A systematic review of environmental interventions to improve child language outcomes for children with or at risk of primary language impairment

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Abstract

Systematic reviews are important as a key source of information for commissioners and for developing practice in speech and language therapy and early years. Interventions in this field are often complex and are delivered in community settings. This paper applies a systematic review of environmental interventions in early years for children with speech, language and communication needs. Interventions for primary language impairment may be divided into those which are child focused and those which are focused on the environment. In both cases, the aim is to effect changes in the child's language skills. The paper introduces the context of evidence based practice and commissioning of such interventions and argues that systematic reviews may be combined with other evidence to provide information which is fit for purpose for commissioners and for practitioners in the field.

134 words

Key words

Systematic review, speech and language, early years, evidence based practice, commissioning

Introduction

Systematic reviews are widely regarded as one of the best sources of research evidence for practitioners and, increasingly, for commissioners and policy makers involved in planning services. They are especially valuable for practitioners who want an overview of the highest quality studies addressing a single research question. This paper explores the application of systematic review methods to environmental interventions to improve child language outcomes for children at risk of or with identified primary language impairment. Primary language impairment is of concern to parents and professionals alike, tends to co-occur with other developmental delays and behaviour problems and is a risk factor for educational failure (Law et al. 1998).

Background to this systematic review

Speech and language delay

Estimates of speech and language delay amongst children vary. In the Law systematic review (Law et al. 1998), the median prevalence estimate for children with combined speech and language disorders was estimated at 5.9% between 2-7 years whereas Tomblin et al (Tomblin et al. 1997) found a prevalence of 8% for kindergarten boys (ie 5-6 year olds) and 6% for girls. Speech and language delay includes a range of conditions and is typically divided into those children whose speech and/or language skills are delayed in apparent isolation from their other developmental skills (primary speech and language impairment) and those whose speech and/or language delay is associated with other developmental conditions and is commensurate with their other skills (secondary speech and language impairment). Children with speech and language delay often present with special needs in nurseries or in primary schools and are therefore of considerable concern to educationalists and speech and language therapists alike. Interventions for such children are underpinned by philosophical beliefs about facilitating change and may be carried out either:

by working directly to change the child's speech and language behaviour (what may be called 'child-focused approaches')

and/or

by working to change the context in which that behaviour takes place (what may be called '**environmental approaches'**).

Child focused approaches address aspects of the child's cognitive, linguistic and social performance. The focus of the intervention is on directly eliciting progress in the child's communication behaviour.

Approaches that focus on the child's performance do so from the diagnostic perspective of identifying the aspects of weakness or breakdown in the child's performance and thence addressing those. For example if the chid is perceived to have auditory attention deficits as a contributing factor, then work will focus on the child's auditory attention. This type of intervention is underpinned by several theoretical frameworks developed over many years (See Wolf Nelson 1993: for a review) but these theoretical approaches have been criticised because they may not fully explain the nature of the child's disability, may not account for the process of change through intervention nor assist therapists in selecting interventions approaches (Bunning 2004).

"Biological maturation theories emphasise anatomical structures without offering much regarding target content of interventions or procedures. Linguistic theories focus on content and say little about procedures. Information processing theories focus on a content that is not really content and offer procedures that can support other intervention efforts but do not stand well on their own. Cognitivist theories cross wide expanses of content and offer little except developmental expectations and procedural guidelines"

(Wolf Nelson 1993: , page 211)

Child focused models have also been described as having the individual as the 'centre of influence' ((Bunning 2004: pp. 21) because they focus on the individual child's functional competencies and use of language. The child focused models had come to provide the dominant paradigm to explain the development of language but more recently, researchers have begun to include the communicative partner and have regarded the dyad as an area of interest and a source of language variation. The emergence of ecological models has encouraged researchers to look at the influence of non language environmental factors (See Sylvestre et al. 2002: for a review). The leading proponent of an ecological view of child development, Bronfenbrenner , describes the interacting sociocultural systems within which human development occurs from the microsystem of the child's immediate context through to the macrochronological system of the child's cultural heritage (Bronfenbrenner and Morris 2006). Speech and language therapy interventions which build on these ecological

models accept that a child in isolation 'cannot be meaningfully supported' (Gascoigne 2006)

ii. Environment focused approaches concentrate on the people (adult input) and resources (eg toys, tv & radio) around the child and the way that they interact with the child, the opportunities, language models and feedback they provide. The focus of the intervention is on changing the behaviours of those surrounding the child and of the resources available to the child. Stated very simply, the assumption underlying these interventions are that changing the behaviours of those in the child's environment and the resources available to the child, one can produce progress in the child's communication behaviour. Beyond this, there are assumptions about the underlying cause of the child's language delay. For children with an identified impairment, the assumption or theoretical position is that the child, for some reason not readily apparent, has failed to acquire language and therefore the environment needs to be adapted in order to facilitate the child's inductive processes (Bloom and Lahey 1978). On the other hand, similar interventions are on offer for children who are perceived to be at risk of language delays because of some kind of limitations in their environment; sometimes referred to as compensatory programmes, this notion has given rise to programmes such as Sure Start in the UK.

