Chapter One
A Psycholinguistic Approach

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Speech and language development needs to be viewed from various perspectives if the links between spoken and written language are to be understood and appropriate intervention planned for children with difficulties. These perspectives include educational, linguistic, medical, psycholinguistic and psychosocial. All are important and reference will be made to each of these throughout this volume, but the main focus will be on implementing a psycholinguistic approach to the investigation of children's speech processing skills.

A premise of the psycholinguistic approach is that children's speech and literacy development is the product of an intact speech processing system, comprising input, output and storage skills. Although this development is influenced by each of the perspectives mentioned above, any difficulties with speech and literacy performance will arise from limitations within one or more of these speech processing domains. Thus, a key aspect of a psycholinguistic approach is to develop hypotheses about the nature of a child's difficulties and then to test them out through specific assessment and intervention tasks. In their review of psycholinguistic models of speech development and the application to clinical practice, Baker *et al*. (2001) state that such an approach:

> can have important effects on clinical practice – not only in influencing assessment and intervention procedures, but in reshaping our thinking about the nature of speech impairment. (p. 686)

This volume includes psycholinguistic procedures for investigating children's speech input, output and lexical storage skills. The aim of using these procedures is to identify a child's speech processing strengths and weaknesses; use the data collected to plan appropriate

intervention if needed; establish if there are associated language and literacy difficulties; and predict if a child will have persisting speech and literacy difficulties. In order to use the procedures included in this volume, the reader needs to be familiar with the psycholinguistic framework presented in Book 1 of this series (Stackhouse & Wells, 1997).

This chapter will present some background information about children's speech and literacy difficulties and summarise the three main components of the psycholinguistic framework presented in Book 1:

- speech processing profile
- speech processing 'box-and-arrow' model
- developmental phase model

Speech and Literacy Difficulties

Speech difficulties in children are one of the most common communication problems and make up a high proportion of speech and language therapists' caseloads (Enderby & Phillips, 1986). It is estimated that 5 % of primary school children have speech difficulties (Weiss, Gordon & Lillywhite, 1987) and that 3.8 % of children in the USA in the age range of 3–11 years old have what are described as 'phonological problems' (Shriberg, Tomblin & McSweeney, 1999). In the UK, Broomfield and Dodd (2004) estimate that 48,000 children per year are referred to speech and language therapy because of 'primary speech disability'. Speech difficulties may be associated with language impairments. Prevalence rates of specific language impairments in young children are around 7 % (Tomblin, Smith & Zhang, 1997), but a systematic review of the literature by Law *et al*. (2000) indicates prevalence rates of up to 24.6 %. Although these rates are difficult to estimate, it is clear that there are a significant number of children who do not resolve their speech difficulties before they begin school and are not ready to take advantage of literacy instruction given. Predicting which children will not resolve their speech difficulties by 5 years of age is the subject of Chapter 8 in this volume.

The lack of consensus in defining spoken language problems in the population is reflected in the diversity of labels used to describe children's difficulties. When referring to a child's 'speech difficulties' a number of labels may be applied, e.g. articulation difficulties, phonological disorder, phonological delay, expressive phonological impairment, speech disorder, speech sound difficulties, dyspraxia, stammering or non-fluent speech. Some labels indicate causation, e.g. 'cleft palate speech', 'deaf speech', dysarthria (see Book 1, pp. 3–8, for further discussion of the classification of speech problems in children). In this volume, the term *speech difficulty* is used to refer to children who have difficulties with producing speech segments in isolation, in single words or in connected

speech, regardless of the origin of the difficulty. This term is preferred because children with such difficulties do not form a homogeneous group and a fundamental principle of the approach presented here is to investigate a child's needs regardless of any label attached.

Even if a possible cause of a speech difficulty is known or suspected, each child presents his or her speech difficulties in an individual way and with his or her own cluster of associated behaviours. These may include deficits in language skills (Shriberg, Kwiatkowski & Gruber, 1994; Bird, Bishop & Freeman, 1995), auditory discrimination (Bird & Bishop, 1992; Rvachew *et al*., 2003), oro-motor skills (Henry, 1990; Williams & Stackhouse, 1998, 2000), phonological awareness (Rvachew *et al*., 2003; Gillon, 2004) and literacy development (Bird, Bishop & Freeman, 1995; Larrivee & Catts, 1999; Nathan *et al*., 2004a; Stackhouse, 2006). Persisting speech, language and learning difficulties can also be associated with psychosocial difficulties such as bullying (Knox & Conti-Ramsden, 2003), behaviour problems (Botting & Conti-Ramsden, 2000) and school exclusion (Law & Sivyer, 2003). Often self-esteem is affected and intervention programmes need to adopt a total management approach involving the whole child (e.g. Nash, 2006; Nash *et al*., 2002).

Given the heterogeneity of the population of children with speech difficulties, it is important to identify a profile of strengths and weaknesses for each child. For the child with persisting speech difficulties – that is, beyond 5 years of age – this becomes most important in order to support communication skills, psychosocial development, learning strategies and access to the school curriculum. (For further discussion of the management of children with persisting speech difficulties, see Book 3 of this series: Pascoe, Stackhouse & Wells, 2006.) However, these strengths and weaknesses may change as the child develops, or as different demands are made on him/her. It is, therefore, necessary to track the development of spoken and written language skills over time. This will increase our understanding of the way children with speech difficulties progress, which children are likely to resolve their difficulties, and how best to help them. Collecting the speech and language profiles of children whose speech difficulties resolve, compared to those who experience persisting difficulties, is important for both theoretical and practical reasons. Such knowledge enables appropriate service delivery and prioritisation.

There have been several longitudinal studies of children with speech and language difficulties (e.g. Bishop & Edmundson, 1987; Conti-Ramsden *et al*., 2001; Leitao & Fletcher, 2004; Simkin & Conti-Ramsden, 2006), as well as longitudinal studies looking at the phonological awareness and/or literacy development of children with primary speech difficulties (e.g. Bird, Bishop & Freeman, 1995; Webster, Plante & Couvillion, 1997; Larrivee and Catts, 1999). However, few longitudinal group studies of children with primary speech difficulties have looked for predictors or markers of persisting speech difficulties

from a wide range of measures. Shriberg, Kwiatkowski and Gruber (1994) comment:

> Notwithstanding 60 years of research efforts to develop valid predictive instruments for developmental phonological disorders, there currently is no clinically effective procedure to predict which children will normalize with or without intervention. (p. 1129)

Shriberg, Kwiatkowski and Gruber's (1994) follow-up study examined the short-term normalisation of 5-year-old children who had been classified as speech disordered one year earlier. A wide range of predictors was assessed including measures of phoneme accuracy and audiological, developmental, familial, psychosocial and therapeutic measures. Rather than make comparisons with typically developing children, Shriberg, Kiatkowski and Gruber (1994) compared children with speech difficulties who 'normalised' and those who did not. However, while the study offers detailed description of performance in the areas assessed and identifies the proportion of children whose speech difficulties resolved by age 5, the authors were unable to find any significant predictors of this short-term normalisation.

In order to address this issue of prediction and to present procedures that are useful for investigating children's speech and literacy difficulties, findings from two studies are reported throughout this volume. The first was a cross-sectional study of 100 normally developing children in the age range of 3 to 7 years (Vance, 1995; Vance, Stackhouse & Wells, 1994, 1995, 2005). A range of speech processing procedures was designed following the principles of the psycholinguistic framework presented in Book 1 of this series. These tasks were used in this study to investigate typical development in normally developing children, for later comparison with children presenting with speech difficulties. The second was a longitudinal study of 62 children in the age range of 4–7 years who had primary speech difficulties (Nathan *et al*., 2004a). Each child with speech difficulties was matched to a normally developing control child. This study allowed us to develop the procedures used in the first, cross-sectional study; make a direct comparison of the development of children with and without speech difficulties over time; and examine possible clinical markers for identifying children at risk for persisting speech difficulties and associated literacy problems.

