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Cross-Age Tutoring in Kindergarten and Elementary School Settings:

A Systematic Review and Meta-Analysis

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Cross-Age Tutoring in Kindergarten and Elementary School Settings: A Systematic Review and Meta-Analysis

Individualized tutoring is considered to be one of the most effective ways to promote improved educational outcomes (Bloom, 1984; Elbaum, 2000; Ireson, 2006). Non-professional peer tutors can deliver tutoring programmes at schools with reduced costs compared to professional teachers or tutors (Goodlad & Sinclair, 1990; Leung, Marsh & Craven, 2005). Our review considers tutoring schemes, in which children, university students and community volunteers tutor kindergarten and elementary school pupils. These non-professional tutors are considered peer tutors here because they do not have the status of professional educators and are either close in age to the tutees (in the case of school or university student volunteers), or close in terms of background and spatial proximity (in the case of community peer volunteer tutors), and share the local environment with tutees. Therefore, we take a wide, inter-generational view of what constitutes a peer within a community.

Tutoring by school pupils, university students and community volunteers has been reported as an effective intervention for improving academic and attitudinal outcomes among school-aged children (Medway, 1995; Ritter, Denny, Albin, Barnett and Blankenship, 2006; Higgins, Katsipataki, Kokotsaki, Coleman, Major & Coe, 2013). Conversely, several studies have found null or negative effects for non-professional tutoring on academic results of tutees (Jensen, 1991; McKinney, 1995; Ritter, 2000). Therefore there is need for a systematic review to assess what high quality studies report in terms of the efficacy of peer tutoring.

Theoretical background

There is no single dominant theory of change for peer tutoring. Students are expected to improve academic outcomes through elaborating thoughts in the tutoring process, thus

cooperatively constructing knowledge within the so-called *zone of proximal development* (ZPD). The ZPD is loosely defined as the distance between child's independent level of problem solving and the level of problem solving under the guidance of a more advanced peer or an adult (Vygotsky, 1978; Chi, Bassok, Lewis, Reimann & Glaser, 1989; Webb, 1989). In this manner peer tutoring is often reported as being a form of cooperative learning (Pesci, 2015). Peer tutoring can provide students with timely feedback (Bloom, 1984; Merrill, Reiser, Merrill & Landes 1992), increased time on task (Delquadri, Greenwood, Whorton, Carta & Hall, 1986) and more provide appropriate pacing (Shanahan, 1998).

Tutoring programmes are also expected to improve socio-emotional outcomes, such as self-efficacy (Elliott, Arthurs & Williams, 2000), self-confidence (Margolis, 2005), and child's confidence in the academic subject tutored (Koh, Sanders & Meyer, 2012). Peer tutoring is reported to result in improved social ties between tutees and tutors (Goodlad & Hirst, 1989), strengthened attachment to the school, and improved attendance at school (Pridmore, Stephens & Stephens, 2000). Many authors have also suggested that tutors can serve as role models for the tutees (Allen, 1976; Erickson, 1987; Potter, 1994; Topping & Hill, 1995). In this way, peer tutoring by non-professional educators is expected to be qualitatively different from tutoring delivered by professionals and employed teaching staff.

Ongoing programmes

In the USA since the late 1990s America Reads Challenge has mobilized tens of thousands of college students as volunteer reading tutors for children in Kindergarten through Third Grade (Fitzgerald, 2001). In this context, several manualized programmes were developed, such as Book Buddies which involved 45-minute biweekly sessions consisting of rereading a familiar book, word studies, writing, and reading a new book (Meier & Invernizzi, 2001). In India, a

programme called India Reads was managed by the largest educational non-governmental organization, Pratham. The programme is reported to have enabled communities to mobilize and train volunteers to work in schools both during and after school hours. The initiative involved nearly 450,000 community volunteers acting as tutors using techniques described in programme manuals (Poverty Action Lab, 2009). Other programmes have less formal structures for tutoring interactions. The UK literacy charity Beanstalk connected adult community volunteer tutors with 6,400 primary school children in England during the 2011-2012 academic year. It provided community volunteers general guidance, such as "Use open-ended sentences to encourage conversation" and "Be generous with your praise" (Beanstalk, 2013).

Most reports available in English have described tutoring programmes in high-income English-speaking countries, such as USA, UK and Australia, but there are also reports of similar projects in other countries, such as China, India, Jamaica, Lithuania, South Africa, Tanzania and Thailand (Goodlad, 1995, 1998). Banerjee and Duflo (2011) reported that tutoring programmes involving community volunteers are currently being tested in Ghana, with plans for similar programmes drafted in Senegal and Mali.

Existing studies and reviews

Following a number of narrative reviews (Rosenshine & Furst, 1969; Devin-Sheehan, Feldman & Allen, 1976), Hartley (1977) carried out the first meta-analysis on the topic, identified by this review. Hartley summarized peer tutoring studies in mathematics with child tutors and found a mean Cohen's *d* of 0.6. The widely cited Cohen, Kulik and Kulik (1982) review examined 65 randomized and matched studies based in elementary and secondary schools with schoolchildren as tutors. It reported significant overall Cohen's *d Effect Sizes* of 0.29 for reading (95% CI 0.17, 0.41) and significant *Effect Sizes* of 0.6 (95% CI 0.29, 0.91) for

mathematics. However, Rohrbeck, Ginsburg-Block, Fantuzzo and Miller (2003) reported that older meta-analyses may have serious methodological limitations, such as 'lax' and 'non-transparent' study inclusion criteria. More recent reviews (Wasik & Slavin, 1993; Shanahan, 1998; Wasik, 1998; Elbaum, Vaughn, Hughes & Moody, 2000) looked at one-to-one tutoring undertaken by adults, including professional tutors. It was reported that, *"college students and trained, reliable adult community volunteers were able to provide significant help to struggling readers"* (Elbaum et al., 2000, p. 616).

More recently, Slavin and colleagues (Slavin & Lake 2008a; Slavin, Lake, Chambers, Cheung & Davis, 2009a; Slavin, Lake, Cheung & Davis 2009b; Slavin, Lake, Chambers, Cheung & Davis,2009c; Slavin, Lake, Davis & Madden, 2010; Slavin & Madden, 2011) carried out large Best Evidence Encyclopedia syntheses of various reading programmes in Kindergarten to Fifth Grade. The reviews reported significant standardized mean difference *Effect Sizes* of 0.26 for cross-age tutoring. Leung, Marsh and Craven (2005) conducted a meta-analysis of 68 published studies, in which children and university students acted as tutors. It was reported that there were significant *Effect Sizes* of 0.65 for overall academic achievement (95% CI: 0.59, 0.71) and 0.88 for self-concept (95% CI: 0.69, 1.07). In contrast, Torgerson and King (2002) and Ritter, Denny, Albin, Barnett and Blankenship (2006) focused on randomized controlled trials (RCTs) including only adult non-professional tutors. Torgerson and King (2002) summarized four trials, finding a mean *Effect Size* of 0.19 that was not statistically significant (95% CI: -0.31, 0.68). Ritter and colleagues included 21 USA based studies, finding a significant mean *Effect Size* of 0.3 (95% CI: 0.18, 0.42) for the composite measure of reading and a non-significant mean *Effect Size* of 0.27 (95% CI: -0.18, 0.72) for mathematics. A recent review of 76 randomized experiments in education conducted in low and middle income countries found an average effect of 0.10 for

community volunteer teaching (McEwan, 2013). These *Effect Size* estimates are lower than those reported by Leung et al. (2005). Thus results of previous meta-analyses ranged from null to small and medium positive significant effects.

Given the wide diversity of effects identified in previous research, the current review was deemed necessary to systematically identify randomized studies in this area, including the recent research evidence, critically appraise the findings and provide a more precise estimate of the effect of tutoring on academic outcomes. Given the wide use of tutoring programmes, this review is needed to make suggestions for teaching as well as inform possible directions for future research.

Method

Inclusion criteria

To develop inclusion criteria for the review and ensure that only studies with high methodological rigour were included, current criteria published by What Works Clearinghouse (2010), Cochrane Collaboration (Higgins & Green, 2011) and Best Evidence Encyclopedia (2013) were examined. After close examination and discussion within the review team, a full list of inclusion criteria for this review was developed as follows.

