Word Meaning Score: (combining both taught and un-taught words), as well as by participants' own evaluation of their word knowledge as 'green' (4.3/20); 3) participants were able to provide a rhyme for a

mean of 9.64/20 words (48%, range 0-20), with explicit instruction and the acceptance of non-words.

At baseline, the greatest number of participants correctly reported some meaning for the word 'exclude' (81.8%) followed by 'convince' (79.5%). No participants gave a correctly scored response to the words 'infer', 'conglomerate', 'incur', 'distinguish' nor 'liberate'. No answers included multiple contexts in the definitions. Furthermore, often one context was provided across the cohorts' responses. For example, 'exclude' was defined only in relation to school exclusions for behavioural incidents and submit was defined in relation to computer tasks. Tables 4 and 5 show the mean scores on each component of the Word Knowledge Profile, across four assessment times for the Spring and Summer groups.

Insert Tables 4 and 5 around here.

Evaluation of the intervention

Repeated Baseline Phase – stability of outcome measure

The results of the Word Knowledge Profile for both taught and non-taught words across the four time-points in the study are outlined in Table 4 (Spring Group) and Table 5 (Summer Group).

The results across the repeated baseline in the study showed that there were no significant differences at Time 1 or Time 2 baseline measures for either intervention groups on any item on the Word Knowledge Profile. For example, t-tests on the Word Meaning component for taught words show both the Spring Group (t (18) = -1.61, p = .13) and Summer Group (t (12) = .49, p = .64) made no progress during the autumn term over the repeated baseline.

Spring group

A series of paired samples t-test compared results on the Word Knowledge Profile at Time 2 and Time 3. This showed that the Spring Group made progress on the Word Meaning score for taught words over the intervention phase (t (18) = -2.28, p = .035). Although this was approaching significance, it was not significant when Bonferroni corrections were applied. The Summer group, the waiting control group who did not receive intervention, made no progress on the Word Meaning score for taught words (t (15) = .25, p = .81). Figure 1 compares the progress made on the Word Meaning score for taught words over the spring term for the Spring and Summer groups.

Insert Figure 1 about here

However, the Spring Group made progress on the two other items of the Word Knowledge Profile over the intervention phase:

1) Their ability to give a context when they might use the word increased from a mean of 4.95/20 to 10.74/20 (t (18) = -5.48, p = <.001). The eta squared statistic (2.50) indicated a large effect size. The score for taught words increased from 2.53 (SD 1.74) at the start of the intervention phase to 6.37 (SD 3.37) post-intervention (t (18) = -5.83, p = <.001). The score for non-taught words did not significantly increase over the same period.

The Summer group also made progress on their ability to give a context when they might use the word (t (15) = -4.36, p = .002), though this did not reach significance when Bonferroni corrections were applied. However, the Spring Group did not make more progress on this item than the Summer Group (t (30) = -1.74, p = .092), suggesting that progress may not have resulted from attending the intervention.

2) Their ability to give an example of when they enacted the word (e.g. tell me about a time when you evaluated something) increased from a mean of 4.47/20 to 7.32/20 (t (18) = -4.53,

p = <.001). The eta squared statistic (0.53) indicated a large effect size. The score for taught words increased from 2.11 (SD 1.94) at the start of the intervention phase to 4.21 (SD 3.05) post-intervention (t (18) = -4.41, p = <.001). The score for non-taught words did not significantly increase over the same period.

The Summer group also made progress on their ability to an example of when they enacted the word (e.g. tell me about a time when you evaluated something) but these did not reach significance once Bonferroni corrections were applied (t (15) = -3.30, p = .008). However, the Spring Group did not make more progress on this item than the Summer Group (t (30) = 1.90, p = <.001), suggesting that progress may not have resulted from attending the intervention.

Summer Group

A series of paired samples t-test compared results on the Word Knowledge Profile at Time 3 and Time 4. A paired samples t-test showed that the Summer Group made significant progress on the Words Meaning score for taught words over their intervention phase with the Words Meaning score for taught words increasing from 2.69 (SD 1.96) at the start of the intervention phase to 4.38 (SD 2.13) post-intervention (t (15) = -5.40, p = <.001). The eta squared statistic (0.66) indicated a large effect size. The Spring Group, who did not receive intervention in this period, maintained progress following their spring intervention but did not make any further progress (t (15) = .37, p = .72). The Summer group also made more significant progress than the Spring group during this intervention period (t (30) = -4.92, p = <.001), and suggesting that progress on this item resulted from attending the intervention programme. Figure 2 compares the progress made on the Word Meaning score for taught words over the summer intervention period for the Spring and Summer intervention groups.