These two studies, together with a collection of smaller-scale projects, have enabled us not only to refine our assessment procedures, but also to indicate which tasks are the most helpful in predicting speech and literacy outcome. These auditory and speech procedures are presented in this volume. Some normative data have been collected for each of the tasks described. However, these are not standardised 'tests' since they have not undergone widescale normative data collection. Rather, they provide guidelines for interpreting the performance of a child with a speech difficulty across a range of tasks.

Working within the psycholinguistic framework, however, is not done in isolation. It is also important to take on board the other perspectives mentioned above in the introduction. Collecting information about a child's developmental history, psychosocial development and family background is equally important. In this volume we therefore include some of the questionnaires used in the longitudinal study and a discussion of the subsequent findings.

Before making use of the procedures devised, readers should understand the rationale behind the psycholinguistic framework. The remainder of this chapter will provide a brief summary of this. Throughout this chapter and this volume, the reader is referred to Book 1 in this series for further information.

What is a Psycholinguistic Approach?

A psycholinguistic approach to assessment explores how a child receives information of different kinds (e.g. spoken or written utterances), remembers and stores it within *lexical representations* (information about words) within the *lexicon* (a store of words) and how he or she selects and produces spoken and written words. Figure 1.1 illustrates the basic structure of a psycholinguistic model of speech processing.

On the left of the figure there is a channel for the input of information via the ear and on the right a channel for the output of information through the mouth. At the top of the model there are the lexical representations that store previously processed information, while at the bottom

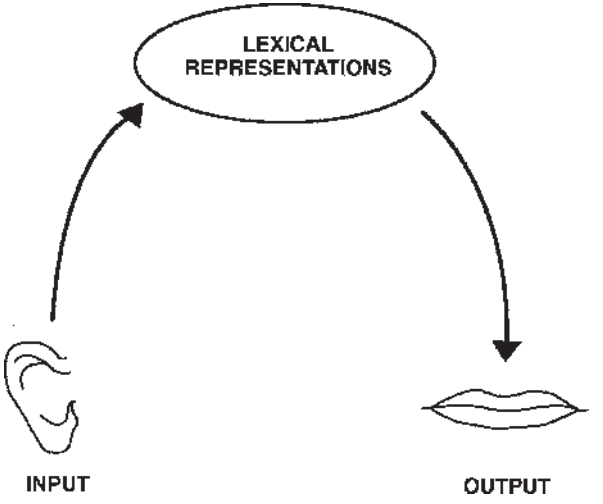

Figure 1.1 The basic structure of the speech processing system
Source: Stackhouse & Wells (1997). Reproduced by permission of John Wiley & Sons, Ltd.

there is no such store. A lexical representation is considered to comprise the following information about a word:

- Semantic representation – information about what the word means, the attributes of the word, what category it is in, e.g. animal, food.
- Phonological representation – information about how the word sounds, allowing discrimination of the target word from other similar words.
- Motor programme – a stored set of instructions for how to say the word, i.e. the pronunciation of the word.
- Grammatical representation – information about the class of word, e.g. noun, how it can be used in a sentence, and whether there is a plural form that can be derived from a rule, e.g. adding 's' at the end of it.
- Orthographic representation – information about what the word looks like in its written form, thus enabling automatic recognition when reading.

See Activity 1.2, Book 1, pp. 9–10 for further information.

In psycholinguistic terms, *top-down* processing refers to speech activity that makes use of previously stored information (i.e. in the lexical representations). A *bottom-up* processing activity requires no such prior knowledge and can be completed without accessing stored linguistic knowledge from the lexical representations. It is helpful to identify four key anchor points in the model above: top and bottom; left and right (see Figure 1.2).

A number of models use the same basic structure of input/output and representations as depicted in Figure 1.1 (e.g. Dodd, 1995, 2005; Stackhouse & Wells, 1997; Hewlett, Gibbon & Cohen-McKenzie, 1998; Chiat, 2000). Although different in their presentations, these models share the premise that children's speech development is dependent on the normal functioning of this system and that children's speech

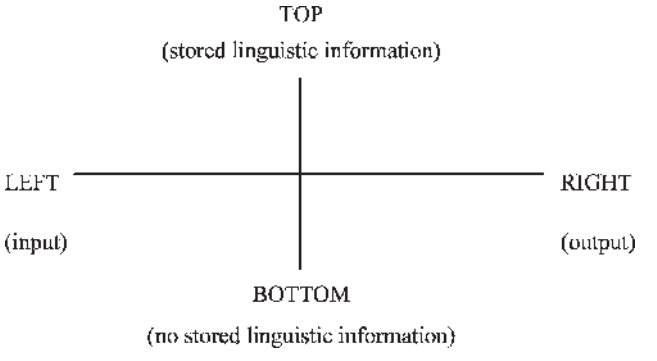

Figure 1.2 The four key anchor points in a speech processing model
Source: Stackhouse & Wells (1997). Reproduced by permission of John Wiley & Sons, Ltd.

difficulties arise at one or more points in a faulty speech processing system (see Baker *et al*., 2001, for a review of psycholinguistic models).

The aim of the psycholinguistic approach in practice and research is to find out exactly where, within a chosen model, a child's speech processing skills are breaking down, and how this might be affecting their speech, lexical and literacy development. The information gathered through this approach informs understanding of a child's communication difficulties and the impact of this on other aspects of his or her development and educational performance.

Principles of a Psycholinguistic Assessment

For assessment purposes, Stackhouse and Wells (1997) analysed the psycholinguistic properties of commonly used tests of auditory discrimination, speech and phonological awareness to address the question *What do tests really test?* (see Chapters 2 and 3 in Book 1). By asking questions about each task, they were classified within the simple speech processing model (depicted in Figure 1.1) as being input or output and top-down or bottom-up. The first question to ask about a task would be: *Is this an input or output task?* That is not as straightforward as it sounds! A task may require a verbal response, but still be an input task. For example, if the child is asked to say 'same' or 'different' in response to two words presented by the tester, this is not counted as an output response. The child could perform the task equally well by nodding or shaking his or her head or pointing to a symbol. An output task, by definition, requires the child to generate different answers for each item, for instance naming a series of pictures or producing a string of rhyming words to a given target. The second question is: *Does the child have lexical representations for the stimuli used in the task?* If the answer to this question is 'Yes' then the task is more of a top-down than bottom-up task. However, another question also needs to be asked: *Does the child* ***have*** *to access these lexical representations in order to complete the task*? If 'Yes' then the task involves the higher levels of processing, if 'No' then it is not reliant on top-down processing.

A clearer perspective on what aspects of processing a task is really testing allows for more systematic interpretation of results and a more precise understanding of the nature of a child's difficulties, thus supporting more appropriate planning of intervention. If you are familiar with these concepts then read on. If not, it is essential to read Chapter 2 of Book 1 and carry out the activities in that chapter, before administering and interpreting the procedures included in Chapters 3–7 of this volume.