Sample size included at least two classrooms per treatment group. Contextual factors in education research are important (McCartney & Ellis, 2008). In small-scale studies, intervention effects are likely to have confounds with particular schools, classes, or teachers, dramatically limiting generalizability of the results. There will be some common attributes of the 'cluster', and there is a danger in single classroom/context studies that the strength of the common attribute. For example teacher quality, school quality or socio-economic status of participants, may be more powerful than the effects of the intervention (Slavin & Smith, 2009). Therefore, in

agreement with What Works Clearinghouse guidelines (What Works Clearinghouse, 2008), studies with only one classroom per treatment were not included due to the risk of single context effects biasing reported outcomes.

Randomization was used to assign to treatment or control condition. Randomized controlled trials (RCTs) are studies, in which participants, or groups of participants, are randomly assigned to experimental and control groups. The experimental participants receive treatment, while control participants receive treatment as usual, an alternative treatment or no treatment at all (Bowling, 2009). Randomized controlled trials are widely recognized as the most reliable research design to assess the effectiveness of an intervention as they create two equivalent groups to identify intervention effects (Guyatt, Oxman, Kunz, Falck-Ytter, Vist, Liberati & Schünemann, 2000; Glazerman, Levy & Myers, 2003; Petticrew & Roberts, 2003; Agodini & Dynarski, 2004; Wilde & Hollister, 2007). Although randomized controlled trials and high-quality matched studies may identify similar *Effect Sizes* (Torgerson, 2007), randomized controlled trials and matched studies do not always lead to same conclusions (Heinsman & Shadish, 1996; Glazerman et al., 2002). RCTs tend to report lower *Effect Sizes* than matched design experiments. This review relies exclusively on studies with an RCT research design so that outcomes were not unduly affected by research design.

Outcome measures did not bias treatment over control condition. The review included studies with measures that were reliable and valid. A measure is inherent to the experimental treatment if it assesses particular skills or concepts that have been taught only to the experimental group. Miller, Maguire and Macdonald (2012) reported that measures described as directly related to the programme's goals may be inherent to the treatment and thus bias any comparison in favour of the intervention group. It follows that findings of a study are

determined not only by the intervention investigated and the nature of the comparison group, but also by the quality and independence of measures used. Gersten, Baker and Lloyd (2000) highlighted that when experimental design was undertaken in education, it was important to distinguish experimenter-developed and external measures. This review included studies that used attainment scales in which the reliability and validity of measures could be ascertained, e.g. where a standardized instrument was used or at least a full description of the psychometric properties of the scale and its scoring were available. Pre-test differences between control and treatments groups had to be reported as non-significant, or any pre-test differences controlled for during analysis.

Outcome measures of academic or socio-emotional ability. Secondary outcomes are outcomes that are not priority of the review, but are important for explaining intervention effects (O'Connor, Green & Higgins, 2008). Tutoring is theorized to rely not only on cognitive, but also socio-emotional outcomes (Robinson, Schofield & Steers-Wentzell, 2005), such as confidence (Koh et al., 2012), self-efficacy (Elliott et al., 2000) and self-confidence (Margolis, 2005). Therefore, although academic outcomes were the primary aim of the review, socio-emotional results, if available, were included as secondary outcomes.

Intervention length was 12 weeks or longer. The review focused on *"practical programmes that can be used over extended time periods, not theoretically interesting but impractical procedures that could never be replicated for extended periods"* (Slavin, 2008, p. 11). Consequently, to achieve higher external validity and relevance to school practice, the minimum length for a study to be included in this review was 12 weeks between pre-test and post-test, following Best Evidence Encyclopedia standards (Center for Data-Driven Reform in Education,

2013) on this issue. In contrast, very short programmes may not lead to forming sustainable habits (Lally, Jaarsveld, Potts & Wardle, 2010).

Nature of tutoring.

1) School-based programmes using individualized instruction in dyads or small groups, involving a more academically advanced tutor and one or more less advanced tutees (Medway, 1995; Topping, 1998).

2) Tutor and tutee had fixed roles, i.e. tutoring was non-reciprocal, and tutors and tutees remained in those roles for the duration of the programme.

3) Tutoring was delivered by classmates or older students, parents, university students, or other adults (for example community volunteers) acting in a non-professional peer tutoring role. Paraprofessional and professional teachers, and professional tutors were excluded.[1]

4) Tutoring took place in a face-to-face setting (this was used as an inclusion criteria as the differences between face-to-face and on-line tutoring have not yet been fully explored in the research literature).

5) Tutoring was carried out within the school context of the tutee.

6) The recipients of the tutoring were tutees in a kindergarten, primary, or elementary school setting, which corresponds to the age bracket of five to eleven years old.

7) Tutoring had an academic focus in any subject area.

8) Outcome measures included attainment tests, and information was provided that allowed *Effect Sizes* to be calculated from the reported data.

9) Intervention tested tutoring on its own without significant additional components, such as scholarships.

[1] To distinguish peer volunteers and paraprofessionals, this review considered tutors to be volunteers if they received no payment at all or if they were only reimbursed for travel to the school (Lee et al., 2010) and other participation costs incurred (Cabezas et al., 2011).

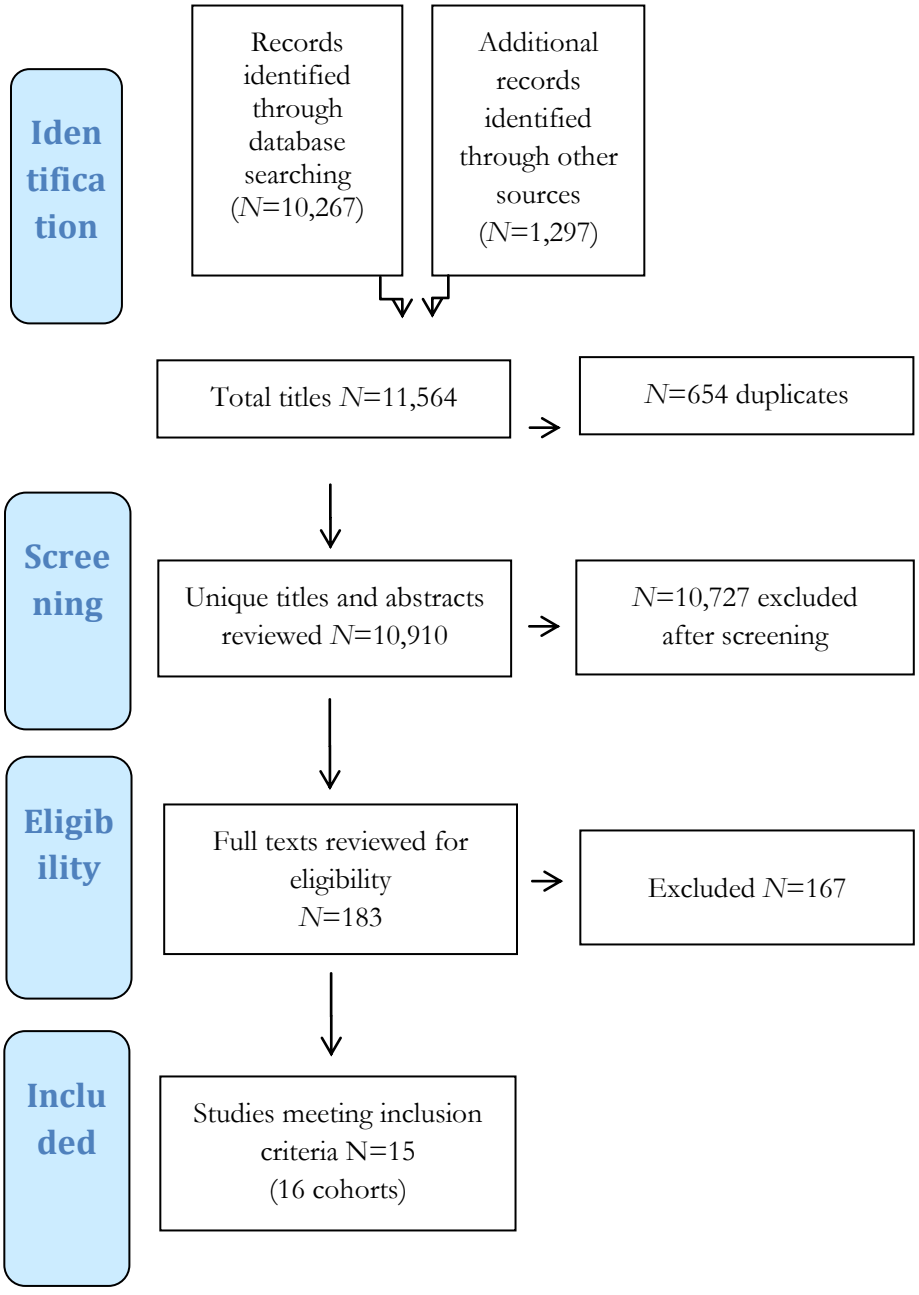
10) The duration of the tutoring intervention was not less than 12 weeks long.