Insert Figure 2 about here

The significance of progress on the Word Meaning item when both intervention groups are combined

To analyse the overall effectiveness of the intervention programme, one-sample t-tests were conducted to see if progress was significantly higher than 0 across the intervention period. This proved to be the case for the Word Meanings for taught words following intervention (Mean 1.17; SD 1.40; t (34) = 4.94, p = <.001), with an eta squared effect size of 0.42, but not for the Word Meaning score for non-taught words (Mean 0.03; SD 1.04; t (34) = .16, p =.87). Figure 3 compares the progress made on taught versus non-taught words for both intervention groups.

Insert Figure 3 about here

Figure 4 shows the distribution of gains made in participants' knowledge of taught words following intervention. This chart presents the increase to the Word Meaning score for taught words, comparing pre- and post-intervention results. It shows that five participants were able to describe the meaning of fewer words following intervention (of note, all five participants needed referral to the school's behaviour support team during the intervention sessions). Most participants were able to describe the meaning of two extra words following intervention (n=12).

Insert Figure 4 about here

DISCUSSION

This study designed, delivered and evaluated a ten week intervention programme to increase adolescents' knowledge of cross-curriculum words, delivered in small groups. Results were promising and showed that participants significantly improved their knowledge of target

words, as indicated by their increased ability to describe the targeted words' meaning during the Summer intervention period.

Adolescents' knowledge of cross-curriculum words

Adolescents in this area of social disadvantage had limited knowledge of commonly used cross-curriculum words – scoring correctly on only 25% of these words pre-intervention. Where participants did have some knowledge of words, answers were related to one functional context (e.g. 'exclude' was related to school exclusion and 'submit' to online games), rather than demonstrating rich word knowledge across contexts. This is important given the association between poor vocabulary knowledge and academic outcomes (Townsend *et al*. 2012). A key priority for teaching and educational policy is therefore to raise awareness of the need to explicitly teach cross-curriculum words, particularly with students at risk of low educational attainment in contexts of social disadvantage.

Knowledge of cross-curriculum words was measured using the Word Knowledge Profile, which may be useful in other educational and clinical contexts when profiling adolescent language skills as part of a wider battery of measures. The Word Knowledge Profile's Word Meaning score (based on participants being asked to describe the meaning of the target word) was positively correlated with the BPVS, the Formulated Sentences subtest of the CELF-4 and the CATV, suggesting a shared underlying construct with standardised measures of language ability (it was not correlated with the nonverbal measure - CATNV). Further study is needed to examine the reliability and validity of the Word Knowledge Profile in order to establish its utility as a clinical tool.

Evaluating the intervention programme on knowledge of functional cross-curriculum words

An intervention programme was designed to build on evidenced principles of effective vocabulary instruction. Cross-curriculum words were chosen due to their potential to impact on learning across the secondary school curriculum. Participants were given many opportunities to practice and personalise word meanings (Townsend and Collins 2009) and were provided with explicit instruction in how to use the words in authentic speaking and writing contexts (Nagy and Townsend 2012). The ten-week programme targeted one main word per week, although each lesson included morphological analysis and adding suffixes or prefixes to build related words.

The results evaluating the impact of the ten-week intervention programme on adolescents' knowledge of cross-curriculum words were promising. Both intervention groups increased their knowledge of the taught words but showed no progress in their knowledge of matched non-taught words. The Spring group made progress during the spring term on two items of the Word Knowledge Profile (when asked to describe when they would use the targeted word and when asked when they would 'perform' the word, e.g. 'when would you summarise something?'). However, the Summer group (waiting control) also made some progress on these two items, so the progress may not be attributable to the intervention progress.

During the summer term, the Summer group made significant progress on the Word Meaning item, indicating that they were more able to describe and give definitions of the targeted word. Furthermore, the Summer group made significantly more progress than the Spring group during this intervention period. This, plus the lack of progress during the repeated baseline period, strengthens the assertion that change in word knowledge was a result of the intervention.