The communication environment has been described by Bunning (2004) and the elements most relevant to children's communication are:

- the underlying values of the setting, relationships between individuals, their roles, social standing, power and influence;
- the people present in the environment with whom the child communicates including their styles of communicating, attitudes and sensitivity;
- the conditions of the setting including the formality and general ethos and the reasons for communicating;
- the activities and opportunities which are available to those in the setting.

Our interest in wanting to understand the evidence base for environmental approaches arose because we recognised that speech and language therapists in the UK were increasingly becoming involved in work to change aspects of the child's environment to improve language development (in health care, education and social care settings), but apparently with limited evidence to support such approaches. 'Environmental approaches' have become a very common approach to intervention, for example in programmes such as SureStart¹ (a programme described by Glass 1999), with progressively more emphasis placed on the child's environment, rather than targeting intervention more directly on the child's language skills. Typically interventions in such programmes involved a wide range of professionals, including teachers (Sawyer et al. 2007). In environmental approaches, practitioners draw on theories about factors (components) in the environment which have been shown or are thought to have an impact on both normal language development and on language impairment/delay. Alongside the theories there are a series of assumptions including that '**positive' factors** derived from 'normal' language acquisition will be applicable to and facilitate change in those with language impairment. Conversely, it also seems to be implicitly assumed that if '**negative' factors** can be removed or ameliorated, this too will facilitate language learning in children with language delay. This application of research from normal language development studies to those of language delay is not always based on evidence and may be difficult to interpret when looking at children whose language development is slower or different.

For the SLT practitioner, the dichotomy of these two paradigms is probably not a true reflection of their practice. It is likely that speech and language therapists consider both environmental and child focused factors in their work with child language difficulties (Roulstone 1997) and combine child focused and environmental focused approaches within a single intervention. Such interventions would thus be regarded as 'complex' interventions' (Campbell et al. 2000); that is they include several components which can then be a source of variation within and between services. The emphasis or theoretical model used is likely to vary, depending on the therapist's own view of the value and effect of the different approaches and also on their assessment of the needs of the child. As indicated above, practitioners using environmental approaches are not necessarily attributing the child's impairment to deficiencies in the environment, although it is often interpreted in this light by parents (Glogowska and Campbell 2000:, Rannard et al. 2004). The approach taken will depend on their views about the environment and factors which may be perceived as maintaining the child's communication problem. Some of the research on explanatory models which examines the views of parents and practitioners about language development suggests that therapists tend to assume that the environment is the cause of the presenting difficulty if

¹ Announced in the 1998 Comprehensive Spending Review, the Sure Start programme invested in young children and families in areas of disadvantage, to improve children's developmental outcomes, was one strand of the UK government's approach to managing child poverty.

they cannot demonstrate a deficit in the child's language performance, (Marshall et al. 2004: , Marshall et al. 2007). In order to be able to identify the current evidence base for environmental interventions we decided to carry out a systematic review.

Systematic reviews – advantages and disadvantages

Systematic reviews have been defined as 'concise summaries of the best available evidence that address sharply defined clinical questions' (Mulrow 1994) and as 'a scientific tool which can be used to summarise, appraise, and communicate the results and implications of otherwise unmanageable quantities of research.' (CRD 2001).

Systematic reviews are seen as playing a critical role in evidence based practice (EBP) (Schlosser 2007) which emphasises the integration of individual clinical expertise, user and stakeholder preferences with the best available evidence (Sackett et al. 1996). The barriers to EBP in speech and language therapy are widely recognised (See Schlosser 2007: for an overview) and include the time consuming nature of this method, the requirement for critical appraisal skills and the diverse literature sources for interventions, which include the disciplines/fields of education, psychology, sociology and medicine, to name but a few.

Systematic reviews have a number of advantages, including managing large amounts of information, avoiding bias in the evidence that is included, and permitting identification of gaps in the evidence base. They are by definition, systematic and transparent in their methods (CRD 2001). There are also a number of disadvantages to systematic reviews. Although methods are being developed to include qualitative studies (Dixon-Woods et al. 2006), systematic reviews typically draw on quantitative studies and specifically randomised controlled trials (RCTs). Secondly, the synthesis that is used with RCT data, namely meta analysis, is also reductive. In fields such as speech, language and communication difficulties, this reliance on RCTs is a particular problem because, for a variety of reasons, RCTs are relatively few in number. Often, the final number of included studies is therefore very low. The research participants, contexts and intervention methods used in this field are frequently complex and heterogeneous, rendering numerical synthesis less meaningful and in some cases unrealistic.

Systematic reviews are also less helpful when trying to understand *why* and *how* an intervention works since the focus of the review is on whether or not the intervention

works and not necessarily the underlying mechanism. Given that much work with children who have speech, language and communication difficulties is individualised, a more detailed understanding of evidence may be needed. Finally, systematic reviews may be difficult to interpret for clinical practice – frequently because clinical populations and clinical practice may not match the subjects and interventions highlighted in RCTs.