By analysing tasks in this way, a framework for collating and interpreting assessment results emerged. Tasks clustered together at hypothetical points on the model, depending on their processing demands

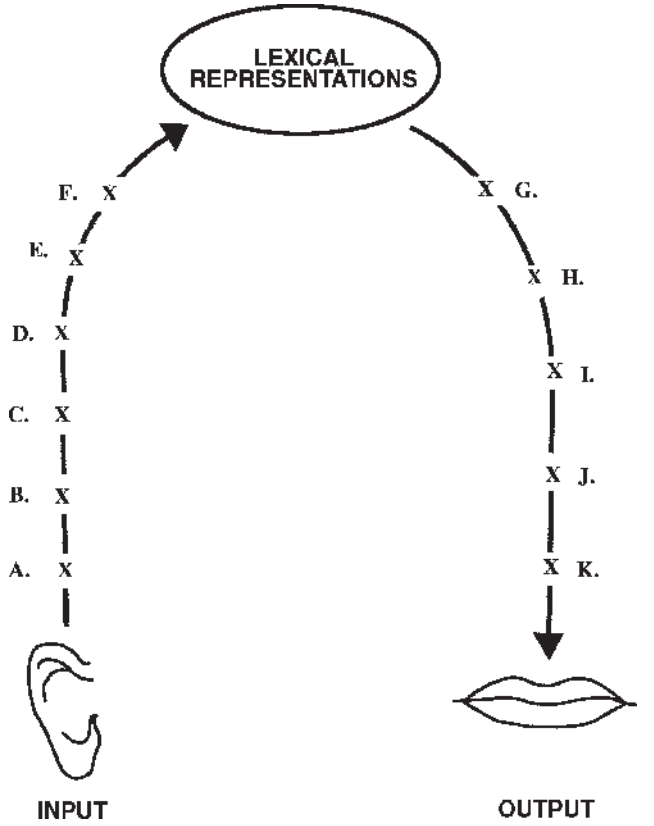

Figure 1.3 Crosses on the simple speech processing model to mark the levels at which tests cluster. *Source*: Stackhouse & Wells (1997). Reproduced by permission of John Wiley & Sons, Ltd.

(see Figure 1.3). However, this clustering was not always as might be expected. Some of the tests that could be considered to be assessing different areas because of their 'title' (e.g. 'auditory discrimination', or 'phonological awareness' or 'speech') clustered together. They were tapping the same level of processing, for example auditory discrimination of spoken minimal pairs and rhyme detection of spoken words (without pictures). Other tests that all had the same title (e.g. auditory discrimination) were tapping different levels of processing because of the nature of the stimuli involved, for instance discrimination of real or non-words. A clear message was: 'Do not believe what you read in a test title or description!' Before using a task, it should be analysed in terms of how it is presented; the stimuli involved; and the response required. (See Rachel Rees, Chapter 3 in Book 2, Stackhouse & Wells, 2001, for how to apply these principles to intervention tasks.)

Using the illustration in Figure 1.3, we recognised the need to assemble a profile for summarising a child's speech processing skills (see Book 1, Chapter 4). To develop such a profile, we posed a question about each

level of processing marked by a cross on the model. For example, to assess the effectiveness of processing at point A, nearest the ear, we asked: *Does the child have adequate auditory perception?* This could be answered by doing a hearing test. At point K, nearest to the mouth, we asked: *Does the child have adequate sound production skills?* This could be answered by an oral examination. Thus, appropriate investigations can be selected and/or devised to answer the questions posed at each level of processing (see Figure 1.4 for a complete list of assessment questions). Questions placed on the left of the model (A–F) address input; questions on the right

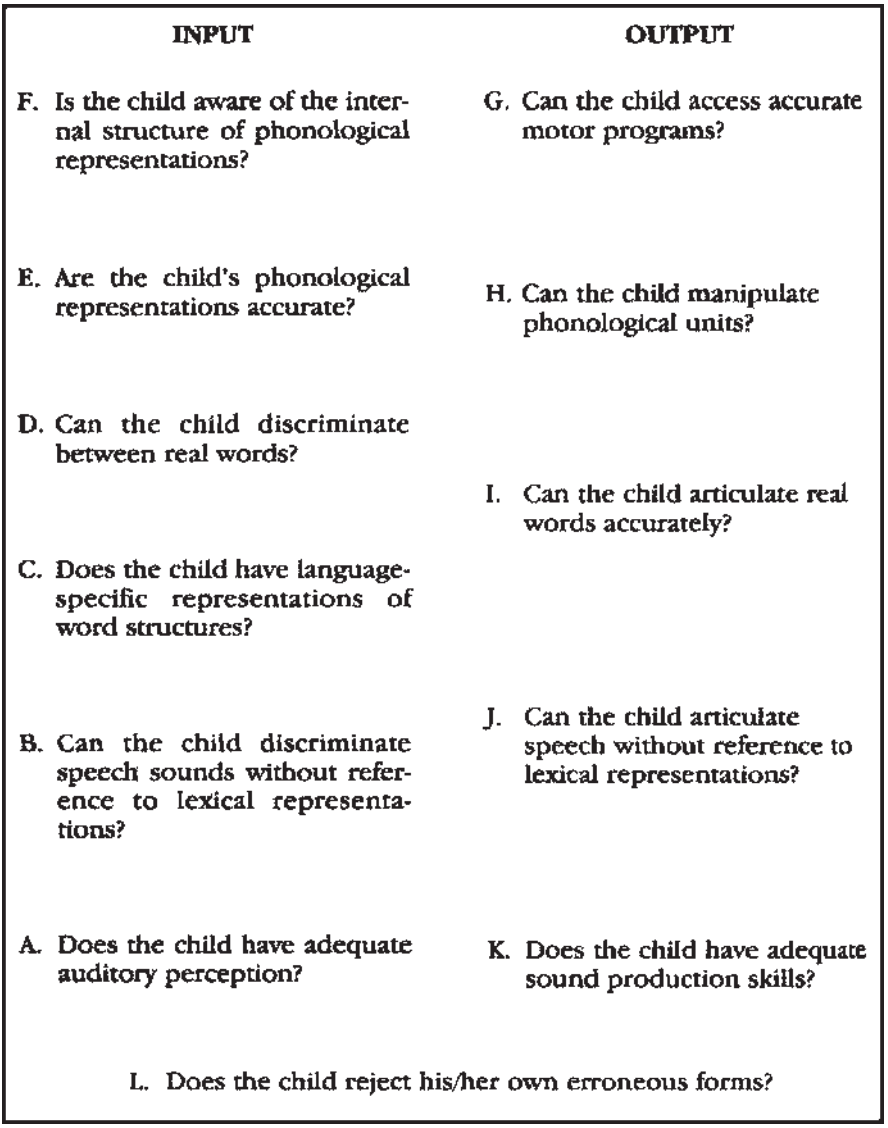

Figure 1.4 Questions for the speech processing profile. *Source*: Stackhouse & Wells (1997). Reproduced by permission of John Wiley & Sons, Ltd.

(G–K) address output; questions near/at the top of the model on both sides are addressed by tasks that require access to lexical representations; and questions near/at the bottom of the model on both sides are addressed by tasks that do not require lexical access. We have added a question 'L' between the mouth and the ear to remind us of the importance of observing if a child can monitor their own speech output, and, if so, can change it to produce a more accurate pronunciation.

Appendix 2 of Book 1 lists examples of existing tests that can be used to answer the questions posed in Figure 1.4 and to complete a speech processing profile on a child. Appendix A.1 of this volume supplements this list by including additional, specifically designed speech and auditory tasks. These may help fill in some gaps in assessment material, and provide useful examples for how to design a series of tasks to assess a child's individual speech patterns. However, the framework of questions is not restricted to only the tasks presented here; any task that involves speech processing can be classified within this framework. Indeed, an aim of this series is to encourage readers to devise their own procedures, based on a hypothesis testing approach, for investigating children's speech and literacy difficulties.

Answering each question about a child's speech processing skills will normally involve administering more than one procedure (Book 1, pp. 99–101). Few individual tasks provide the answer to a question directly. An exception might be a test of hearing to answer Question A. However, problems identified at one level, such as a hearing impairment, do not necessarily mean that the child will perform poorly or as expected at all the other levels (see Ebbels, 2000 for a psycholinguistic case study of a child with a hearing impairment). Another point to remember is that the two dimensions of the model (left/right and top/bottom) are not organised in terms of difficulty. Tasks tapping lower levels of processing on the model are not necessarily easier than tasks involving higher levels of processing. Similarly, tasks placed on the left-hand side of the model are not necessarily easier than those placed on the right-hand side. What is easier or more difficult for an individual child will depend on his or her own profile of skills, not on the structure of the framework. Identification of a child's strengths and weaknesses is best done by contrasting results from different procedures *within* and *between* levels of processing.