It is interesting to note that the Summer group made more progress than the Spring group on this Word Meaning score. It is unclear why this was the case and a number of factors could

be relevant. Although based on established research into new word learning, this translational project involved delivering a new programme of intervention in a real-world context for the first time. It could be that the speech and language therapists delivering the programmes were in some way more effective during the second implementation of the programme in the summer term. The Spring group had more participants who required referral to the school's behavioural management system during the sessions (9 participants in the Spring group and 4 in the Summer group). This may have impacted on these participants' own learning and that of their peers during the sessions. Results may also be due to the relatively small cohort sizes as the Spring group did make progress which was significant ($p = .035$) before Bonferroni corrections were applied.

While there is an established evidence base for supporting vocabulary intervention with young children (Lubliner and Smetena 2005; Best, Dockrell and Braisby 2006) and those with diagnosed language impairment (Steele and Mills 2011), there is currently very little evidence for the effectiveness of small-group vocabulary interventions aimed at adolescents, particularly within contexts of social disadvantage. Notable exceptions include a small-group intervention for younger adolescents targeting vocabulary and narrative skills (Joffe 2006). Whole-class vocabulary interventions have also been evaluated: *Word Generation* in the USA that demonstrated the impact of whole-school vocabulary programmes with older children (Snow *et al*. 2009). This study therefore contributes to the existing small evidence-base in this area, which is important given that developing and implementing evidence-based practice is of increasing importance in the changing landscape of service commissioning arrangements (DoH 2010) and an increasing need for joint working across the health and education sectors (DfE 2012).

Although participants made a significant improvement on the Word Knowledge Profile outcome measure, the mean number of words learnt was 1.17 during an average of 6 sessions

attended by participants. Progress also did not generalise to untaught matched words. Such a small and specific change is not unusual, for example in the *Word Generation*, project participants improved by an average of four out of the 40 targeted words on a multiple choice comprehension test over a yearlong programme (Snow *et al*. 2009). As highlighted by Nagy and Townsend (2012: 101), rich instruction resulting in ownership of new words is time intensive and intervention studies therefore typically target small numbers of words. Non-intensive instruction does not reliably increase comprehension of new words (Stahl and Fairbanks 1986). Further research is required to investigate why this may be, for example it could be due to the complex and abstract nature of taught words, or that verbs are more difficult to acquire than nouns (Nash and Snowling 2006).

This study also used an outcome measure that required an advanced depth of processing of the targeted words. Participants were asked to generate a novel response to a word, explaining the meaning in their own words and relating the word to personal contexts (Stahl and Fairbanks 1986). It may be that an outcome measure that was able to measure increases in associative knowledge of the word (where the targeted words are matched with a specific definition or context) or increased comprehension of the word (for example, by asking participants to use definitional information to find an antonym) would be more sensitive to progress following intervention. The intervention sessions also included significant work on morphological analysis and participants needed support to use suffixes and prefixes to build derivatives of the word. While the sessions targeted one word (e.g. evaluate), the session included information on related words (e.g. positive and negative) as well as derivatives (e.g. evaluation, evaluated) and gains in such related words were not captured by the outcome measure.

The current study is important as it shows the investment required to remedy adolescents' poor knowledge of academic vocabulary. This may have implications for schools and speech

and language therapists planning related policies and interventions. Future research is needed to investigate the clinical significance of the findings and whether the programme is a viable, cost effective option for schools.

Evaluation of the study and future directions

The study had a robust evaluation design and was implemented across one school year to enable: a) multiple baseline measures to be taken, b) delayed intervention allowing comparison of intervention group with a control group, c) the use of taught and matched non-taught words, d) the development of a non-standardised Word Knowledge Profile to assess the specific impact of the intervention, and e) blind assessment. However, the study design had important limitations. The evaluation conducted was small in scale and based in one school which means that further research is needed to investigate generalisation to other groups of adolescents at risk of educational underachievement. Future work could investigate whether similar or more positive results are found with other age groups, or when the programme is delivered by other professionals within the school. A larger cohort would also enable a more thorough examination of potential influencing factors on the outcomes of the intervention, such as disruptive behaviour, group effects, or initial knowledge of words.