Search strategy for identification of studies

Given the spread of published educational intervention research over many resources (Newman, 2003; Glanville & Paisley, 2010), a wide range of databases were identified to reduce the possibility of missing studies. Modifications of the search string *tutor* AND (peer* OR cross-age OR volunteer*) AND (evaluation* OR program* OR experiment* OR random*) NOT technolog** was used on ASSIA, Australian Education Index, British Education Index, ERIC, International Bibliography of Social Sciences, JSTOR, PsycINFO, PRISMA, ProQuest Dissertations & Theses, Web of Knowledge, Social Services Abstracts, and Sociological Abstracts.[2] In addition to databases, organizations' websites, and bibliographies of key studies, literature reviews and meta-analyses were analysed for review titles. Furthermore, 104 researchers who have published studies on tutoring were contacted by email to identify unpublished studies.

[2] Using * (wildcard) at the end or in the middle of a word will return searches of all letter strings/spellings that are contained in the string. For example randomi*ed would return all search items with spelling of both randomized (USA spelling) and randomised (UK spelling).

Figure 1. Flowchart of study selection adapted from PRISMA Statement (Moher et al. 2009)



Data presented in Figure 1 shows the flow diagram of identification and screening of studies. A total of 11,564 titles were retrieved through the review searches. Citations were imported into Microsoft Excel, which was used to remove duplicated records, leaving 10,910 unique titles and abstracts. Initial screening of titles and abstracts by the first author left 183 studies for further review. Shenderovich and Thurston also examined the full list of titles to discuss any studies that caused uncertainty as to whether further screening would be required and made decisions in each case. Full texts of the 183 studies were obtained and assessed for eligibility Shenderovich. Both Shenderovich and Thurston further screened a randomly selected 20% of studies with no disagreements. Fifteen studies (reporting data from 16 cohorts of participants) fulfilled all inclusion criteria as determined by two authors.[3] All studies were fully coded by Shenderovich, and half were blind double-coded by both Shenderovich and Thurston. The other half of included studies were checked by Thurston for coding accuracy and to ensure inclusion criteria were met.

Effect Size calculations

To determine if tutoring had greater effect in any area of reading sub-skills, reading outcomes were categorized under the following categories for separate meta-analyses: comprehension, fluency, decoding, writing and overall reading ability, using the approach adopted by Ritter et al. (2006). As mathematics outcomes are categorically different from reading outcomes, reading and mathematics outcomes were maintained as separate variables. In cases where several measures within a study assessed the same construct, *Effect Sizes* and their confidence intervals were averaged to make sure that no study was unduly weighted (Becker,

[3] One study (Allor & McCathren, 2004) included two separate cohorts of students in two consecutive years

Hedges & Pigott, 2004), assuming a correlation of 0.5 between related scores (Borenstein, Hedges, Higgins & Rothstein, 2009).

Analyses were carried out using Comprehensive Meta-Analysis software, version 2 (Biostat Englewood, NJ). Standardized mean difference (Cohen's *d*) is the appropriate *Effect Size* metric to contrast two groups on continuous variables, such as test performance (Lipsey & Wilson, 2001). Standardized mean difference is calculated as difference in mean outcomes between groups divided by pooled standard deviation of outcome among participants. *Effect Sizes* and confidence intervals were divided by Hedges's approximation (Hedges & Olkin, 1985; Lipsey & Wilson, 2001). Given the diversity of tutoring programmes, random-effects model was pre-selected in the review protocol to make studies more equally weighted (Sterne, Egger & Smith, 2008) and results more generalizable (Field, 2001). Manuscript authors were contacted directly if any missing information was needed to calculate *Effect Sizes*.

In educational research it is common to assign groups of children, such as classes or schools, to treatment and control groups (Boruch, May, Turner, Lavenberg, Petrosino, De Moya & Foley, 2004; Campbell, Elbourne & Altman, 2004). The effective sample size in a cluster-randomized trial is the original sample size divided by the "design effect", which equals 1+(M−1)*ICC, where M is the average cluster size and ICC is the intra-cluster correlation coefficient (Higgins et al., 2008). ICC adjustment was applied for the Elliott et al. (2000) study, the only included cluster-randomized trial. We used ICC of 0.15, the value suggested by a recent compilation of research on intra-class correlation values of academic achievement in the USA (Hedges & Hedberg, 2007).

Results

Description of the included studies

As described in Table 1, eleven of the investigations were carried out in USA, four in the UK and one in Chile. The majority of tutoring programmes focused on low-achieving children, indicated either by their classroom teacher or test assessment. In respect to external validity, it is important to point out that the majority of studies recruited what appeared to be a convenience sampling of classrooms and schools, and are therefore not necessarily generalizable to other settings. However, some studies used representative samples, either of local schools (Miller & Connolly, 2012) or of the tutoring programme's participants (Lee, Morrow-Howell, Jonson-Reid & McCrary, 2010). All studies focused on schools with disadvantaged socio-economic profiles. Several programmes targeted one age group (Pullen, Lan & Monaghan, 2004; Allor & McCathren, 2004 – Gr 1, Cabezas, Cuesta & Gallego, 2011 – Gr 4), while others included a variety of primary school grades (Ritter, 2000 – Gr 2-5, Lee et al., 2010 – Gr 2-3).

Study sizes ranged from small-scale trials with 42 (Rimm-Kaufmann, Kagan & Byers, 1998) and 47 children (Pullen et al., 2004), to large-scale studies with 734 (Miller & Connolly, 2012), 883 (Lee et al., 2010) and 6,136 children (Cabezas et al., 2011) enrolled respectively. In total studies involved 9,484 participants. Following the approach of Best Evidence Encyclopedia, this review defines large studies as those with greater than 250 participants (Slavin, 2009). Five included studies with samples over 250 looked at on-going programmes (Experience Corps, West Philadelphia Tutoring Project, Time to Read, Servicio País en Educación) in multiple locations and, thus, were effectiveness—as opposed to efficacy—studies (Haynes, 1999; Flay, 1986, 2005).

Most included studies focused on reading, and two studies involved tutoring in mathematics. Ham (1977) assessed the "halo effect" of tutoring in reading on achievement in mathematics. The observed emphasis on reading focused studies could be reflective of the importance of

reading in primary school, as well as of the more complex nature of designing tutoring procedures in mathematics (Topping, 2004). Studies identified by this review did not target any other academic subjects.

Two cohorts included in the review utilized older schoolchildren as tutors (Jensen, 1991; Policy Studies Associates, 2007), and fourteen investigated tutoring by adults (eight of them involved adult community volunteers, and six with university student volunteers). All studies except one involved English-language instruction (Cabezas et al., 2011 studied reading in Spanish language in Chile). In addition to tackling outcomes of primary school tutees, some of programmes aimed to improve achievement of tutees who were school or university students (Policy Studies Associates, 2007) or to contribute to social wellbeing of older tutors (Lee et al., 2010).

Seven studies examined programmes that prescribed specific tutoring lessons and materials or specified time allocated for various activities. This review characterizes such programmes as "highly structured" – incorporating standardization by precise activities or by functions and processes (Baumann, 1991; Backer, 2001). More structured programmes also had more extensive tutor training. For instance, Pullen et al. (2004) provided university student volunteers with step-by-step lesson guides, and the tutoring sessions were observed by supervisors. On the other hand, nine studies provided only general advice to tutors and are therefore classified as "loosely structured". For example, in Northern Ireland the Time to Read programme, evaluated by Miller, Connolly, and Maguire (2012), adult community volunteers did not receive a pre-set tutoring session structure. In Baker et al. (2000), adult community volunteers were *"provided with a broad framework to use during sessions, rather than specific techniques"* (p. 497). Similarly, in the Ritter (2000) evaluation of West Philadelphia Tutoring Project, tutors

(University of Pennsylvania volunteer students) had general guidance on working with their tutees, and curriculum guides were only provided in some of the participating schools. There was no structured process evaluation, but anecdotal reports suggested that during sessions tutors helped pupils with homework tasks or made up their own exercises in reading and mathematics.