Assessing *within* levels establishes whether or not the child can demonstrate adequate processing skills. Investigations of different complexity can be carried out at the same level of processing. For example, for Question B auditory discrimination tasks using non-words are used. These tasks can comprise simple stimuli, for example VOS/VOT; articulatorily complex stimuli, for example VOST/VOTS; or multisyllabic stimuli, for example IKIBUS/IBIKUS. Tasks may have increased memory demands such as listening to two similar-sounding words such as

VESH/FESH and deciding if a third word heard, such as FESH, was the first or second of the original pair. Comparison of performance across these tasks establishes if the child has a specific difficulty at this level; that is, if he or she cannot perform age appropriately on the simple auditory discrimination task, or whether the 'discrimination' problem is on complex words only, or only when there is an increased memory load.

Testing *between* levels involves unpicking why a child may have difficulties at one of the levels. Naming is a good example of this. A child may make errors on a picture-naming task for a number of reasons. The difficulty may be related to inaccuracies within the lexical representations, and/or at the level of assembling the word for spoken output, and/or at a lower level of articulatory difficulty that affects the pronunciation of the word. Comparison of performance across a number of output levels will allow the precise nature of the difficulty to be identified (see Book 1, p. 100, for more details). Identifying which levels of processing are involved will have implications for the design and delivery of an intervention programme (see Constable, 2001, Chapter 10 in Book 2).

The Speech Processing Profile

The speech processing profile provides a structure for organising a wide variety of assessment procedures in such a way that a child's performance on a range of tasks can be interpreted from a psycholinguistic perspective and over time. The purpose of collecting assessment information is to arrive at a greater understanding of a child's needs. However, the results of an assessment procedure are limited in value if viewed in isolation. A bit of assessment information is like one piece of a jigsaw puzzle; it is necessary to collate results from different procedures and tasks in a systematic way in order to get the whole picture of the child's needs. The aim of the speech processing profile is to fit together all the pieces to form a picture of the child's strengths and weaknesses in terms of input, lexical representation and output skills. On the basis of this profile a comprehensive individual intervention programme can be designed, which takes into account the nature of the child's speech processing difficulties. Without this, less obvious factors, such as subtle auditory processing deficits, can easily be overlooked, particularly when there appears to be a very obvious explanation for the child's speech problems, such as a physical abnormality of the oral structure or cerebral palsy.

For example, Pascoe, Stackhouse and Wells (2005) present a 6-year-old girl whose speech processing deficits belied the expectations one might have had given the child's diagnosis of ataxia. Based on her speech processing profile, intervention did not focus on lower-level articulatory skills per se but rather on her auditory discrimination and

connected speech. It is only by profiling a child's speech processing skills that the true extent of the underlying difficulties can be confirmed. The individualised nature of this approach to assessment does not, however, preclude the subsequent therapy or teaching being carried out in groups or within the classroom (see Popple & Wellington, 2001, Chapter 9 in Book 2).

A child's speech processing profile is constructed by providing answers to at least some of the questions A–L presented in Figure 1.4. For the purpose of recording a child's profiling skills succinctly, a profiling sheet has been devised that incorporates these questions (see Figure 1.5, and Appendix A.2, which may be photocopied). This profiling sheet allows space to indicate a child's performance at each level. This may be in the form of ticks (✓) for age-appropriate performance or above, and crosses (x) for performance that is less than age appropriate. Where the child's performance can be compared to normative data, we can mark the degree of severity in terms of distance from the mean by standard deviations (sd), for example 1 cross (x) = −1sd; 2 crosses (xx) = −2sd; and 3 crosses (xxx) = −3sd. Where normative data is not available, a more subjective indication of degree can be given. There is also space for administrative information about the child (e.g. name, date of birth, age, date of profile and name of profiler) and for general comments.

Using this profile in practice and research has demonstrated how children given the same diagnostic label (e.g. 'phonological impairment' or 'verbal dyspraxia') can perform very differently (Stackhouse & Snowling, 1992; Williams & Stackhouse, 1998). Profiles of Tom and Zara, both 4 years of age and described as having phonological delay, are presented in Book 2 and in Figures 1.6 and 1.7 of this volume. These illustrate how Zara's difficulties were confined to the right-hand side of the profile – that is, she had a specific speech output difficulty – while Tom's were more pervasive, involving both input and output difficulties. The case of 5-year-old Alan, presented by Waters (2001, Chapter 6 of Book 2), demonstrates how a child can have severe speech output difficulties but still have intact input skills (see Figure 1.8). Interestingly, the approach taken by Waters in intervention was to work on speech input; that is, using Alan's strengths. For further discussion of intervention case studies carried out within this framework, see chapters in Book 2 by Corrin, Waters, Dent, and Nathan and Simpson; Stackhouse, Pascoe & Gardner (2006); and Book 3 of this series, which focuses on school-age children. Similar intervention approaches are described by Dodd (2005); Crosbie, Holm & Dodd (2005); Crosbie & Dodd (2001); Dodd & Bradford (2000); and Ebbels (2000).

The psycholinguistic framework presented here comprises not only the speech processing profile in Figure 1.5 but also two associated theoretical speech processing models: a box-and-arrow model, and a developmental phase model. For many practical purposes of assessment and

SPEECH PROCESSING PROFILE

Name: Comments:

Age: d.o.b:

Date:

Profiler:

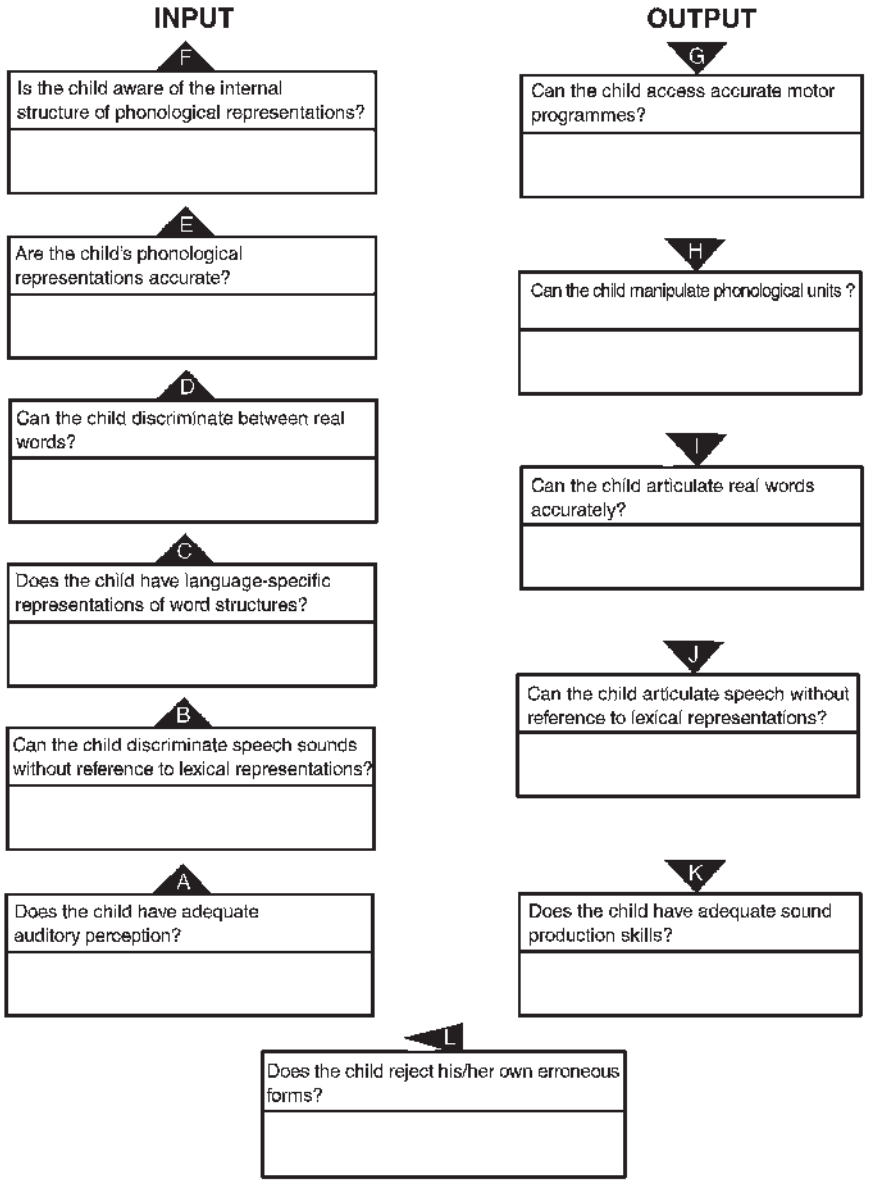

Figure 1.5 A speech processing profile summary sheet. *Source*: Stackhouse & Wells (1997). Reproduced by permission of John Wiley & Sons, Ltd.