Further research could also follow-up adolescents in the classroom to see if they use their new vocabulary knowledge outside of the intervention sessions. Indeed, an important potential confound in the study could be that they were exposed to the target words in their subject lessons. The situation in the participating school at the time of the study did not allow for investigation of exposure to target words or generalisation of word knowledge in relation to the curriculum. However, the lack of progress during the repeated baseline period does suggest that the targeted words were not being learned in the classroom.

The intense nature of this intervention programme is challenging. While no participants chose to withdraw from the programme, challenges such as timetabling sessions to minimise the impact on participants' core curriculum classes was difficult and school absenteeism was also a challenge with participants missing an average of 3/9 of sessions (33%). Such challenges meant that group sizes varied between 3 and 5, which may have impacted on equal opportunities to engage with the programme across groups. Alternative service delivery models are needed, and whole-school interventions or supporting school staff to deliver intervention sessions may be more appropriate (Joffe 2006) and multidisciplinary collaboration may increase the impact of intervention (Steele and Mills 2011). However, the current study was based in a very challenging secondary school, which was implementing a rigorous scheme of school improvement measures as stipulated by school regulators. When designing the project in collaboration with this school, teachers strongly favoured a small-group intervention for these particular adolescents over a whole-school or school-led intervention programme. This was due to both the schools' limited staff time and resources and the nature of the adolescents' difficulties requiring more targeted and specialist support than could be given in a whole-school approach. This study therefore raises questions about the best way to support language skills in such challenging contexts, particularly where the resources of both secondary schools and speech and language therapy services are limited. Notwithstanding these concerns, this study has provided evidence that a busy secondary school was able to host and support the intervention programme, resulting in the participants making progress.

Conclusion

Adolescents at risk of low educational attainment in a context of social disadvantage had limited knowledge of cross-curriculum words which are commonly used in the classroom (e.g. 'summarise'). Adolescents were not making progress in relation to their knowledge of

these words without specific intervention. This is important, given the potential consequences of poor vocabulary skills for literacy skills and educational attainment. Therefore explicit teaching of such vocabulary is needed, particularly in secondary schools in areas associated with social disadvantage. Delivering a small-group vocabulary intervention programme in a busy secondary school was challenging. Despite this, the study provides evidence that the programme was effective in increasing adolescents' knowledge of cross-curriculum words, adding to the evidence base for successful language intervention for adolescents in mainstream secondary schools.

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What this paper adds

What is already known on this subject

Knowledge of cross-curriculum vocabulary is important for literacy skills and for learning in the classroom. Interventions can be effective in increasing vocabulary knowledge for younger children and for children with diagnosed language difficulties. Research has identified strategies and principles for intervention to increase depth of word knowledge. Much less is known about interventions to facilitate depth of knowledge of cross-curriculum words during adolescence.

What this study adds

A ten week intervention programme was delivered by a speech and language therapist to small groups of adolescents in a mainstream secondary school. At the start of the intervention, participants lacked knowledge of academic, cross-curriculum vocabulary, potentially critical to educational success. The intervention was evaluated using a robust study design (an AABA design, with a repeated baseline, delayed intervention cohort and blind assessment). The intervention resulted in positive changes to participants' depth of knowledge of ten cross-curriculum words, indicated by increased scores on a bespoke outcome measure.

Clinical implications

This study shows that adolescents identified by teachers as being at risk of educational under-achievement lacked knowledge of cross-curriculum words such as evaluate, summarise and discriminate. It provides evidence that intervention was effective in supporting these adolescents to increase the depth of their understanding of cross-curriculum vocabulary. Clinicians and educators may use this study: a) to justify support for adolescents' word learning; b) for information about interventions to increase

adolescents' knowledge of cross-curriculum vocabulary; and c) to design robust evaluations of intervention. The study's session plans and outcome measures are also freely available on a project website for use by practitioners.

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APPENDIX 1.Languaeg assessments administered

The following battery of assessments was administered: *British Picture Vocabulary Scale* 3rd Ed (BPVS) (Dunn, Dunn, Sewell and Styles 2009) assessed receptive vocabulary; *Recalling Sentences* subtest of the *Clinical Evaluation of Language Fundamentals*, fourth edition UK (CELF4 UK) (Semel, Wiig and Secord 2006) assessed expressive language ability; *Formulating Sentences* subtest of the CELF4 UK (Semel *et al.* 2006) assessed participants' expressive language ability including their ability to formulate sentences of increasing length and complexity including simple, compound, and complex sentences; *Spoonerisms* subtest of the *Phonological Awareness Battery* (PhAB) (Frederickson, Frith and Reason 1997) assessed phonological awareness.