Objectives of the review

Our initial objectives for the review were as follows:

- 1. To assess whether (speech and language therapy) interventions aimed at influencing factors in the communication environment, for children aged 0-5,11 with (speech and) language impairment are more effective than no intervention at all.
- To assess whether one particular type of intervention is more effective than others in improving (speech and) language impairment in children aged 0-5,11 years.
- To model the environmental factors which are known to influence the development of speech and language in children with (typically developing and) delayed language.
- 4. To identify what factors in a child's communication environment can be manipulated, in what situations, with which children and with what effects.

Preliminary test searches of the literature indicated that interventions beyond speech and language therapy were also targeting the language development of children. We therefore extended objective 1 to include any interventions targeting children who were at risk of language impairment as well as those where the impairment has already been identified and where the intervention was directed by people other than speech and language therapists. Typically, systematic reviews following the methodology of the Cochrane Collaboration would be concerned with objectives 1 and 2. Objectives 3 and 4 reflect a broader remit and required us to look beyond Cochrane methods.

Methods

Search strategy

The search strategy was developed with staff from Information Resources, ScHARR, including determining a priori inclusion and exclusion criteria, specification of search terms, and decisions regarding which journals were to be included (Appendix 1). To be included, studies had to comply with the following:

- Intervention: an empirical evaluation of an intervention and therefore included randomised controlled trials, experimental and quasi-experimental studies and case studies which included multiple baseline or other systematic manipulation of the intervention.
- Age of children in sample: at least 80% of the sample were required to be within the age range 0 – 5,11 years
- Environmental focus to the intervention: studies were included if the intervention under examination focused on an aspect of the child's environment.
- Language and communication outcomes: one of the primary outcomes of included studies would be one or more of the following:

language, semantics, morphology, syntax communication -social interaction-verbal or non-verbal

Studies were excluded on the basis of:

- Child group: children whose language appeared to be developing typically with no evidence provided of factors to suggest that their language was 'at risk' or if their language delays were associated with other developmental or pervasive conditions such as learning difficulties, autism, cleft palate, cerebral palsy.
- Outcomes: social and behavioural outcomes that were not language or communication related; where outcomes were only phonology, articulation or speech sounds, they were excluded.
- Design: Case-cohort and observational studies were excluded.

Search procedure

A pilot search of a small number (3-4) of the features of the environment that can be varied was conducted; for example parent activity, TV-watching, attitudes and beliefs. We searched for empirical studies that investigated environmental manipulations in

order to sensitise our search terms, particularly in terms of the terminology and keywords used to describe the underlying theories. The search terms for the full review were then set up and databases were searched from 1996 onwards. This generated 7431 papers. Inclusion and exclusion criteria were confirmed at this point. The titles and abstracts of these 7431 were divided among the first four authors who scrutinised them in relation to the exclusion and inclusion criteria.

This resulted in the exclusion of 7094 papers which clearly failed to meet the inclusion criteria. At this stage all papers about which there was any uncertainty remained included. Full papers of the remaining 247 titles were reviewed in detail to see if they met the inclusion criteria. The full papers were reviewed by someone other than the first reviewer in order to increase consistency.

At this point, the data extraction process commenced. Through this process many of the papers 247 papers were excluded because detailed consideration revealed that they involved child focused intervention or no intervention at all, because they addressed phonology or articulation or because the participants had some other primary impairment. This left only 17 papers for the quality appraisal process described below. Appendix I shows the design, and intervention type for each of the 17 papers, along with an analysis of the intervention type and whether the participating children were considered to be language impaired or at risk of language impairments.

Insert flow diagram for the management of the literature Figure 1

Quality Appraisal and Data Extraction

In deciding on methods, the quality appraisal materials developed by the Critical Appraisal Skills Programme (CASP) at the Public Health Resource Unit and the system proposed by Downs and Black (Downs and Black 1998) were reviewed. Whilst the CASP materials are particularly useful for reviewing quality across a range of study types - systematic reviews, RCTs, case control and cohort, and qualitative studies, it was felt that their requirement to pool responses to questions would lead to lower agreement between the four appraisers. Also, the studies identified fell into a rather narrow range of experimental and quasi-experimental for which the Downs and Black tool seemed particularly appropriate; the criteria also allocated points for each criteria, thus providing a final score for each paper. The set of criteria presented by Downs & Black are shown in table 1.

Insert Table 1 about here

There have, however, been some criticisms of using these kinds of checklists to rule studies in or out of a systematic review. Gough {2007 #1488} for example, argues that if research is to be of value in applied settings then instead of what he refers to as "abstract generic criteria", we should be looking for the fitness of purpose and relevance of the research in answering the different conceptual or empirical questions. So, he argues that, rather than making an all or none decision, it is helpful to think about weighting of studies.

We therefore added two extra questions which aim to identify how far the study provides evidence for the hypothesis or theory and how that relates to the theory on environmental interventions. The detail of the theory building to support the results of the systematic review will be published as a separate paper. So whilst we considered carefully the quality of the remaining papers, it is our intention not simply to rule studies in or out of our last 17 papers but to review the strength of the evidence that they provide towards the support of our basic premise. Each paper was therefore scrutinised for quality using the Downs & Black checklist, the key quality issues summarised under the Down's & Black headings (from table 1) and then the paper was assigned a quality score.

Following the quality appraisal, a summary of each paper was produced using the following questions

What interventions?