Table 1. Overview of Key Features of the Included Studies

Authors of study	*N*	Description of tutees	Description of tutors	Total (in hours)	Per week (in hours)	Length (weeks)	Fidelity	Location	Intervention description
Allor & McCathren (2004)	86 *year 1*	Gr.1 *M*= 6.7 y.o.	University education major student volunteers	12	1	26	Used a checklist *M*= 86.98 % (*SD* = 5.67)	8 underachieving schools, urban south USA	- Outside class during school day - Remedial tutoring for low-achieving children - Tutor training: America Reads tutor training, 3 1-hour trainings, monthly training, and on-site assistance - Scripted lessons with progressively challenging lessons, containing games on phonemic awareness, letter-sound correspondence, word-study activities and reading of levelled books - 3 research assistants observed and supported tutors
Allor & McCathren (2004)	157 *year 2*	Gr.1 *M*= 6.6 y.o.		13	1	26	*M*= 86.53% (*SD* = 4.80)	10 underachieving schools	
Baker, Gersten & Keating (2000)	84	Gr.1	Adult community volunteers (33% 30-45 y.o., 29% 45-65, 20% > 65)	37	1	72	Not reported	6 Title-1 schools, Oregon, USA	- Outside class during school day - Remedial tutoring for low-achieving children - Tutees selected based on reading difficulties and need for relationship with a caring adult - Tutor training: 1-2 hour training and community volunteer handbook - Tutoring focused on increasing children's interest in reading, program providing books for children to take home.
Cabezas, Cuesta & Gallego 2011	4903	Gr.4 9-10 y.o.	University student volunteers	18	1.5	12	High volunteer turnover	85 vulnerable schools in 10 counties in Biobio and Great Santiago regions, Chile	- After class - School-wide one to small group tutoring (5-6 students assigned to a tutor) - Tutoring focused on "shared-reading … of traditional stories and informative texts, which are age-and interest appropriate for students" - Volunteers supported by an employee of "Fundación para la Superación de la Pobreza" at each school - Volunteers received stipends for travel

Authors of study	*N*	Description of tutees	Description of tutors	Total (in hours)	Per week (in hours)	Length (weeks)	Fidelity	Location	Intervention description
Elliott, Arthurs & Williams (2000)	30	Reception class 4-5 y.o.	Adult community volunteers	19	1	19	Didn't measure	3 low-SES schools, Northeast England, UK	"Time for Reading" - During school day, both in and outside classroom - Class-wide tutoring one to small group tutoring - Tutor training: 6 hours over 3 weeks - Tutors worked alongside classroom teacher, providing "individual assistance … The focus of the work was reading for meaning and most of the training sessions involved the child reading to the helper from a fiction text and discussing elements of the story"
Ham (1977)	147	Gr. 1, 2, 3	Adult community volunteers,	36	2	22	Record keeping failed, high tutor turnover	4 schools with low SES & minority students, Sumter County, rural USA	- During language arts classes, outside class - One-to-one and small groups tutoring - Remedial tutoring for low-achieving children - Tutors worked following teachers' recommendations, "because of the turnover in volunteers and because volunteers as persons are difficult to program or control, plans for standardization of instructional approach had to be abandoned" p. 63
Jensen (1991)	93	Gr.2	Gr. 5	46	2	23	Not reported	7 elementary schools, Cache Valley, Utah, USA	- One-to-one tutoring - Remedial tutoring for low-achieving children - Tutor training: weekly sessions on "effective tutoring techniques, error correction procedures, and proper prompting techniques"; effects on tutors also assessed -Tutoring focused on timed reading aloud, reading passages assigned by paraprofessionals; tutors corrected mistakes and feedback for correct reading, asked comprehension questions
Lee (1980)	40	Gr.3-6	University volunteers, juniors and seniors	76	4	19	Not reported	4 schools, low SES & minority, urban USA	- After class - One to small group tutoring - Remedial tutoring for low-achieving children, or based on minority status or residence - Tutoring focused on homework assignments, improving reading and maths skills, addressing

Authors of study	*N*	Description of tutees	Description of tutors	Total (in hours)	Per week (in hours)	Length (weeks)	Fidelity	Location	Intervention description
									personal concerns - Tutor training: 7 training modules; tutors supervised by two graduate counselling students
Lee Morrow-Howell, Jonson-Reid & McCrary (2012)	881	Gr.1, 2, 3 *M*=7.09 y.o.	Adult community volunteers, 50 to 93 y.o., mean 65	21	1.75	36	Not reported	81 schools in Boston, 52 in New York, and 41 in Port Arthur, USA	"Experience Corps" - One-to-one tutoring - Remedial tutoring for low-achieving children - Tutor training: 15 to 32 hours - NY: Book Buddies (phonics, rereading familiar books, word study, writing, and reading a new book) - Boston: Reading Coaches (building student's oral vocabulary and increasing reading comprehension by asking prediction questions, discussing, and writing about the story) - Port Arthur: Brigance Inventory of Basic Skills materials (word recognition, comprehension, and word analysis) Nationally, 43% of community volunteers have high school diplomas, and 75% –some college education, some are former teachers
Loenen (1989)	81	7-11 y.o., *M*= 8.8 y.o.	Adult community volunteers	24	1	26	Observed 15 tutors, low fidelity to the training	13 schools in inner London, UK	"Volunteer Reading Help" - Outside class during school day - One-to-one tutoring - Remedial tutoring for low-achieving children - Tutor training: short compulsory training course (3 1.5- sessions on reading & practical tips) - Volunteers encouraged to talk to teachers, but no formal structure

Authors of study	*N*	Description of tutees	Description of tutors	Total (in hours)	Per week (in hours)	Length (weeks)	Fidelity	Location	Intervention description
Miller, Connolly, Odena & Styles (2009)	734	8-9 y.o.	Adult community volunteers	13	0.5	58	High tutor turnover, "variation in delivery"	Northern Ireland, UK 50 schools	"Time to Read" - Outside class during school day - One-to-one tutoring - Remedial tutoring for below-average performing children - Tutor training: half-day tutor training in paired reading strategies to improve reading fluency, word recognition, meaning, and comprehension for tutors, emphasizing repetition, alternate reading, word recognition, word meaning and comprehension, no structure provided for the sessions but a set of books. Some children received a workplace visit.
Miller,Connolly & Maguire (2012)	483	8-9 y.o.	Adult community volunteers	29	1	29	Not recorded	50 schools in Northern Ireland	"Time to Read" See above (note increased intensity/dose)
Policy Studies Associates (2007)	124	Gr.2	Gr. 4-5	72	2	36	Not recorded	Irving, TX, and Mongomery County, Maryland, US	"Reading Together" - Outside class during school day - One-to-one tutoring - Remedial tutoring for students at risk of reading failure, - Tutor training: 9 hours - Tutoring focused on a curriculum on "reading comprehension, reading fluency, vocabulary, and writing ... to move students from decoding to comprehending"
Pullen, Lane & Monaghan (2004)	47	Gr.1	University student volunteers, majors related to education	10	0.75	12	Used a checklist *M*=92%	North-central Florida, US 10 schools	- Outside class during school day - One-to-one tutoring - Remedial tutoring for students below 30th percentile - Tutor training: 4 hours - Three-step tutoring model: repeated reading of familiar text, explicit coaching in decoding and word-solving strategies, and reading new books during each session

Authors of study	*N*	Description of tutees	Description of tutors	Total (in hours)	Per week (in hours)	Length (weeks)	Fidelity	Location	Intervention description
Rimm-Kaufman, Kagan & Byers, (1998)	42	Gr.1	Community volunteers	72	2.25	35	Not reported	Cambridge, MA, US 6 schools	- Outside class during school day - One-to-one tutoring - Remedial tutoring for students below 30th percentile - Tutor training: 5 sessions and bimonthly meetings - Prescribed tutoring session schedule: reading for meaning associations between print and pictures, phonetics taught within the context of stories). "The tutors used games, drawing, writing, and related activities to engage the children in learning".
Ritter (2000)	319	At-risk Gr.2, 3,4, 5	University volunteers	21	1	21	Not reported	Philadelphia, PA, US 11 schools	"West Philadelphia Tutoring Project" - Outside class during school day - One-to-one tutoring - Remedial tutoring for students below 30th percentile - Tutor training: minimal training and supervision - Limited tutoring structure - "variety of tasks … spelling, reading, math problems, games, puzzles, crafts, and storytelling"

*SES-socioeconomic status, y.o.- years old

Description of excluded studies

Most studies were excluded due to lack of randomization. In addition, to examine sustainability, a minimum of 12 weeks length was set for inclusion, as discussed above, which left out several otherwise eligible studies. For instance Spörer, Brunstein and Kieschke (2009), randomized 210 elementary school children from 4 classes in a medium-sized German town to four groups: instructor-guided small groups; direct instruction followed by reciprocal tutoring; a mix of direct instruction and reciprocal tutoring; and a no-intervention control group. However, the study only lasted seven weeks. In addition, several studies were excluded because of a lack of eligible comparison groups.