APPENDIX 2. Information about words targeted during intervention and matched non-taught words

Taught words	**Frequency according to BNC**	**Control words**	**Frequency according to BNC**	**Number of Syllables**	**Phoneme structure**
interpret	1313	establish	5213	3	VCCVCCVC
evaluate	1087	eliminate	1100	4	VCVCVCVC
exclude	1319	exploit	1176	2	VCCCCVC
sustain	1228	submit	1224	2	CVCCVC
discriminate	446	conglomerate	331 (as a noun)	4	CVCCCVCVCVC
infer	319	incur	324	2	VCCV
contribute	2643	distinguish	1967	3	CVCCCVCCVC
generate	1967	dominate	992	3	CVCVCVC
summarise	199	liberate	164	3	CVCVCVC
consult	5350	convince	1200	2	CVCCVCC

APPENDIX 3. Principles of word learning applied during intervention

- Supporting deep understanding of a relatively small number of words.
- Multiple repetitions or exposures to new words in a variety of contexts.
- Both explicit discussions of word meaning and opportunities for participants to derive meaning from implicit information.
- Collaborative learning, working with participants to actively construct a meaning based on their experiences.
- Multiple opportunities to use the word in different contexts.
- Focus on different aspects of a word (including semantic, phonological, morphological, grammatical and orthographic) in order to establish clear lexical representations (Stackhouse and Wells 2001).
- Strategies and activities to increase motivation and engagement.
- Activities in which the participants experienced carrying out the action of the verb in order to enable mapping the word onto the action, based on previous research into verb-learning with younger children which involve miming an action while modelling the word (Riches, Tomasello, and Conti-Ramsden 2005).
- Development of transferable word-learning strategies, for example dictionary skills, inferring word-meaning from context, and encouraging participants to ask when unsure of a word.
- Facilitation of generalisation to the class or home situation, through the use of personal challenges at the end of each session.

Appendix 4. Further information about items on the Word Knowledge Profile

Item	Description
Word repetition	Participants were asked to repeat each word after one adult model.
Rhyme production	Participants were asked to generate a rhyming word for each word. If they were unable to think of a real word, they were encouraged to think of a non-word. Both real word and non-word rhymes were accepted as correct.
Spelling	Participants were asked to spell six of the 20 words. Phonetically plausible attempts were accepted as correct.
Knowledge rating	Participants were asked to rate their own knowledge of the word according to a red-amber-green system. They were given the following instructions (adapted from Beck, McKeown and Kucan 2002): Red: I do not know this word. I have not heard it before and cannot use it. Amber: I know something about this word. I have heard it before but am not sure how to use it. Green: I know this word. I know what it means and can use the word. If the participant rated the word as 'red', the participant was usually unable to complete the rest of the Profile for this word.
Ability to use the word in a sentence	Participants were asked to use the word in a spoken sentence. This was scored as correct if the participants produced the word as a verb in a sentence which was syntactically and semantically correct. Sentences without an appropriate semantic component such as I exploited something were not scored as correct.
Word meaning task	Participants were asked to describe the meaning of each word. This was scored correctly if the student indicated that they knew something about the meaning of the word. Detailed definitions or multiple contexts were not required for a mark but were noted on the Profiling sheet. Very few responses included a detailed definition; therefore this liberal scoring procedure was adopted.
When or where would you use this word?	Participants were asked to think of an example of when or where they might *use* the word. This was used as an indication of the participants' engagement with the word and the likelihood of the word being used. If the participant was able to give an example of when they would use the word, their response was scored correctly (e.g. 'I would use eliminate during a computer game').
Personal context	Participants were asked to give an example of a personal context in which they had executed the action of the word for example for *evaluate* 'Can you give me an example of when you have evaluated something?'. If the participant was able to give an example of when they had completed the action, their response was scored correctly (e.g. 'I evaluated the word learning lessons in the interview')