Were delivered by whom?

To which children?

In which contexts?

With what outcomes?

What was the authors' theory?

How far does the evidence presented in the paper support that theory?

What evidence is therefore available to support the basic premise of environmental interventions?

Synthesis

The process of synthesis in this project consists of three stages. The first stage provides a descriptive summary of the main components of the studies under four headings:

Who are the children? In what cultural contexts do these studies take place? Who delivers the interventions? What are the interventions?

The second stage of synthesis categorises the interventions according to the approach used and summarises the outcomes for that approach. During this stage, concepts and issues which are important to the understanding of how the intervention operates are also identified.

The final stage of synthesis will take each group of studies, analyse the theories espoused in the studies and identify how far they uphold or elaborate the basic premise of environmental interventions set out above .

This paper presents the preliminary results of the first two stages of synthesis and the categories of environmental approaches that have been identified in this review.

Results

Quality appraisal

The detailed appraisal of quality of the studies is provided in the project report (submitted). Overall the quality was variable, with some high quality studies with clear reporting. However, it seems that few of the studies were using CONSORT guidance regarding the reporting of trial (Begg et al. 1996: Altman et al. 2001). Although CONSORT was designed for the reporting of randomised trials, the principles contained therein are a useful guide for all reports of intervention evaluations.

Types of study design (Appendix II)

Before summarising the preliminary results, it is helpful to be aware of the study designs used in the papers we have reviewed. Of the 17 papers which reached the quality appraisal stage, ten reported trials where participants had been randomised to the intervention and to a control condition. Two of these compared groups who had been randomly assigned to receive different approaches; four compared a treatment group and the remainder used 'no treatment' control groups. In four studies, allocation was done geographically, sequentially or with matched controls and, in two instances, a comparator site had been established. One study was a multiple baseline design and two papers reported a follow-up study of an earlier intervention (one of which was an earlier RCT that is reported in this review).

The children

The remit of the review to a large extent governed which children would be participants in the studies included, since the review set age boundaries and focused on children who were identified with, or at risk of, primary language impairment. Over 5000 children were involved in the studies included in the review; the youngest were 'recruited' as part of a mother-infant dyad whilst still in utero and the oldest were aged 66 months. The ages at which the children received the interventions are not always the ages at which they were assessed, since follow-up times varied. For the majority of the children a diagnosis or categorisation of language impairment had not been made. Most of the participants included in studies in this review (n ~ 4500) were recruited as a motherinfant dyad. They were targeted for the intervention because they lived in families who were identified as 'at risk'. The sorts of characteristics which led to the classification of 'at risk' included aspects of the family context, such as poverty (for example defined as being below the US Federally defined poverty line), mother's education or other social, medical and biological risk factors (such as low birth weight, parents who are substance abusers). The remaining children (approximately 200) were reported as having some level of language delay: in three studies, the children were recruited via existing speech language therapy lists (Gibbard et al. 2004: , Baxendale and Hesketh 2003: , Girolametto et al. 1996). In the remaining studies that included children with an identified language impairment, the children either had identified special educational needs (Crain-Thoreson & Dale 1999) or were identified (or appear to have been identified) in the process of recruitment to the study rather than as part of the local service system. (Riley et al. 2004, Peterson, 2005). Identifying the numbers of children who were recruited to the studies, how many were assessed at the different stages and how many were seen at the final follow-up was frequently difficult to identify in the reports.

The context

Most of these studies took place in the US (11), two in Canada, one in Australia and three in the UK. This may be an artefact of our search process as we searched only for English language studies. As one might expect from the previous section, many of the studies have deliberately sampled families from low income backgrounds and from a

range of ethnicities. Only one study focused entirely on children from families described as 'middle class' and where the majority of mothers had completed postsecondary education; these families were self-selected from within existing waiting lists for parent-focused intervention (Girolametto et al. 1996). Reporting on the languages used by the families is mixed, with seven studies not commenting on this at all; some studies report that the families used more than one language (n=4); the other studies report that their participants were either monolingual (in one study, participant mothers were monolingual in Spanish) or used English as their primary language.

Who delivers the intervention?

By definition, when considering environmental interventions, the intervention is not targeted at the child's language /communication but at individuals or resources in the child's environment. Within the studies reviewed, most are focused on supporting or changing the mother's functioning in some way, although there are a small number that focus on child-care professionals or on parent volunteers. Even where resources such as books or toys are provided, there is also a component which provides training for people who are interacting with the children. So, in all cases, the study provides some kind of support or training or intervention to those who are expected to deliver the intervention to the child. But who delivers this intervention to those people? In fact there is minimal discussion of this issue in these papers and a number of studies do not specify who delivers the intervention. Only one study (Olds et al. 2002: , Olds et al. 2004) contrasts the relative impact made by nurses compared to 'paraprofessionals' (people with a high school education but no college education in the helping professions (Olds et al 2002)). In four studies, the intervention is delivered by speech and language therapists and in the rest, a variety of professionals (for example, nurses or physicians), pre-school specialists of some sort or graduate students worked with the families. As might be predicted, those interventions led by speech & language therapists are the interventions involving children with identified language impairments.