In another excluded paper, an unpublished study based in migrant schools in Beijing, China (Li et al., 2010), all study groups were paid for grades, and, in addition, a third of the 850 students received tutoring from classmates and a third tutoring from classmates, plus a parental communication intervention. Thus, there was not a tutoring only group where no payment was made available. It was reported that tutoring and pay showed an *Effect Size* of 0.14 on reading and the group with tutoring and pay plus parental communication had an *Effect Size* of 0.2. Another study (Banerjee, Banerji, Duflo, Glennerster & Khemani, 2010) describes a set of interventions evaluated in 65 randomly assigned villages in India in 2005. Similarly, none of the interventions tested tutoring on its own, so the study was not included. All three interventions involved sharing information on educational resources with communities through small-group discussions. A second intervention also included offering communities testing tools to assess children's reading and mathematics results, and the third facilitated community volunteer tutors providing afterschool reading.

Overall effects

The review suggested small (as defined in Cohen, 1988) statistically significant positive effects, with high heterogeneity, of cross-age tutoring programmes on reading overall, as well on decoding and comprehension skills, while outcomes on other reading measures and mathematics were non-significant. The high heterogeneity of findings for many of the outcomes indicates that the studies, populations and interventions included are diverse.

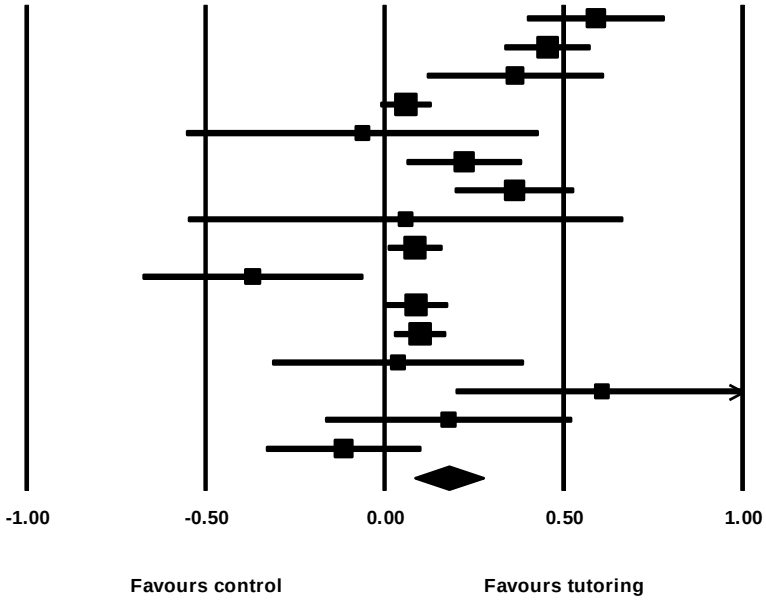
Outcome measures were grouped into seven categories, following the example of the Ritter et al. (2006) systematic review:

- Composite measure of reading: measure combining all reading scales available in each study (see Forest plot in Figure 2)
- Overall reading: overall batteries in reading achievement tests
- Decoding: subtests on decoding of words and knowledge of words, consonant sounds, short vowels, digraphs and combinations, sight words, and non-word decoding
- Comprehension: reading comprehension subtests
- Fluency: fluency subtests
- Writing: writing subtests
- Mathematics: mathematics outcomes

These seven categories covered the reported attainment measures of all included studies and therefore form an all-inclusive set of outcome descriptors. Figure 2 shows the composite measure of reading, with upper and lower *Effect Sizes* for the battery of reading tests reported by each manuscript.

Figure 2. Forest plot of comparison between control group and tutoring on the composite measure of reading

Study name	Study size	Measure	Hedges's g	Lower limit	Upper limit	p-Value	Relative weight
Allor 2004-1	86	Combined	0.59	0.40	0.78	0.000	6.91
Allor 2004-2	157	Combined	0.46	0.34	0.58	0.000	8.34
Baker 2000	84	Combined	0.36	0.12	0.61	0.004	5.84
Cabezas 2011	4903	Combined	0.06	-0.01	0.13	0.102	9.13
Elliott 2000	30	Combined	-0.06	-0.55	0.43	0.806	2.69
Ham 1977	147	Combined	0.22	0.06	0.38	0.007	7.54
Jensen 1991	103	Combined	0.36	0.20	0.53	0.000	7.43
Lee 1980	40	SAT reading, gr. 3-6	0.06	-0.55	0.67	0.849	1.95
Lee 2012	883	Combined	0.09	0.01	0.16	0.028	9.07
Loenen 1989	81	Combined	-0.37	-0.68	-0.06	0.019	4.79
Miller 2009	734	Combined	0.09	-0.00	0.18	0.051	8.89
Miller 2012	483	Combined	0.10	0.03	0.17	0.007	9.12
PSA 2007	124	Terra nova reading	0.04	-0.31	0.39	0.833	4.16
Pullen 2004	47	Combined	0.61	0.20	1.02	0.004	3.47
Rimm-Kaufman 1998	42	Combined	0.18	-0.17	0.52	0.309	4.25
Ritter 2000	328	SAT-9 Reading	-0.11	-0.33	0.10	0.299	6.43
			0.18	0.08	0.27	0.000	



Homogeneity analysis

Table 2 lists several measures of homogeneity. *Q* represents a standardized measure of total variation, and *df*, the expected variation. Thus *Q* minus *df* is the excess variation. The *Q* statistic and its *p*-value are a test of significance of the viability of the null hypothesis of zero true dispersion. I^2 is the percentage of the dispersion that is real and not due to sampling error. Higgins, Thompson, Deeks & Altman, (2003) tentatively suggest that I^2 values of 25%, 50%, and 75% are respectively low, moderate, and high, with about a quarter of meta-analyses having I^2 over 50%. Finally, T^2 is the variance and T the standard deviation of true effects, measured on the same scale as effects. The level of heterogeneity for decoding, fluency and composite measure of reading was high. Nevertheless, Ioannidis, Patsopoulos and Rothstein (2008) suggest that overall meta-analysis is usually desirable, even with high statistical heterogeneity. Although statistical homogeneity tests are weak and not very precise (Ioannidis et al., 2007; Thorlund Imberger, Johnston, Walsh, Awad, Thabane, Gluud, Devereaux & Wetterslev, 2012), statistical heterogeneity can be a useful tool (Berlin, 1995) as it points to the presence of clinical or methodological diversity, or both (Deeks, Higgins & Altman, 2011).

Table 2. Effect Sizes and random effects of included studies

Outcome area	*N* cohorts	*N* students	Hedges' *g* (random effects)	95% CI	*p*-value	Heterogeneity
Composite measure of reading	16	8251	**0.18***	0.08, 0.27	<0.001	Q=97.8; df=15; p=0.000; I^2=84.663; T=0.155; T^2=0.024
Overall reading ability measure	6	1457	0.07	-0.06, 0.20	0.299	Q=7.903; df=5; p=0.162; I^2=36.737; T=0.095; T^2=0.009
Decoding measure	9	7081	**0.29***	0.13, 0.44	0.000	Q=60.095; df=8; p=0.000; I^2=86.688;

						T=0.208; T^2=0.043
Comprehension measure	10	6945	**0.11***	0.01, 0.21	0.025	Q=15.223; df=9; p=0.085; I^2=40.877; T=0.091; T^2=0.008
Fluency measure	4	687	0.11	-0.21, 0.44	0.494	Q=13.104; df=3; p=0.004; I^2=77.106; T=0.275; T^2=0.075
Writing measure	3	4975	0.01	-0.07, 0.09	0.774	Q=0.281; df=2; p=0.869; I^2=0.000; T=0.000; T^2=0.000
Mathematics measure	3	506	-0.02	-0.18, 0.13	0.778	Q=1.774; df=2; p=0.412; I^2=0.000; T=0.000; T^2=0.000