Tables and Figures

Table 1. Study design including delayed intervention and waiting control

	Autumn Term		**Spring Term**		**Summer Term**	
	Time 1	**Time 2**		**Time 3**		**Time 4**
	Baseline	**Repeated Baseline - 6 weeks after Time 1**	*Spring Intervention (10 weeks)*	**Assessment – 10 weeks after Time 2**	*Summer Intervention (10 weeks)*	**- 10 weeks after Time 3**
Spring Group: Intervention	Standardised assessment and Word Knowledge Profile	Word Knowledge Profile	**Yes**	Word Knowledge Profile, post-intervention	No	Word Knowledge Profile, follow up
Summer Group: Delayed intervention group	Standardised assessment and Word Knowledge Profile	Word Knowledge Profile	No	Word Knowledge Profile, pre-intervention	**Yes**	Word Knowledge Profile, post intervention

Table 2. Summary of participant characteristics

		Spring group N=19	**Summer group N=16**
Age in years and months at start of study		12:8 (range 12:0 – 13:11)	12:11 (range 12:1 – 13:11)
Year group	Year 8	15	9
	Year 9	4	7
In receipt of free school meals		11	4
Gender	male	11	11
	female	8	5
Language Status: Pupils speaking English as an additional language		3	0
SEN status*	No SEN	14	8
	SA	1	1
	SA+	4	7
Mean number of intervention sessions attended		7.42 (1.12)	6.63 (1.20)
Number of participants with disruptive behaviour		9	4

* SA = School Action level of support (additional need identified and supported by school), SA+ = School Action Plus level of support (additional support provided by outside agency such as a mental health team or educational psychology).

Table 3. Participants' scores on the language profiling assessments and the Cognitive Abilities Test and comparison of intervention groups

	Whole cohort (n=35)				Intervention group means		Comparison of intervention groups		
	Standard Score Mean (SD)	Standard Score Range	Comparison with the normative mean		Spring (N=19)	Summer (N=16)	*t*-test for equality of means		
			One sample t-test	Cohen's d			t	df	Sig.
CAT verbal	84.20 (7.23)	66 – 96	t= -12.92 P=<0.001**	-1.05	83.79	84.69	-.36	33	.72
CAT nonverbal	83.00 (7.16)	70 - 104	t= -13.63 P=<0.001**	-1.13	82.72	83.33	-.24	31	.81
CAT quantitative	81.69 (8.23)	68 - 112	t= -13.16 P=<0.001**	-1.22	80.58	83.00	-.86	33	.39
BPVS	81.69 (9.51)	69 - 109	t= -11.39 P=<0.001**	-1.22	81.42	82.00	-.18	33	.86
CELF4UK Recalling Sentences subtest	6.23 (2.64)	1 – 11	t= -8.43 P=<0.001**	-1.26	6.32	6.13	.21	33	.84
CELF4UK Formulated Sentences subtest	8.26 (3.71)	1 – 13	t= -2.78 P=0.009	-0.58	7.89	8.69	-.63	33	.54
PhAB Spoonerisms subtest	89.86 (8.40)	69 - 106	t= -7.14 P=<0.001**	-0.68	90.16	89.50	.23	33	.82

CAT, BPVS, PhAB standard scores = mean of 100, standard deviation of 15
CELF4UK scaled score = mean of 10, standard deviation of 3.
**. Correlation is significant at the <0.001 level (2-tailed).

Applying a Bonferonni correction for multiple comparisons sets the significance level at .007.

Table 4. Spring Group Word Knowledge Profile performance for Time 1 – 4.