The interventions

Reports of the interventions vary in the amount of detail given in the paper. A number of the studies evaluate well known interventions such as Head Start (http://www.nhsa.org) or the Hanen programme (http://www.hanen.org) that are reported in more detail elsewhere. Others report follow-ups of studies described in more detail in earlier papers (eg Olds et al 2004). At this stage in the review, we have not yet tracked these back to identify the detailed components of all the interventions from original publications. Papers also vary in the terminology used to describe the various approaches and components. For example, in studies carried out by SLTs, the terms 'direct' and 'indirect' are often used where the former means that the SLT works directly with the child and the latter that the SLT works with the parent or carer or another professional. These terms are not used in the more generic interventions.

It is possible to identify a continuum of interventions within and across the studies. At one end of this continuum, there are interventions which aim at a broad systemic adjustment of the child's environment, providing a spectrum of services that (may) include parent training, child care, parent support and social experiences. Some studies focus on the provision of resources, such as developmentally appropriate books and/or toys although, as indicated above, typically, some kind of training is offered alongside the provision of these resources. At the other end of the continuum, the interventions seek to change the micro-interactions between parent and child in everyday contexts and sometimes in specific interactions, such as in shared book reading. Within these interactions, the focus varies from increasing the amount of contingent responding, through to specific language interactions such as modelling and labelling. Those interventions targeting children with identified language impairment tend to be at the more language focused end of the continuum.

At the second stage of synthesis we have categorised the interventions according to the main emphasis of the study. Although the studies contain some or all of the above components, the general approach can be divided into four types of studies (see Appendix II):

Systemic adjustment of environment (n = 4)

In these studies, as indicated above, there is a broad spectrum of provision including child care and the deliberate provision of social opportunities for parents (usually mothers) to meet and mix with each other. The aim seems to be the more general support of families and may include parent training although the specific nature of what is taught varies. These interventions .may or may not include specific attention to communication.

Parent interaction (n = 8)

In the studies that we have grouped under this heading, we have included those which focus specifically on changing or improving parents' interaction with their target children. For example, studies aim to increase parents' responsiveness to their children, both in terms of positive warmth, as well as responsiveness to the child's attempts at communication and in some studies, specifically their language outputs.

Language Enrichment (n = 2)

The two studies here are both classroom-based studies and one labels the process as one of 'enrichment', but could be regarded as a curriculum-based intervention. The interventions are wide-ranging and indeed some of the activities described could be regarded as 'child-focused' activities. However, in both instances, the communication environment is implicated. For example, one study talks about strategies such as turn taking and the other talks about the activities as 'integral to the daily teaching plan' (McIntosh et al. 2007). Being classroom-based, these interventions target children who are approximately five years of age - at the top end of the age range of the review.

Books (n = 3)

Three studies focused on the process of shared book reading with the children. The overall aim of the three studies is similar, to increase the amount and quality of book reading and meaningful language exchanges and opportunities; two of the studies actually provide books, one to the family and the other to child care centres. As in the previous category, the children involved in these interventions are amongst the oldest children in the review, mostly aged around 3-5 years. Full synthesis of the outcomes of studies is underway.

Discussion

There is no doubt of the need for high quality research into complex interventions, at least in the UK as evidenced by the recent creation of a Public Health Review Group as part of the Cochrane Collaboration2. Announcing the formation of this group, (Doyle et al. 2008) Doyle noted that the task of reviewing the evidence for population level interventions would be difficult because they were typically complex, used a variety of study designs and methods and tried to explore how interventions worked, why they

 $^{^{2}}$ Cochrane Collaboration is an international not-for-profit organisation providing up to date information about the benefits of healthcare.

worked and what they cost. Our experience in this systematic review to date would echo their comments. Synthesis of the findings of the reviewed studies was complex because of heterogeneity, a lack of detail of intervention, different study designs and limited explanation of how and why the interventions worked. In planning the review, we had considered whether the results from the systematic review method would be *sufficient* to answer the sorts of questions asked by both healthcare commissioners and researchers. Our knowledge of the literature in this area of practice suggested that the interventions provided to children with language impairment were likely to be complex. Evaluation of such interventions is made more difficult because of potential problems in developing, documenting and replicating the intervention. Although RCTs are widely accepted as the most reliable method of determining effectiveness, they may be less well suited to complex interventions in part because of the inherent additional complexity and combining evidence from a variety of research designs will offer a much better insight into effectiveness (Campbell et al. 2000).

First stage findings

At this stage four general points can be made about the findings. Firstly, although gains on some dimensions were identified on all the studies there are a number of issues which make it difficult to conclude that these studies provide evidence that environmental interventions are universally valid. For example, when studies have examined the impact of the intervention on subgroups of children or families, it is clear that there are differential effects. For example, (Robinson and Emde 2004) in their analysis of Head Start programmes, found that significant changes in interactions were only found in mothers with depression or with depression and negative attitudes. As some studies did not include a 'no treatment' control, it is difficult to confidently ascribe the changes to the specific intervention rather than to maturation or in some cases, to a Hawthorne effect.