SPEECH PROCESSING PROFILE

Name: Zara

Age: 4;3

Date: T 1

Profiler:

Comments:

Non-verbal SS II

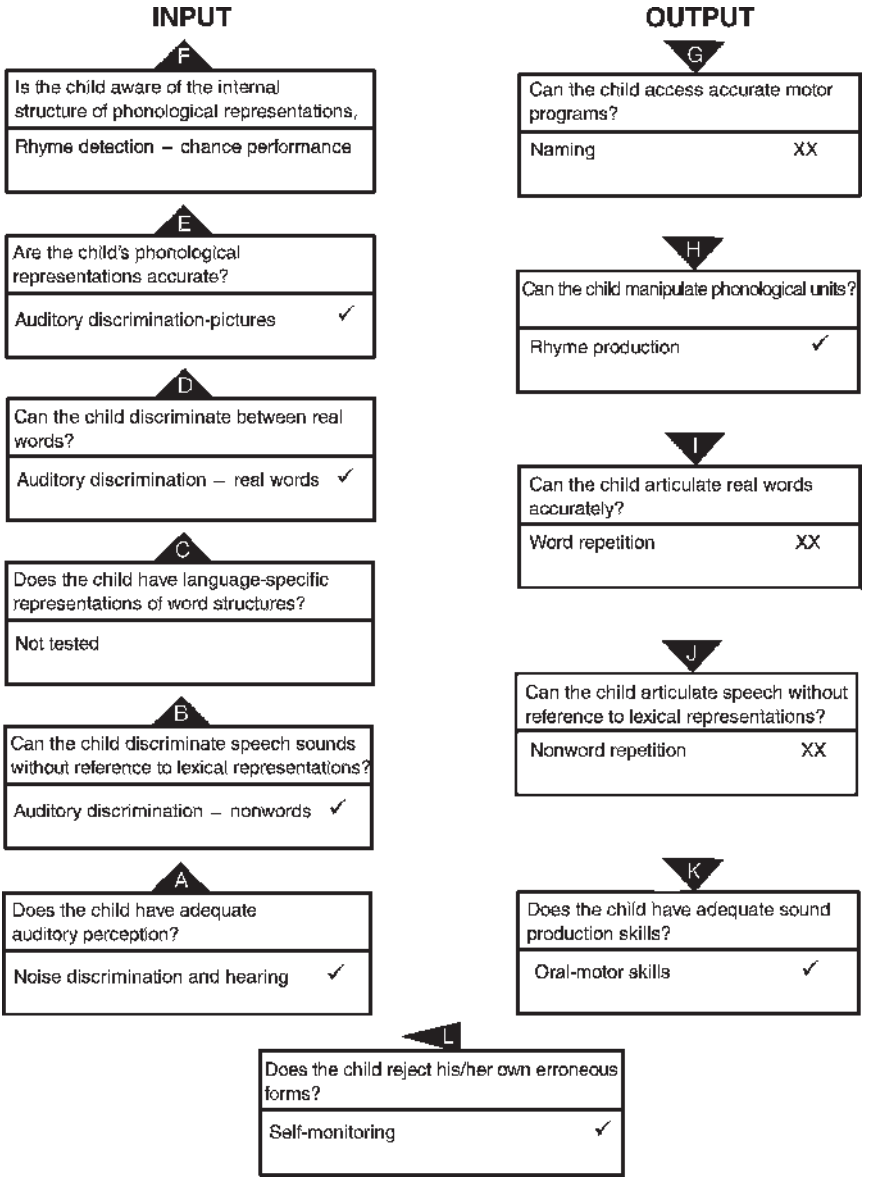

Figure 1.6 Zara's speech processing profile CA 4;3

SPEECH PROCESSING PROFILE

Name: Tom

Age: 4;0

Date: T 1

Profiler:

Comments:

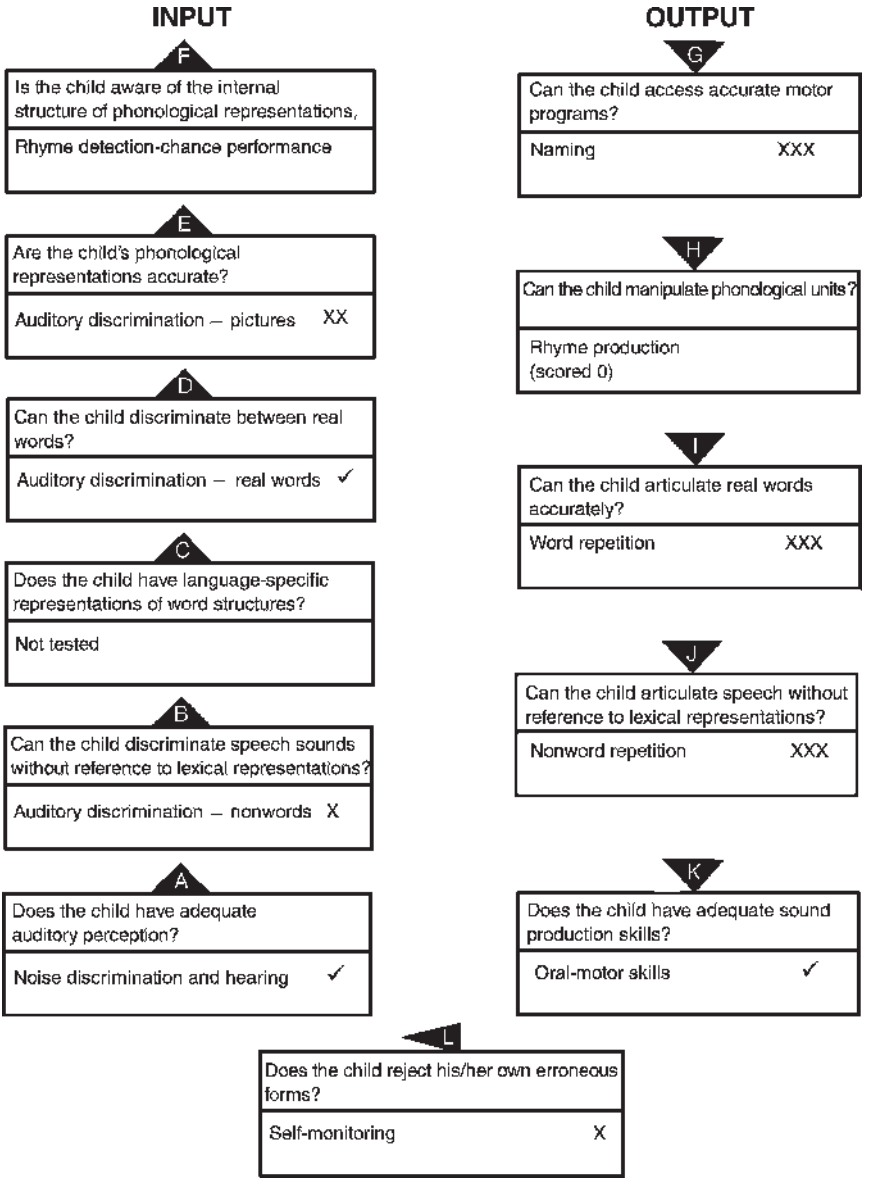

Figure 1.7 Tom's speech processing profile CA 4;0.