** Significantly different from zero, p < .05, favouring tutoring over the control.*

Sensitivity analysis

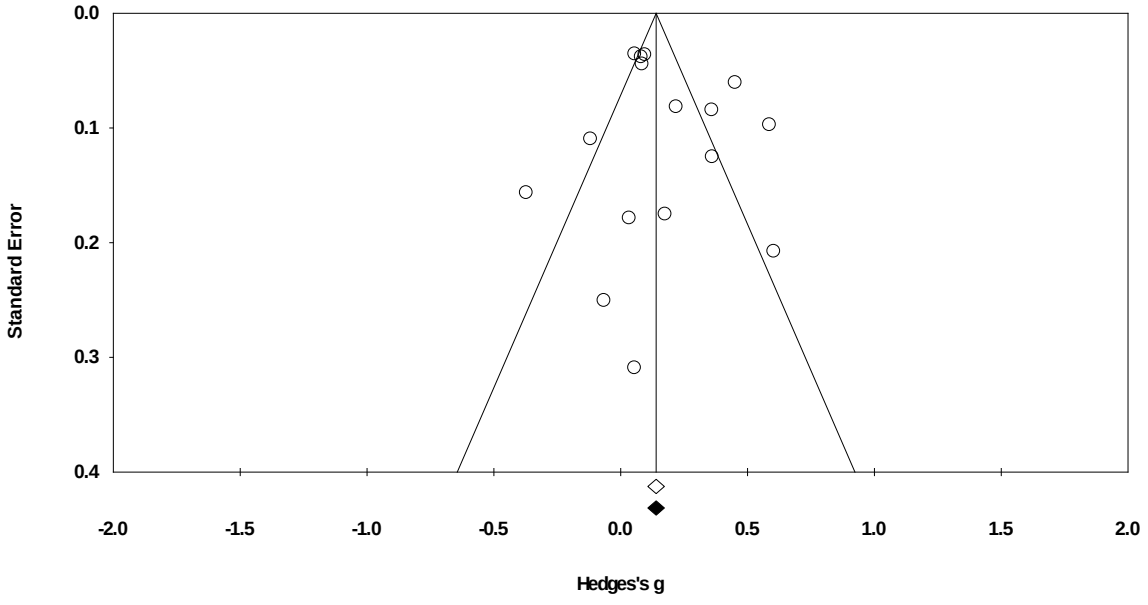
Sensitivity analysis is necessary to assess potential bias that may be associated with individual *Effect Sizes* and distort the aggregated effects (Hedges & Olkin, 1985). "One Study Removed" analysis allows to assess if any single study has disproportionate influence. In this set of studies, several very large samples are present. In particular, the large sample (N=4,903) in Cabezas et al. (2011) made up 59% of all reading studies' participants. Using a random effects model, all estimates with one study removed fell inside the 95% confidence interval of the overall estimate with all available studies. Therefore no study was found to have an excessive influence on results.

Publication bias

Five of the included studies have not been published in academic journals. Three were dissertations and two were reports. Non-significant or negative results, especially in small-sample studies, are often not submitted or not accepted for publication, although they may be of equal quality as published work (Iyenger & Greenhouse, 1988; Hopewell, Loudon, Clarke, Oxman & Dickersin, 2009). To assess the possibility of publication bias, the "trim and fill"

procedure (Duval & Tweedie, 2000) was conducted for each outcome to identify and correct funnel plot asymmetry (see Figure 3 for composite measure of reading funnel plot). The "trim and fill" procedure for the composite measure of reading did not indicate any missing studies. However, there was an indication of studies missing to the left of mean effect sizes for the overall reading ability, comprehension, decoding, and mathematics measures, suggesting possible publication bias. The impact of publication bias still may be trivial as at least 8-10 studies are required for trim-and-fill test to have sufficient power (Sutton, Duval, Tweedie, Abrams & Jones, 2000a, 2000b). In addition, Egger's regression testing asymmetry of the funnel plot was not significant (p>0.05) for any measure, indicating low risk of publication bias, although the small number of studies does not allow for definitive conclusions.

Figure 3 Funnel plot of standard errors by Hedges's g *for composite measure of reading, random-effects*



Moderator analyses and meta-regressions

Several programme features were examined through subgroup analyses and meta-regressions. Grouping of studies was used to assess the possibility of varying reading outcomes of different types of programmes to analyse possible sources of heterogeneity (see Table 3 for a summary). Mixed effects analysis was used, meaning that random-effects model is used within groups and fixed effects across subgroups with pooled estimates of T^2. Studies were grouped by the variable of interest, and subgroup effects were compared using significance of *Q* to see if *Effect Sizes* between groups were statistically different.

Study size. Eleven studies had samples of 30 to 157 children, and were coded as "small", while five studies with samples of 328 to 4,903 were coded as "large". Difference between two groups was statistically significant for Composite measure of reading ($p<0.01$) and Decoding ($p<0.001$), with larger studies showing significantly smaller effects than smaller studies. This is a common feature when reporting data in systematic review and comparing studies. Similarly to previous studies, there were much higher levels of heterogeneity among smaller studies ($Q=41.176$, $df=10$, $p<0.001$, $I^2=75.714$) than among larger studies ($Q=3.714$, $df=4$, $p=0.446$, $I^2=0.000$). Smaller studies are subject to higher sampling variation (Higgins & Altman, 2008) and have lower statistical power, increasing likelihood of a false positive result (Christley, 2010). Larger studies produce more precise estimates as they are generally better powered to detect effects (Ginsburg-Block, Rohrbeck & Fantuzzo, 2006). Method of moments meta-regression suggests no significant correlation between study size and composite measure of reading ($p_{slope}=0.315$).

Tutoring structure. Highly structured programmes (9 studies, $g=0.33$, 95% CI: 0.14, 0.52, $N=1,388$) had a significant advantage over low-structure programmes (7 studies, $g=0.08$, 95%

CI: -0.01, 0.16, *N*=6,863) on the Composite measure of reading outcome. Comparing groups with the *Q*-test (Borenstein, Hedges, Higgins & Rothstein, 2009, p. 178), Q=5.903, p=0.02, thus *Q* is statistically significant, and *Effect Size* is related to the level of structure.

Type of tutor. Subgroup differences by type of tutor comparing tutors who were university students, adult community volunteers or peer tutors did not indicate significant differences in random effect analysis.

Publication status. Subgroup differences depending on publication status being published or unpublished report or thesis did not indicate significant differences in random effect analysis.

Table 3 Reading Effect Sizes by moderator

Study feature	*N* cohorts	Hedges' *g* (random effects)	95% CI	Homogeneity between groups (random effects)
Study size				
Large	5	0.08	0.04, 0.11	Q=9.771*, df=2, p=0.008
Small	11	0.23	0.07, 0.39	
Publication status				
Journal article	11	0.21	0.08, 0.34	Q=0.619, df=0.6, p=0.431
Report or dissertation	5	0.13	-0.03, 0.28	
Type of tutor				
Older child peer tutor	2	0.24	-0.07, 0.55	
University student	6	0.28	0.03, 0.53	Q=2.230, df=2, p=0.328
Adult community volunteer	8	0.11	0.03, 0.18	
Tutoring structure				
Loosely structured	9	0.33	0.14, 0.52	Q=5.903*, df=1, p=0.015
Highly structured	7	0.08	-0.01, 0.16	

Amount of tutoring. Method of moments meta-regression examines differences in the effect of tutoring on composite measures of reading, depending on 'dose' of tutoring, as measured by the number of tutoring hours. Amount of tutoring did not give a good explanation of effectiveness of tutoring in included studies (p_{slope}=0.584).

Social, self-concept and behavioural outcomes

Few studies included in this review tested non-academic outcomes alongside academic skills. Due to their diversity and small number, non-academic results were not meta-analysed but are summarized in Table 4, and all were non-significant except one.