Secondly the outcomes are measured relatively close to the period of intervention; in some instances, this is immediately afterwards or within a year, so the longer term impact of the intervention is unclear. Earlier putative differences between interventions and controls may wash out, or indeed become more apparent as time evolves.

Thirdly, most of the studies do report a measure of the change in the environment, such as changes to parent-child interactions or in one case, photographic records of changes to classroom book corners (Neuman 1999). This suggests that the interventions have indeed made an impact on the children's environment. However in many cases, the measure of the environment and the measure of the child's language take place at the same point in time. Once cannot therefore assume a causative influence from the change in environment to the child's language. As Baxendale & Hesketh (2003) acknowledge, the direction of influence could indeed be in the opposite direction – i.e. that the changes in the child's language bring about changes in parent-child interaction.

Finally, it has not been possible to identify the critical components of interventions. In some instances, the detail of the interventions was not available in the paper and at this stage in the review we have not been able to access the original descriptions of the interventions. In other instances, the studies provide broad evaluations that cannot be used to identify any particular effects within the interventions. The study by Landry et al (Landry et al. 2006) is a notable exception to this. Their study investigated how different maternal behaviours could be said to relate to a concept of responsiveness and also how particular components of responsiveness related to particular child outcomes. They found that maternal affective behaviours were associated with changes in the child's behaviours whereas maternal language behaviours were associated with changes in the children's word use.

The implications

The credibility of the systematic review method is based on the systematic and transparent nature of its process, with explicit criteria for the search terms and inclusion criteria, the integral quality checking of papers and on the agreement between a team, in terms of the classification of interventions. The preliminary findings of this systematic review are timely. In September 2007, John Bercow, MP began a review of services for children with speech language and communication needs (DCSF 2008), which includes the populations of children included in our systematic review. Early on, the need to share good practice in commissioning emerged as a theme and was highlighted in the final document. Implicitly, this included the use of research evidence. The final report, published in July 2008 recognised the particular needs of this group of children and included a recommendation to publish an annexe to the National Service Framework for disabled children and young people, detailing the very particular needs of this population of children. The Bercow report (2008) makes 40 recommendations, including changes in the commissioning process. One of the evidence sources to inform the commissioning process is research, suggesting that the results of this systematic review has the potential to add further meaningful evidence and encourage debate.

Korfmacher (2001) has suggested that commissioners and policy makers need to ask more probing questions about interventions to replace '*what* works?', with questions including: '*how* do interventions work' (theoretical frameworks) 'for *whom* do they work?' (populations) and 'in *which circumstances* do they work?' (contextual factors in implementation). By framing questions in this way, we should be able to reflect the differences between different interventions and also begin to capture differences between individuals, in terms of what they gain from interventions which may appear the same on the surface but which are different in implementation.

The review is one source of evidence but decision makers are left with the question of how to weight the research evidence vis à vis other evidence sources (Nutley et al. 2002). Gough argues that research evidence should be weighted based on quality and relevance to the research question. Part of the local context which is needed to make sense of the research evidence will be provided by clinicians and managers, based on their understanding of the local population and the factors which impact locally in translating or implementing research results. The Bercow Report (2008) places considerable emphasis on leadership. It recommends that each local NHS Trust Board has a member leading on the needs of children with speech, language and communication needs and that joint commissioning arrangements take account of the provision across health, social care and education. Furthermore in line with recommendations of Lord Darzi (DoH 2008), it recommends that the Department of Health supports the development of appropriately skilled and experienced clinical leaders who can interpret policy and research to support the delivery of evidence based practice, taking full account of joint commissioning for provision across sectors. Whilst confirming the role of SLTs in the commissioning process (DoH 2007: , DoH 2003), there is a clear need for research findings to be translated within policy contexts, tailoring the findings to the target group and facilitating debate about the implications (Nutley et al. 2002: , Walter et al. 2005). Clinicians are well placed to take on this role, at least in part, although they may need some development in terms of skills and knowledge in epidemiology (Antoniadis and Lubker 1997). Nutley also notes that an analysis of the local context and particular factors is key to successful interpretation and implementation of research findings. In addition to using existing research evidence, commissioners may wish to influence research activity to answer questions relating directly to the provision of health care rather than the agenda being driven primarily by the research community (Nutley et al. 2002). Whilst our results may not yet be in a

format to be of use to commissioners, further analysis will provide the basis for their use in a dialogue in the near future.

The second stage of this work

Understanding the needs of commissioners and recognising the impact of the final findings for them will inform our choices for the next stage of analysis to synthesise the evidence for the outcomes of each of the four approaches to intervention in light of the theories espoused in each group, alongside the evidence, to establish how far the basic premise of environmental intervention is supported.

Furthermore, we intend to sample the literature purposively to investigate certain issues that have arisen in the process of the review and in particular to elucidate the underpinning rationale and evidence for environmental interventions.