SPEECH PROCESSING PROFILE

Name: Alan

Age: 5;0

Date:

Profiler:

Comments:

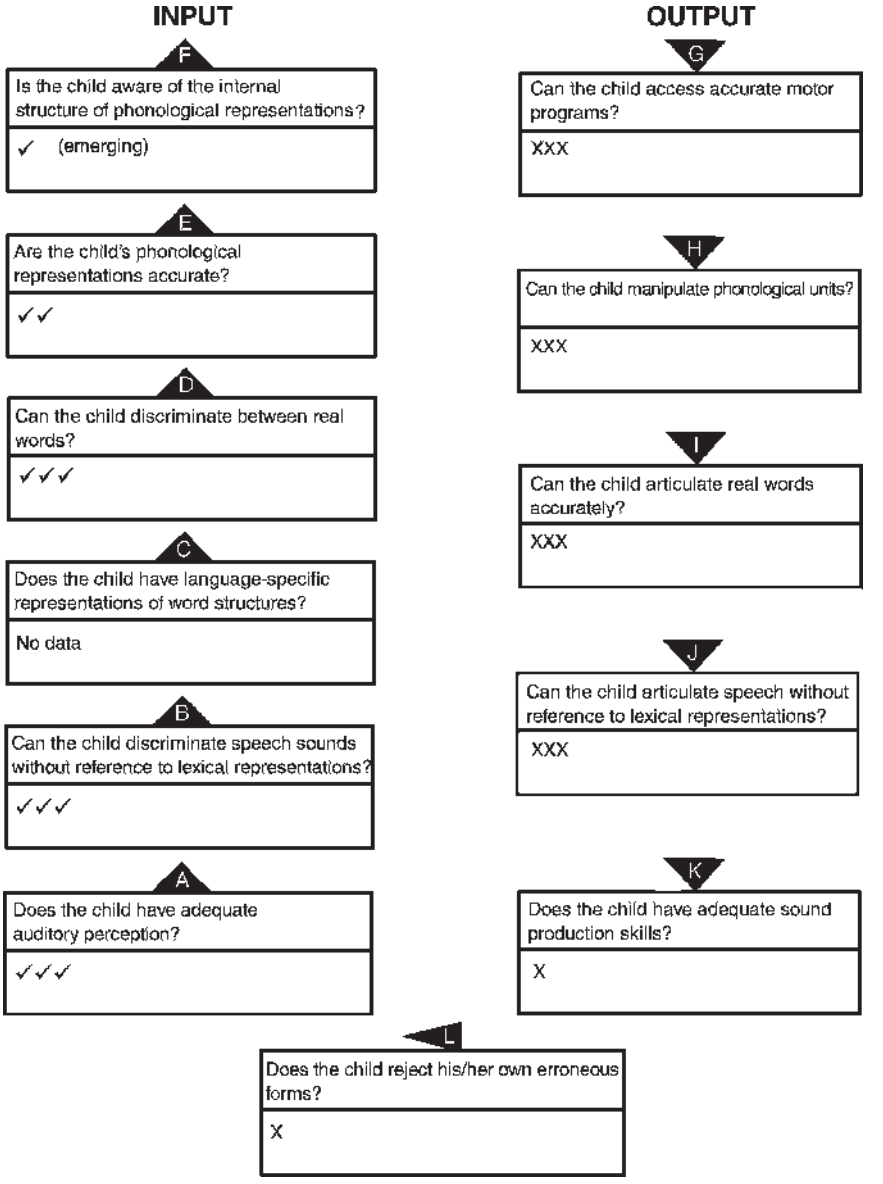

Figure 1.8 Alan's speech processing profile at age 5 years

intervention, using the speech processing profile format and procedures to identify a child's speech processing skills will suffice. However, using a psycholinguistic model can add another dimension to our understanding of a child's needs. Some users of the framework find models helpful for practice and research, for developing theoretical understanding and for communicating with others about using a psycholinguistic approach.

Theoretical Speech Processing Models

Box-and-Arrow Model

The conventional way of representing levels of processing and routes between them is through an information processing model in the form of boxes (levels of processing) and arrows (flow of information):

> Such models make explicit the hypothesized information-processing activities as carried out in a particular cognitive function (such as language), in a manner analogous to computer flowcharts that depict the processes and decisions carried out by a computer program. (Baker *et al*., 2001, p. 687)

The box-and-arrow model used in the framework described in this book is presented in Figure 1.9 (and in Appendix A.3 for photocopying). Plain boxes represent levels of processing, boxes in bold represent stored knowledge and shaded boxes represent off-line processing. Arrows show the route of processing of spoken material, and the broad arrows show how information flows between boxes as part of the learning process; that is, off-line processing. Such a model allows us to be more explicit about the levels of processing and processing routes that tasks are tapping. To understand many of the popular procedures, such as picture naming, it is informative to follow the journey taken through the model as the task is performed (see Book 1, pp. 173–187 for examples of routes). The model can, therefore, be used to illustrate the processing demands made by individual tasks and tracking routes through the model allows the demands of different tasks to be compared.

The following is a summary of the components of the model in Figure 1.9:

- **Peripheral auditory processing** refers to general auditory ability, not specifically related to speech.
- **Speech/non-speech discrimination** is a pre-linguistic level of recognising that what is heard is speech rather than non-speech sounds and noises.

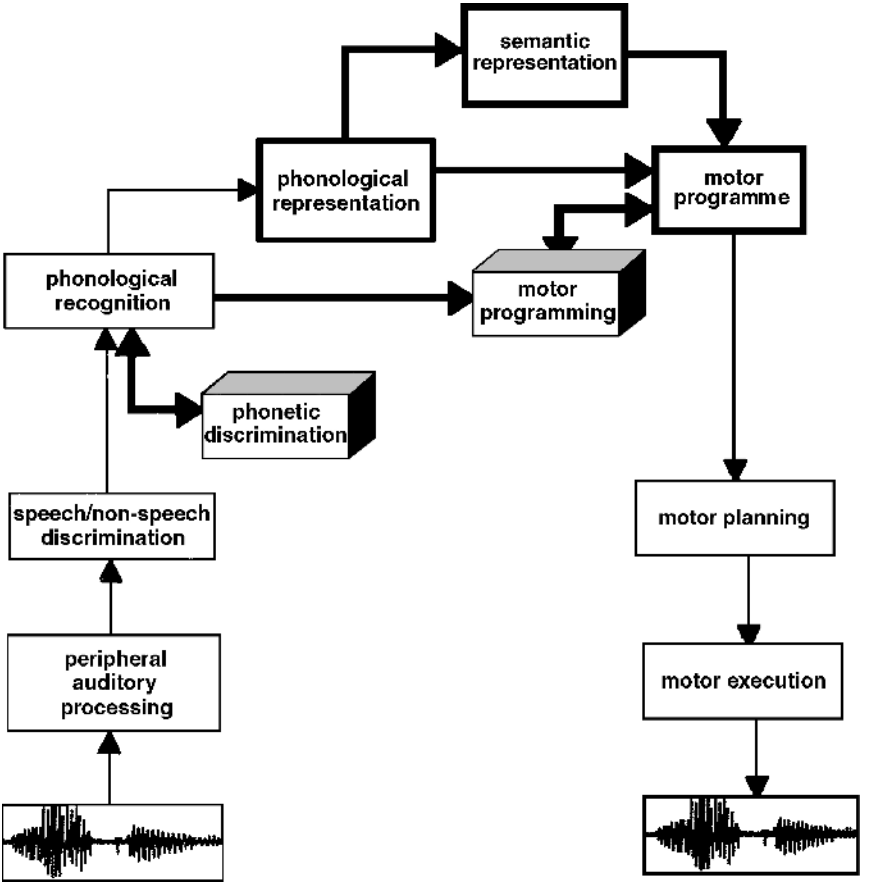

Figure 1.9 The box-and-arrow model. *Source*: Stackhouse & Wells (1997). Reproduced by permission of John Wiley & Sons, Ltd.