Table 4. Non-academic outcomes in the included studies

Study	Outcome	Scale	Hedges *g* (95% CI)
Lee 1980	Self-concept of reading	Piers-Harris Children's Self-Concept Scale	0.31 (-0.32, 0.93)
	Classroom behaviour	Devereaux Elementary School Behavior Rating Scale	-2.12 (-2.90, -1.35)
Loenen 1989	General self-concept	McDaniel-Piers Young Children's Self-concept Scale	0.06 (-0.39, 0.51)
	Composite classroom behavior	Rutter B-scale for teachers	-0.10 (-0.58, 0.39)
Miller 2009	Future aspirations	Future aspirations (Loeber, Stouthamer-Loeber, Van Kammen & Farrington, 1991))	0.17* (0.02, 0.33)
	Enjoyment of learning	Enjoyment of Learning (Pell and Jarvis's 2001)	–0.09 (–0.22, 0.03)
	Self-esteem	Global Self-Worth Scale of the Self-Perception Profile for Children (Harter, 1985)	–0.04 (–1.87, 0.10)
	Locus of control	Rotter's Locus of Control Scale	–0.05 (–0.31, 0.21)
Miller 2012	Enjoyment of reading	The Garfield Elementary Reading Attitudes Scale	0.03 (-0.11, 0.17)
	Reading confidence	The Reader Self-Perception Scale (Henk and Melnick, 1995)	0.03 (-0.13, 0.22)
	Aspirations for the future	Aspirations for the Future Scale (Loeber et al., 1991)	0.03 (-0.11, 0.17)

The quality of evidence

Littell, Corcoran and Pillai (2008, p. 72) propose that *"Even when a review is limited to randomized controlled trials, a deeper assessment is needed to judge variations in quality of those studies that may be associated with bias."* This is particularly important because

randomized controlled trials in school and educational settings are reported to have lower quality than in healthcare (Torgerson, Torgerson, Birks & Porthouse, 2005). Assessments of domains of bias specified in Cochrane Collaboration Risk of Bias Tool (Higgins & Altman, 2008) are outlined below. As reported in Table 5, the included studies did not address many areas of potential bias.

Table 5. Cochrane Collaboration Risk of Bias Tool application in the included studies

Study	Selection bias: sequence generation	Detection bias: blinding of outcome assessors	Attrition bias: incomplete outcome data
Allor 2004-1	?*	?	-*
Allor 2004-2	?	?	-
Baker 2000	?	+*	+
Cabezas 2011	?	?	+
Elliott 2000	?	?	+
Ham 1977	+	?	+
Jensen 1991	?	+	+
Lee 1980	?	?	-
Lee 2012	?	?	-
Loenen 1989	?	?	-
Miller 2009	+	+	-
Miller 2012	+	+	-
PSA 2007	?	?	-
Pullen 2004	?	+	-
Rimm-Kaufman 1998	?	+	?
Ritter 2000	+	?	-

**Note + low risk of bias - high risk of bias ? unclear risk of bias*

Selection bias. Only four studies specified their approach to generation of randomization sequence, and all four used computer-generated sequences. Two studies, Loenen (1989) and

Ritter (2000) discussed practical challenges surrounding gaining cooperation from schools for randomization. Therefore, it is not possible to rule out selection bias as a contributing factor to effects in some studies due to sequence generation and allocation concealment.

Performance and detection bias. Although blinding of study participants and intervention personnel (such as class teachers and tutors) is not possible in a tutoring intervention, it may be possible to blind the assessors. Six of the studies did this. Rimm-Kaufmann, Kagan and Byers, (1998) reported that classroom teachers were blinded to which children were assigned to the control group.

Attrition bias. The studies described a wide range of attrition levels, some as high as 35%. There was no standard approach to intention to treat analysis and so it was not possible to assess attrition risk in a quantifiable manner.

Reporting bias. The presence of differences between reported and unreported findings could not be assessed due to lack of study protocols

Other biases. 1) There were significant pre-treatment (baseline) differences between treatment and control groups (either due to chance or problems with randomization) in two studies (Jensen, 1991; Pullen, Lane & Monaghan, 2004), but it was reported that differences were accounted for in ANCOVA analyses.

2) There was a lack of long-term follow up measurements in the included studies. A possible explanation for this may be sue to ethical and practical difficulties of having a no-intervention control group in schools. Only the Policy Studies Associates (2007) and Elliott et al. (2000) studies had follow-up assessments. Thus the review is primarily based on post-test (tests at the end of interventions) rather than on follow-up measures. Longevity of change was therefore difficult to assess.

3) Five large studies used multilevel modelling to account for classroom and school effects. However, smaller studies did not adjust for clustering effects within classrooms and schools, and as Miller & Connolly (2012, p. 12) note, "clustered nature of data" is present when children come from the same classrooms and schools, violating statistical assumptions of independence.

Discussion

Whilst publication bias was not apparent, evidence presented by the review must be viewed with caution due to high heterogeneity, quality limitations and small number of included studies. The review suggested that tutoring programmes had small positive effects on combined measures of reading as well as specifically on decoding and comprehension. However, Chall's synthesis of theories of reading concludes that both decoding and fluency skills are necessary for comprehension skills to develop (Chall, 1989). One explanation is that decoding and comprehension measures had more eligible large and well-powered studies included in the synthesis, and thus the meta-analyses for these measures had more power to detect effects (Borenstein, Hedges, Higgins, and Rothstein, 2009).

In-line with previous reviews on tutoring (Fitz-Gibbon, 1977; Palincsar & Brown, 1989; Wasik & Slavin 1993; Ginsburg-Block, 2006; Ritter, 2009; Ewan 2013), studies with a pre-set structure of tutoring report greater *Effect Sizes*. This could support the idea that *"open-ended discussions and explanations are problematic, confusing and ineffective"* (Fuchs et al., 2001, p. 16). Non-trained tutor behaviours have been reported to use 'knowledge-telling' rather than 'knowledge-building' explanations (Roscoe & Chi, 2007). However, findings of subgroup analyses are observational and should be treated with caution as we cannot account for potential confounders. For example, it is also possible that more structured programmes were better organized in other respects, such as better tutor training. Moderator analyses suggested that

using different types of reading tutors, depending on who is available in the given community, could produce similar results, if a structured tutoring programme was established. However, the number of studies is small, and only two eligible studies with child tutors were identified.

Based on meta-regression results, there was no difference in reading outcomes by dose of tutoring, as measured by number of hours. It should be noted that meta-regressions have very weak statistical power a low number of studies. Regarding this apparent lack of dose-response relationship in tutoring, the findings of this review are in line with results of recent large-scale randomized trial of peer tutoring study in Scotland, The Fife Peer Learning Trial (Tymms, Merrell, Thurston, Andor, Topping & Miller, 2011). A no-intervention control group was absent, and the different groups served as controls to each other (e.g. reading tutoring children served as controls for mathematics and vice-versa), so the study was not included in this review. The study was a large-scale district-wide effectiveness trial involving two-15 week tutoring periods spread out over two years (129 elementary schools, nearly 9,000 pupils). The factorial design examined effects of intensity (once per week against three times per week), cross-age (10 year olds tutoring 8-year olds) against same-age tutoring (8-year olds) and tutoring in maths only, reading only and both reading and maths. HLM analysis indicated that intensity did not have a significant effect on outcomes in Performance Indicators in Primary Schools standardized tests, but that *Effect Sizes* for cross-age tutoring were significantly greater than for same-age tutoring (0.25 as compared to 0.02).

On the other hand, Vadasy, Jenkins, Antil, Phillips and Pool (1997) compared a group of paraprofessional tutors who came to each session and tutored the full amount of time to a group who did not follow time commitments as closely. The study found much higher *Effect Sizes* for tutees whose tutors attended regularly, suggesting that quantity of tutoring may have an impact

on student outcomes. However, it should be noted that the study had a very small sample of 20 students. Similarly, in Lee et al. (2010) reported gains were slightly stronger (*Effect Size* 0.01-0.04) on three out of four decoding measures for students who received at least 35 tutoring sessions. However, it is possible that the Fife Peer Learning Project gives better comparability as students received fewer sessions by design and findings were unlikely to be biased by clustering effects of the quality of implementation.

There was not a significant correlation between study size and *Effect Size*, but the five large tutoring studies had significantly lower effects than the smaller studies. Thus, the large studies seemed to disagree with the smaller ones. Four out of five of the largest cross-age tutoring studies also had low-structure sessions, so differences could have been an artefact of low structure of sessions in the large studies. Still, this difference could point to super-realization bias as smaller studies offer the potential to be closely overseen by researchers (Cronbach, 1980). LeLorier, Gregoire, Benhaddad, Lapierre and Derderian (1997) reviewed 12 clinical medical interventions and reported that outcomes of larger studies (1,000 patients or more) were not predicted accurately 35% of the time by earlier meta-analyses on the same topics. Based on included studies in this review, it appears likely that *"the larger studies tend to be those conducted with more methodological rigour, or conducted in circumstances more typical of the use of the intervention in practice"* (Sterne et al., 2008, p. 321), so evidence from large trials needs to be given priority when using systematic reviews to report results that may be generalizable.