For example, the terms 'direct' and 'indirect' are used to differentiate approaches where the child is or is not present. Although similar in some ways, these are not synonymous with our dichotomy of 'child focused' and 'environment focused' interventions. For example, in the study by Baxendale & Hesketh (2003), they compare the effects of a Hanen parent training programme with intervention delivered by the SLT in the clinic. On first inspection this appears to differentiate between child focused and environmental focused intervention, but uses the terms direct and indirect. Closer inspection of the intervention in the two contexts reveals that the two are perhaps overlapping rather than distinct. So that, in the direct intervention, the parents are present in every case, and although the SLT interacts directly with the child, the purpose is also to "demonstrate to the parent various techniques" and to encourage the parents to adopt these techniques once on their own with their child. There is no requirement for the strategies demonstrated or taught to parents in the direct and indirect approaches to be distinguishable. Furthermore, Boyle following an evaluation of direct versus indirect approaches with older children within a school context, conclude that SLT assistants can act as 'surrogates for SLTs', suggesting that the indirect approach is not always aimed at producing environmental interventions but is aimed rather at training someone other than a therapist to deliver child focused interventions (Boyle et al. 2007).

Conclusion

Within early years settings and particularly within speech and language therapy, there has been a growing emphasis on interventions that make changes to a child's

environment, with the aim of promoting the child's developmental progress. This approach to intervention is now pervasive, with a growing evidence base to support its implementation. However, its potential for impacting on a child's language skills, particularly for children with primary language impairment is less clear. The work reported in this paper is the first stage of a larger project which investigates not only whether or not the interventions work, but also identifies for which children and in which contexts these interventions are appropriate. The preliminary findings of this systematic review of recent literature recognise different types of interventions and suggest that, although there are some positive impacts, we are still some way from confident conclusions regarding the critical components of interventions and how best to differentiate which interventions or their components are likely to be successful for subgroups of the population. Furthermore, we have identified no studies which compare different types of environmental intervention. Such an evidence base present challenges both for commissioners and for managers in trying to interpret the results and secure value for money for their populations. The project will continue to map the evidence against the different kind of approaches that have been used, identifying which environmental factors have been manipulated with what effect, with which children.

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Appendix I

Example Search Strategy for Embase (via OVID)

1 exp Pediatrics/ 2 exp CHILD/ 3 exp INFANT/ 4 child\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] 5 infant\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] 6 (paediatric\$ or pediatric\$).mp. [mp=title, original title, abstract, name of substance word, subject heading word] 7 toddler\$.mp. [mp=title, original title, abstract, name of substance word, subject heading word] 8 boy\$.ti,ab. 9 girl\$.ti,ab. 10 (school child\$ or schoolchildren\$).ti,ab. 11 (pre school\$ or preschool\$).ti,ab. 12 or/1-11 13 speech disorder\$.ti,ab. 14speech intelligibility\$.ti,ab. 15speech therap\$.ti,ab. 16 language therap\$.ti,ab. 17 speech development.ti,ab. 18 speech delay.ti,ab. 19 language disorder\$.ti,ab. 20 language development disorder\$.ti,ab. 21 sign language\$.ti,ab. 22 child\$ language.ti,ab. 23 language therap\$.ti,ab. 24 language development.ti,ab. 25 language delay.ti,ab. 26 nonverbal communication.ti,ab. 27 non verbal communication.ti.ab. 28 communication development.ti,ab. 29 exp Speech Disorders/ 30 Speech Intelligibility/ 31 "rehabilitation of speech and language disorders"/ or language therapy/ or speech therapy/ 32 Language Development Disorders/ 33 Language Disorders/ 34 Sign Language/ 35 Child Language/ 36 Language Development/ 37 exp Nonverbal Communication/ 38 Communication Disorders/ 39 maternal responsiveness.tw. 40 directiveness.tw. 41 maternal interactive styles.tw. 42 compliance.tw. 43 maternal personality.tw.

44 child temperament.tw. 45 or/13-44 46 exp Mental Retardation/ 47 exp child development disorders, pervasive/ or asperger syndrome/ 48 Cleft Palate/ or Cleft Lip/ 49 Otitis Media with Effusion/ 50 exp Hearing Loss/ 51 exp Blindness/ 52 Stuttering/ 53 Aphonia/ 54 exp Pain/ 55 Crying/ 56 exp Analgesia/ 57 Reading/ 58 exp Dyslexia/ 59 Cerebral Palsy/ 60 (alternative and augmentative communication).mp. [mp=title, original title, abstract, name of substance word, subject heading word] 61 "alternative and augmentative communication".mp. [mp=title, original title, abstract, name of substance word, subject heading word] 62 exp aged/ 63 geriatrics/ 64 or/46-63 65 (12 and 45) not 64 66 randomized controlled trial.pt. 67 controlled clinical trial.pt. 68 randomized controlled trials/ 69 random allocation/ 70 double blind method/ 71 single blind method/ 72 clinical trial.pt. 73 exp clinical trials/ 74 (clin\$ adj25 trial\$).tw. 75 ((singl\$ or doubl\$ or trebl\$ or tripl\$) adj25 (blind\$ or mask\$)).tw. 76 placebos/ 77 placebo\$.tw. 78 random\$.tw. 79 research design/ 80 "comparative study"/ 81 exp evaluation studies/ 82 follow-up studies/ 83 prospective studies/ 84 (control\$ or prospectiv\$ or volunteer\$).tw. 85 (control\$ or prospectiv\$ or volunteer\$).tw. 86 or/66-85 87 "animal"/ 88 "human"/ 89 87 not 88 90 86 not 89 91 65 and 90 92 Limit 92 to "1996-2007"

Table 1: Quality appraisal criteria, adapted from Downs & Black

Reporting	clarity of descriptions - aims, hypotheses, participants etc.
External validity	were subjects and facilities representative
Internal validity –	blinding, data dredging, appropriate analyses, adjusting for
bias	confounding, fidelity, reliable measurements.
Internal validity -	allocation of participants, randomisation, losses to follow-up
confounding	
(selection bias)	
Power	did the study have sufficient power to detect a clinically
	important effect where the probability value for a difference
	being due to chance is less than 5%?