		Time 1	Time 2	Time 3	Time 4
		Baseline 1	**Repeated baseline**	**Post intervention measure**	**Follow-up**
		Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Word repetition (/20)		19.06 (1.52)	19.37 (1.1)	19.42 (1.9)	19.63 (1.0)
Rhyme production (/20)		10.44 (5.7)	9.37 (7.4)	9.89 (6.6)	11.47 (6.6)
Phonetically plausible spelling (/6)		4.63 (1.8)	4.47 (2.0)	4.68 (1.8)	5.11 (1.5)
Words self-evaluated:	**Red**	8.89 (3.7)	8.58 (5.0)	8.16 (4.8)	8.87 (5.2)
	Amber	7.16 (3.0)	5.89 (3.2)	6.26 (3.0)	6.44 (3.5)
	Green	3.95 (3.5)	5.53 (3.8)	5.58 (3.8)	4.75 (3.2)
Use of word in a sentence (/20)		6.50 (3.2)	5.11 (3.6)	5.32 (3.7)	6.53 (3.7)
Word Meaning	**Taught words (/10)**	2.42 (1.9)	2.95 (2.0)	3.68 (2.2)	3.38 (2.1)
	Non-taught (/10)	2.63 (1.4)	2.47 (1.5)	2.58 (1.4)	2.81 (1.5)
	Total (/20)	5.05 (2.9)	5.42 (3.0)	6.26 (3.3)	6.19 (3.4)
Example of where participant would use this word	**Taught words (/10)**	3.26 (2.6)	2.53 (1.7)	**6.37 (3.4)****	5.69 (3.1)
	Non-taught (/10)	3.05 (1.8)	2.37 (1.6)	4.37 (3.0)	3.93 (2.2)
	Total (/20)	6.32 (4.2)	4.89 (3.1)	**10.74 (6.1)****	10.06 (5.5)
Personal context	**Taught words (/10)**	2.63 (2.5)	2.11 (1.9)	**4.21 (3.0)****	3.69 (2.6)
	Non-taught (/10)	2.68 (1.4)	2.32 (1.5)	3.16 (2.1)	2.50 (1.8)
	Total (/20)	5.32 (3.5)	4.32 (3.0)	**7.37 (4.9)****	6.35 (4.0)

** A significant change at the <0.001 level (two-tailed) when compared to the last assessment time point (e.g. Time 1 compared to Time 2, Time 2 compared to Time 3, Time 3 compared to Time 4),

Applying a Bonferonni correction for multiple comparisons sets the significance level at .001.

Table 5. Summer Group Word Knowledge Profile performance for Time 1 – 4.

		Time 1 Baseline 1	Time 2 Repeated baseline	Time 3 Waiting control	Time 4 Post intervention measure
		Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Word repetition (/20)		19.06 (1.52)	19.08 (1.8)	19.13 (1.5)	19.38 (1.1)
Rhyme production (/20)		10.44 (5.7)	10.38 (5.8)	11.00 (6.0)	10.69 (6.6)
Phonetically plausible spelling (/6)		4.63 (1.8)	4.69 (1.6)	4.94 (1.3)	5.27 (0.9)
Words self-evaluated:	**Red**	7.13 (3.8)	8.38 (4.4)	7.38 (3.2)	7.25 (3.3)
	Amber	8.06 (3.4)	6.81 (3.6)	7.31 (3.1)	6.81 (3.4)
	Green	4.81 (2.9)	4.81 (3.5)	5.31 (4.2)	6.06 (4.2)
Use of word in a sentence (/20)		6.50 (3.2)	5.13 (3.8)	6.19 (2.7)	8.00 (4.0)
Word Meaning	**Taught words (/10)**	2.88 (1.9)	2.75 (1.7)	2.69 (2.0)	**4.38** (2.2)**
	Non-taught (/10)	2.94 (1.4)	2.69 (1.7)	3.19 (1.6)	3.13 (1.9)
	Total (/20)	5.69 (3.1)	5.44 (3.2)	5.81 (3.4)	7.50 (3.6)
Example given of where participant would use this word	**Taught words (/10)**	4.36 (2.4)	1.77 (1.2)	4.94 (2.5)	5.75 (2.1)
	Non-taught (/10)	3.79 (2.6)	2.08 (1.4)	4.37 (2.9)	3.56 (2.1)
	Total (/20)	8.87 (4.6)	4.94 (4.0)*	9.31(5.1)	9.31 (3.9)
Personal context	**Taught words (/10)**	2.07 (1.9)	1.46 (1.7)	2.38 (1.9)	3.31 (2.0)
	Non-taught (/10)	2.79 (2.0)	1.31 (1.4)	2.63 (2.3)	2.13 (1.8)
	Total (/20)	4.94 (3.6)	3.38 (3.5)	5.00 (3.9)	5.44 (3.6)

** A significant change at the <0.001 level (two-tailed) when compared to the last assessment time point (e.g. Time 1 compared to Time 2, Time 2 compared to Time 3, Time 3 compared to Time 4),

Applying a Bonferonni correction for multiple comparisons sets the significance level at .001.