- **Phonological recognition** describes the level at which a listener recognises the language heard as familiar as compared to a language that is not. The listener is using knowledge about language-specific structures and will recognise, for example, that BLICK is a possible English word but BNICK is not.
- **Phonetic discrimination** is the recognition of phonetic distinctions that are new to the listener, and is used in early stages in language learning as a child begins to learn which segments are contrastive. It is also used in second-language learning when unfamiliar segments are heard.
- **Phonological representations** contain enough information for a heard word to be recognised as distinct from other similar-sounding words (e.g. TAP vs. CAP; CAP vs. CAT).
- **Motor programmes** are a series of stored gestural targets (or articulatory instructions) for the production of known words.

- **Motor programming** is a facility to create new motor programmes. It is conceived as a store of phonological units that are selected and assembled into new combinations so that new productions of words can be articulated.
- **Motor planning** assembles the gestural targets (articulatory instructions) into the correct sequence in real time, taking into account the context, for example assimilations and the appropriate intonation for a question form.
- **Motor execution** refers to the peripheral production of speech at the level of the vocal tract.

If this material is not familiar to you, you should read Chapter 6 in Book 1 and work through the activities, as this model will be used throughout this volume to illustrate the processing routes of the tasks presented.

The model can also be used as a summary sheet to show a child's specific speech processing deficits. For example, in Book 2, Waters (2001) interprets Alan's speech processing profile at 5 years of age through the box-and-arrow model and summarises his performance by using ticks for strengths and crosses for weaknesses on the model itself (see Figure 1.10). She concluded that Alan's internal representations were accurate, but that he had an inability to devise motor programmes to reproduce either stored phonological representations or auditorily presented familiar or novel combinations of phonemes.

As with the profile, the model can also be used to track a child's development over time. For example, although speech intelligibility and performance on speech processing tasks change, a core deficit may remain that can be depicted on the model and used as evidence for why a child may still need support even though progress has been made. The case of Zoë between the ages of 3;09 and 9;08 presented in detail in Chapters 9 and 10 in Book 1 is an illustration of this. Zoë's speech was unintelligible at 3;09 and at 5;11. She had pervasive speech processing difficulties affecting both input and output, as demonstrated in the profile and the model. Although her speech was intelligible by 9;08 there were still residual speech problems, not obvious to her teachers, and also associated spelling difficulties. Figure 1.11 shows her persisting core deficits in the context of other processing strengths.

One criticism of using box-and-arrow models with children has been their failure to account for developmental change (Stackhouse & Wells, 1996). This is addressed in Book 1 by building up the speech processing model developmentally from *Cries to Words* (Chapter 7) and from S*peech to Literacy* (Chapter 8). From this exercise, a second model was developed to account for developmental phases and change over time.

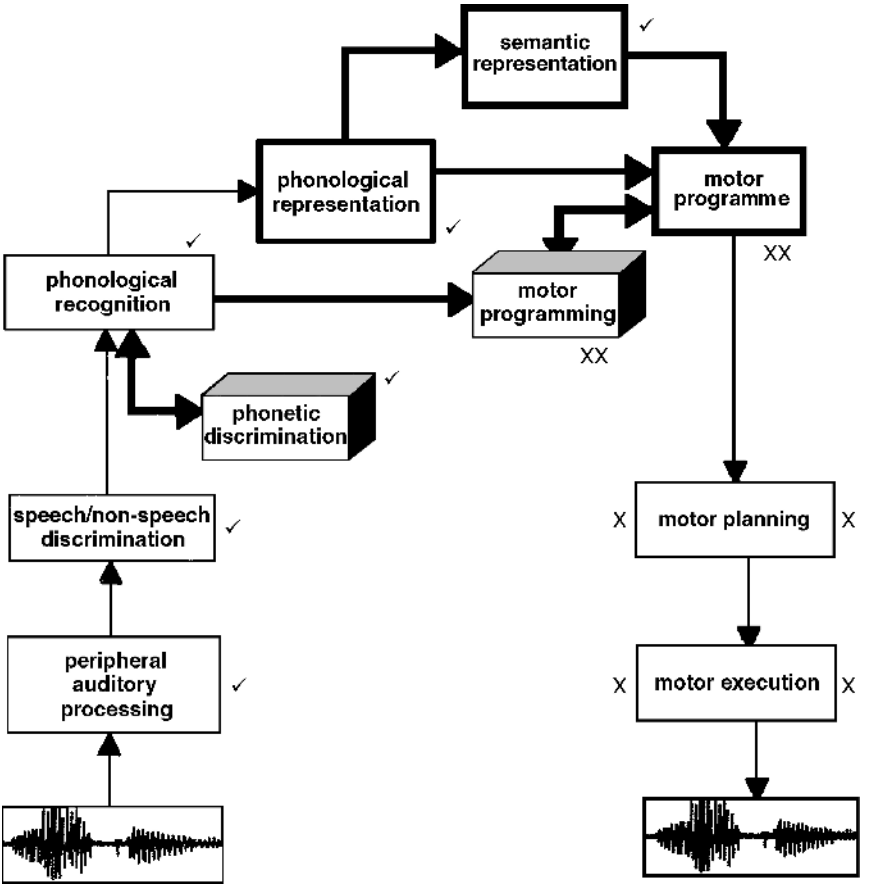

Figure 1.10 Speech processing model indicating Alan's strengths and weaknesses at age 5 years

Developmental Phase Model

The developmental phase model presented comprises five phases:

- **The prelexical phase** includes babbling, up to about 1 year of age.
- **The whole word phase** relates to the learning of first words as gestalts, up to about 2 years of age.
- **The systematic simplification phase** is characterised by the emergence of simplifying processes in speech output between 2 $^1/_2$ and 4 years of age.
- **The assembly phase** describes the mastering of connected speech at about 3 to 4 years of age.
- **The metaphonological phase** relates to the breakthrough to phonological awareness by about 5 years of age.

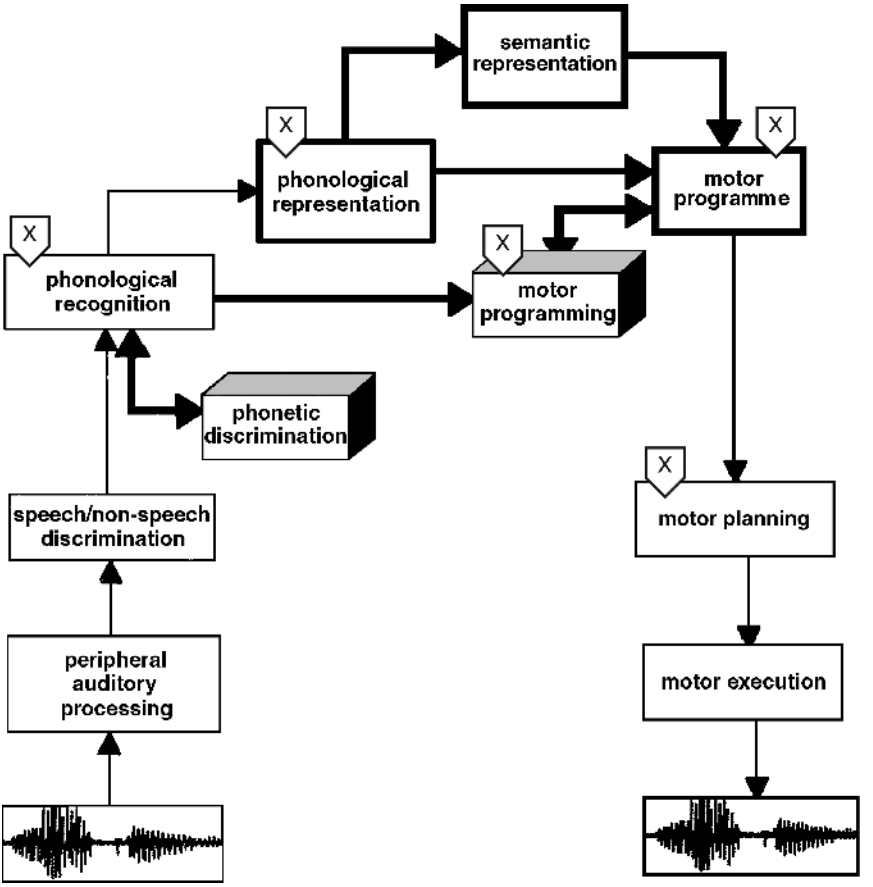

Figure 1.11 Speech processing model for Zoë at CA 9;08. *Source*: Stackhouse & Wells (1997). Reproduced by permission of John Wiley & Sons, Ltd.