Implications for research

Protocol registration and rigorous study design and reporting. One of the important observations from this review is the need for standardized publication of research protocols.

Ideally this should take place prior to research being conducted. Protocols should make particular note of procedures for randomization. In addition it is vital that data is given on demographics of research participants. Some of the key demographic information about participating children, such as their gender and socioeconomic background, was not reported in detail in the majority of studies. Participant demographic information allows for moderator analyses (Gardner 2006, 2010; Drugli, 2010) to help better understand what works for whom and under which conditions (Hargreaves, 1996). For instance, Cabezas, Cuesta and Gallego (2011) reported that overall programme effects were not significant, but subgroup analyses indicated a significant positive impact on reading in low socio-economic status public schools in Bio Bio Region. In addition, the ultimate purpose of interventions are "important gains […] generalized and maintained over time" (Mullen, 2006, p.85). Studies with long-term follow-up are needed (Flay et al., 2005), particularly in mathematics as only two mathematics tutoring programmes were identified by the review.

The implementing organizations also merit more description in future research, given recent evidence suggesting that it can also be very important to student outcomes in educational programmes. It is reported that short-term teacher contracts increased student attainment in Kenya when implemented by non-governmental organization World Vision Kenya, but showed no effects in provinces randomly allocated to condition where there was implementation by government officials (Bold, Kimenyi, Mwabu, Ng'aga'a & Sandefur, 2013). Findings in this study were reported to be due to differences in fidelity of implementation, although fidelity was not formally assessed. It was concluded that the influence of an implementing organization is so significant, that even findings from effectiveness studies may not be directly relevant to programme implementation in real-world settings, if the implementation agent is different from

the one researched. Organizations undertaking RCTs might have to work very hard to ensure a *"stronger drive for performance or generally stronger capability"* (Pritchett & Sandefur, p.31).

Emphasis on theory of change. Previous reviews discussed that tutoring programmes need stronger theoretical grounding (Devin-Sheehan et al., 1976; Rohrbeck et al., 2003). As Miller, Connolly and Maguire (2012, p. 140) reported *"it remains relatively unknown how or why volunteer mentoring programmes are effective"*. For instance, only Lee (1980) and Ritter (2000) studies discussed matching tutors and tutees, although matching has been described as an important programme element by many authors (Wood & Bruner 1976; Reisner et al., 1989; Topping & Whiteley, 1993; University of Barcelona, 2007; Naidoo, 2009).

Every intervention is based on a theoretical model (Weiss, 1997; Bickman, 2000). To be tested effectively, theories need to be expressed in a logic model (Zief, Lawyer & Maynard, 2006; Cooksy, Gill & Kelly, 2001) or described by Causal Chain Analysis (Loyalka, Liu, Song, Yi, Huang, Wei, Zhang, Shi, Chu & Rozelle, 2013). This allows process implementation fidelity to focus on the underpinning logic of the theoretical base. In particular, tutoring is theorized to also rely on socio-emotional processes, but *"tutoring programmes have placed greatest emphasis on cognitive processing"* (Shanahan, 1998, p. 231). This might create space between the logic of theory of how tutoring promotes attainment, and the actual processes that do underpin change. Similarly to previous reviews (e.g., Cohen et al., 1982, Ritter et al., 2009), this systematic review identified few studies measuring socio-emotional outcomes. Developing and testing logic models for peer tutoring programmes could also help to distinguish between elements that are essential and variable in the intervention (Craig, Dieppe, Macintyre, Michie, Nazareth & Petticrew, 2008). Perhaps the best way to compare components of an intervention is within a randomized controlled factorial design (Deeks et al., 2011). If sufficient sample sizes

are recruited, it would allow comparison of several types of tutoring and explore variables individual contribution to outcomes e.g. the effectiveness of different types of tutors. Otherwise, there is danger of being unable to detect how variables such as tutor competence or training may predict outcomes.

Process evaluation. Even potentially effective programmes may fail to improve outcomes due to how treatment was delivered (Dobson, 1980; Hawe, Sheil & Riley, 2004; Mihalic, 2004). Process evaluations add crucial insights to study results (Linnan & Steckler, 2002; Lewin, 2009). Loenen (1989, p. 310) reported observations of 30 tutoring sessions and characterized them as *"different from VRH [Volunteer Reading Help charity, currently Beanstalk] presented in the initial VRH training course"*. What happened in practice was not what the designers had planned. Topping, Miller, Murray and Conlin (2011) undertook process observations in the Fife Peer Learning Trial and data suggested that "tutoring technique was only partly implemented". Lack of assessment of implementation fidelity may produce descriptive ambiguity (Rychetnik, Frommer, Hawe & Shiell, 2002), and result in researchers *"evaluating a programme that has not been adequately implemented"* (Basch, Sliepcevich, Gold, Duncan & Kolbe, 1985, p. 316). Process observations can further illuminate the theory of change through testing correlation between implementation variables and attainment (Topping, Thurston, McGavock & Conlin, 2012).

As part of the process evaluation, intervention cost should be recorded and reported as it informs subsequent recommendations about using an intervention, along with the quality of evidence (Guyatt et al., 2008a; Krishnaratne, White & Carpenter, 2013). Resource scarcity is a notorious issue in education, and it is important to record all resources, including personnel and materials required (McEwan, 2012). Although many programmes mention that they are less

costly then employing professional tutors, only Ham (1977) has given the actual programme costs, although Cabezas et al., (2011) provided a cost-benefit analysis.

Implications for implementation of tutoring programmes

Based on the limited sample of included studies, it appears that using highly structured interactions between tutor and tutee is important. In the West Philadelphia Tutoring Programme, Ritter and Maynard (2008) highlighted the lack of tutor training and tutoring session structure to explain the absence of positive effects. Ritter and Maynard also concluded that highly structured tutoring programmes are more likely to lead to improved reading. Similar phenomenon was observed in the Fife Peer Learning study, which reported *Effect Sizes* of 0.2-0.25 for highly structured peer tutoring in mathematics (Tymms et al, 2011). The impact of structure shows the important role that an educator has in designing tutoring programmes to ensure that interactions maximize the behaviours seen as providing effective learning.

This review included only 16 study cohorts, so any findings must be treated with some degree of caution. Nevertheless, as the lack of statistically significant student improvements on some measures indicated, cross-age tutoring may not always increase academic outcomes as intended. While this review focused on benefits to tutees, some evidence suggested that children benefit to a greater extent when acting in the role of peer tutor rather than tutee (Robinson, 2005). Therefore, this review does not assess the overall benefit of tutoring programmes. This is one of the limitations of the review. Although a transparent and rigorous search strategy was employed, study selection and quality appraisal was intentionally set to a level whereby findings may have been generalised to different educational contexts. However, the small number yet wide diversity of eligible studies limits the strengths of conclusions. The authors are currently

undertaking a large-scale (128 class) cluster randomized trial of cross-age peer tutoring where the differential benefits to tutors and tutees of tutoring programmes will be assessed.

In conclusion there are lessons and messages for both practitioners and researchers from the review. Practitioners need to be aware that studies are not consistent in the definitions of "tutoring", "mentoring" and "volunteering", so it is important to obtain the specific programme descriptions to be clear about the structure and form/function of interactions. In addition practitioners still need to undertake some form of assessment within their specific educational context to ensure that the tutoring that is implemented transfers to their setting. Research on peer tutoring suggested that it has potential to produce consistent positive effects if used in reading with a structured approach, but that studies are not robust enough to ensure that findings transfer and generalise to all contexts. There are also lessons for researchers. Researchers may not have a shared definition of what constitutes a peer tutor, a student tutor, a non-professional tutor, or a community volunteer. However, if manuscripts define how the authors have interpreted these terms then it is possible to synthesise common research in cognate groups, even if original manuscripts have used differing terms and descriptors initially. There are also methodological issues in design and reporting. Medical RCTs generally follow CONSORT guidelines to ensure consistency of approach and that all appropriate variables are reported (Campbell et al., 2004). There may be a need to develop trial and reporting criteria specifically for education RCTs or utilize guidance on reporting social and psychological interventions (Montgomery et al., 2013), otherwise future reviews will be similarly limited in their ability to provide a definitive evidence base to educational professionals.

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