Figure 1: Progress on Word Meaning score for taught words across Spring term

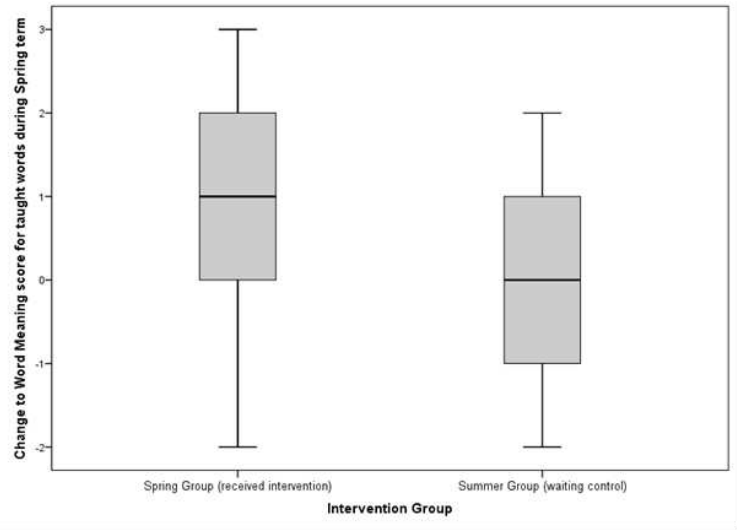

Figure 2: Progress on the Word Meaning Taught Words Score of both intervention groups across Summer term.

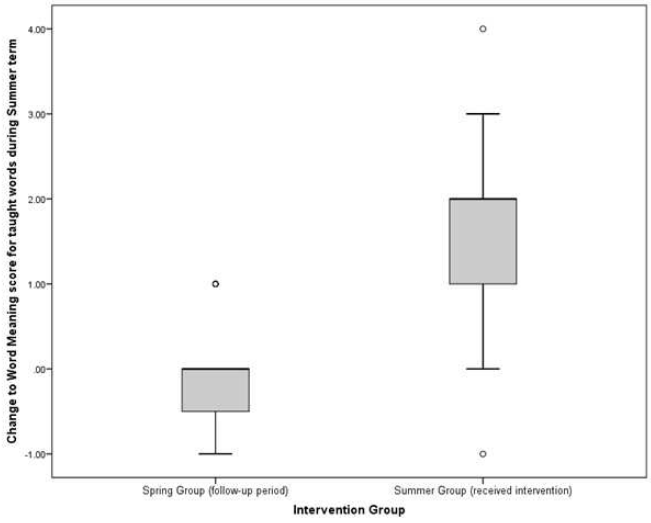

Figure 3: Progress on Word Meaning score on taught versus non-taught words across the intervention phase.

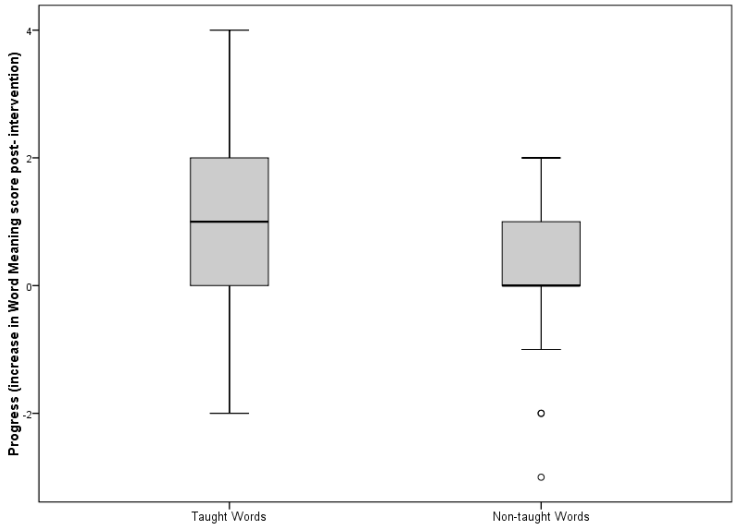

Figure 4: Graph to show how many words participants learned during the intervention (progress on the Word Meaning score for taught words).