From Downs & Black, 1998





Authors	Design	Language impaired or at risk participants	Intervention type	Delivered by	Quality score
Baxendale, J. & Hesketh, A. 2003	Comparing two treatments. Children allocated geographically. No nontreated control	Moderate to severe language delay	Parent interaction	Two Hanen trained speech & language therapists (SLTs)	20
Chao, P-C., Bryan, T., Burstein, K. & Ergul, C. 2006	Randomised controlled trial: includes a 'no treatment' control	Children were included if they were 'at risk' of language and behaviour problems on the basis of scoring at least 1 SD below the mean on the Test of Early Language Development or on the Eyberg Child Behaviour Inventory.	Parent interaction	'Parent-partner' who is a graduate student majoring in special education or speech & language pathology	15
Crain-Thoreson, C. & Dale, P.S. (1999)	Randomised controlled trial; randomised to 3 groups – two intervention and one 'no treatment' control	Mild to moderate language delay - at a least -1 standard deviation on Peabody Picture Vocabulary Test	Books	The authors	15
Gibbard, D., Coglan, L. & MacDonald, J. 2004	Parent group compared with clinic based intervention; participants allocated sequentially.	Expressive language delay	Parent interaction	SLTs trained in the parent- based intervention	13
Girolametto, L., Pearce, P.S. & Weitzman, E. 1996	Randomised controlled trial; intervention compared with delayed treatment	Expressive vocabulary delay	Parent interaction	Two experience Hanen SLTs	17
Landry, S.H., Smith, K.E. & Swank, P.R. 2006	Randomised controlled trial: control group received well child visits	At risk – included very low birth weight babies	Parent interaction	Non-specific 'professionals'	20
Love, J.M., Kisker, E.E., Ross, C., et al 2005	Randomised controlled trial: control group received local services only.	At risk: ~12% had established risks (chromosomal abnormalities, congenital birth defect, sensory impairment, HIV/AIDS); ~18% had biological or medical risk (congenital heart disease, LBW, diabetes, severe chronic illness); ~32% had environmental risks (parental substance abuse, low maternal	Systemic adjustment of the child's environment	Not specified	21

		education, suspected child abuse or neglect, family social disorganisation, or homelessness).			
McIntosh, B., Crosbie, S., Holm, A., Dodd, B. & Tomas, S. (2007	Randomised trial with a 'no treatment' control by default as teacher from one class left and not replaced	The school was located in an area defined as 'low SES' based on Australian census data	Language enrichment	Intervention developed by a SLT and implemented by a teacher and teacher's aide	12
Mendelsohn, A.I., Dreyer, B.P., Flynn, V., et al 2005	Randomised controlled trial: control group received well child visits	At risk was defined by the mothers education (not having graduated from high school)	Parent interaction	Child development specialist	16
Neuman, S.B. 1999	Compared children selected randomly from intervention schools selected and non- randomly from non-treatment comparator schools	At risk - economically disadvantaged	Books	Child care staff	15
Olds, D.L., Robinson, J., O'Brien, R., et al 2002	Randomised controlled trial; comparing nurses with paraprofessionals; no 'no treatment' control	At risk	Systemic adjustment of the child's environment	Nurses and paraprofessionals	23
Olds, D.L., Robinson, J., Pettitt, L.M.,et al 2004	Follow-up of earlier trial	At risk	Systemic adjustment of the child's environment	Nurses and paraprofessionals	Not rated separately as a follow- up study
Peterson, P., Carta, J.J. & Greenwood, C.	Multiple baseline	Language delay on the basis of results on the Sequenced Inventory of Communication Development and on their MLU.	Parent interaction	Not specified	11
Peterson, C., Jesso, B. & McCabe, A. 1999	Randomised controlled trial; included a 'no treatment' control	At risk - Economically disadvantaged	Parent interaction	Not specified	14
Riley,J., Burrell, A. & McCallum, B. 2004	Two intervention and one non- treatment comparator – no randomisation.	At risk – two of the three included schools are in 'deprived' areas	Language enrichment	Two reception teachers provided awareness raising training for other teachers support staff and parents	9

Robinson, J.L. & Emde,	Randomised controlled trial:	At risk	Systemic	Not specified	
R.N. 2004	control group received local		adjustment		15
	services only.		of the child's		
	_		environment		
Theriot, J.A., Franco,	Follow-up of intervention that	Predominantly (89%) Medicaid	Books	Physicians	
S.M., Sisson, B.A. et al	had been in place for 6 years	recipients			17
2003					