It is proposed that typically developing children move through these phases smoothly and, as a consequence, develop the skills necessary to perform phonological awareness and literacy tasks. In contrast, children with speech difficulties have trouble at one or more of these phases. Further, the precise nature of their speech difficulties will depend on which particular phase (or phases) is troublesome for them. For example, children stuck at the whole word phase, who are not yet using phonological simplifying processes, may present with classic symptoms of apraxia of speech. Children who are delayed reaching and/or moving on from the systematic simplification phase present with persisting phonological simplifying processes and may be described as having a 'phonological impairment' or 'delay'. Associated with a delay moving on from the systematic simplification phase in particular are difficulties with connected speech production (in the assembly phase) and with developing phonological awareness; thus putting the child at risk of

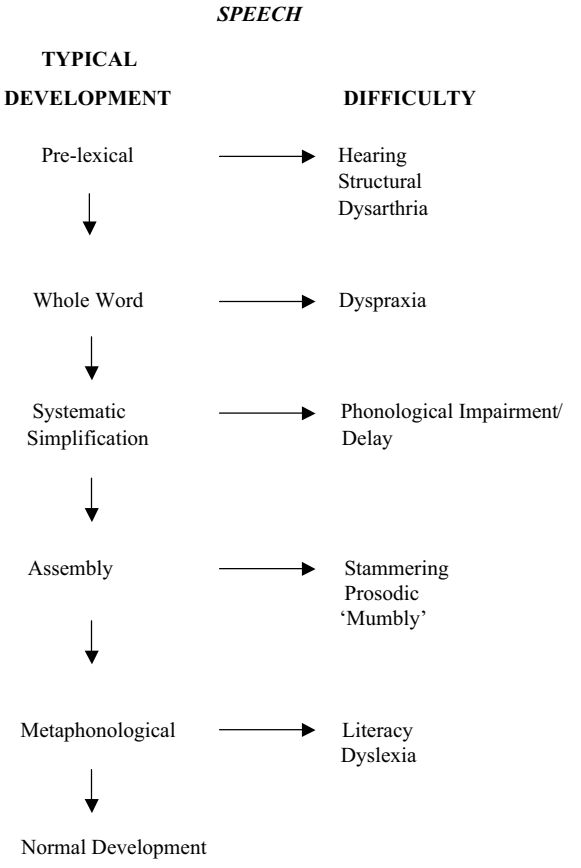

Figure 1.12 A developmental phase perspective on speech difficulties. Typical development is listed on the left of the diagram and the subsequent difficulty arising from arrested or delayed development at each phase is indicated on the right.
Source: Stackhouse & Wells (1997). Reproduced by permission of John Wiley & Sons, Ltd.

literacy problems. Figure 1.12 presents these phases and the difficulties associated with them if development does not follow normal lines.

Katy, the 6-year-old girl described by Pascoe, Stackhouse and Wells (2005), had speech that showed characteristics of the whole word phase, with most productions having a Consonant Vowel syllable structure. Her intervention programme aimed to expand her syllable structures to include CVC, enabling her to make a much greater range of lexical contrasts. Although she had some patterns characteristic of the systematic simplification phase (e.g. stopping), it was developmentally appropriate to focus intervention on the earlier whole word phase. Following intervention it was noted that Katy's speech was more characteristic of the

systematic simplification phase; she had been successfully helped to progress from the earlier whole word phase and could take advantage of intervention aimed at producing phonological contrasts.

Using the Psycholinguistic Framework in Practice and Research

The speech processing profile and models in the psycholinguistic framework are a useful way of systematically collating assessment results. The profile can be used to make two types of comparison: *intra*-child and *inter*-child.

Intra-Child Comparison

When an individual child's assessment results are collated on a speech processing profile, they can be used to determine the child's personal strengths and weaknesses to aid in intervention planning. One of the principles of the psycholinguistic approach is that assessment should reveal a child's processing strengths as well as weaknesses. Another is that it can be helpful to adapt assessments to individuals. To this end, we have tried to develop a set of procedures that can be used in a flexible and informative way:

> The psycholinguistic framework for assessment . . . does not constitute a fixed and immutable set of procedures, and thus differs from a test battery. (Stackhouse & Wells, 1997, p. 307)

Central to the development of assessment procedures are considerations relating to stimuli design (see Chapter 11 in Book 1). It was suggested here that stimuli should be carefully selected based on both lexical (i.e. real or non-words; words with high or low imageability) and phonological criteria (e.g. words with CCVC phonotactic structure; words with /s/ onset). Rees (2001, Chapter 2 of Book 2) suggested that stimuli should be designed to reflect a child's pattern of errors, and gives the example of Robert, a 7-year-old boy with mild cerebral palsy who had difficulty in producing some specific consonant clusters (e.g. syllable initial /pl/) in real and non-words. In a mispronunciation detection task, where Robert was presented with both correct and incorrect forms of target words, his performance varied from word to word: he showed particular difficulties in discriminating the correct and incorrect forms of words such as PLATE and AEROPLANE. These items may not have been included in a generically designed mispronunciation detection task, but were incorporated in Robert's assessment based on his own speech difficulties with /pl/ in a naming task. Bryan and Howard (1992), McGregor and Leonard (1989), and Ebbels (2000) also provide good examples of ways in which

assessment stimuli were modified in light of their participants' specific areas of difficulty.

Book 3 provides further examples of how stimuli for segment, cluster and connected speech tasks were designed for individual children with persisting speech difficulties. A child's progress can be monitored using such specifically designed tasks; in this way the child acts as his or her own control in terms of whether he or she is making the same or fewer errors as time goes on.

Inter-Child Perspective

A child's performance on a particular task can be compared to the performance of age-matched peers on the same task. Any task with norms can be used in this way, entering appropriate ticks or crosses to indicate degree of difference from the normative data on the speech processing profile. The procedures included in this compendium all have some normative data so that an individual child's performance can be interpreted, and his or her progress monitored, in relation to typically developing peers. Using this inter-child perspective does not preclude the adoption of an intra-child perspective: the child will still have his or her own areas of relative strengths and weaknesses. For example, 1 cross (X) at a particular level of processing within the profile may be considered a relative strength for the child, even though performance is 1 s.d. below the mean, when compared to a level that has three crosses (XXX), indicating performance that is 3 s.d.s below the mean.

There is a tension between the provision of normative data for tasks and sets of stimuli to allow inter-child comparison, and the need to identify individual children's particular profiles. These profiles will be more accurate when the stimuli used in input and output tasks reflect the speech errors that the individual child makes (see the example from Rees, 2001 above). It is not possible in this volume to present normative data on every possible type of speech error that children make. Rather, normative data can be provided for tasks with generic sets of stimuli that might indicate whether this is an area of potential concern. Assessment of individual children may then require adaptation of the tasks to use stimuli that target the child's own errors in order to be clearer about the nature of the difficulty.

Conclusion

The psycholinguistic approach to the investigation and management of children with speech and literacy difficulties should not be used in isolation from other approaches, but it does help to provide a foundation on

which to develop 'intervention based on sound rationales' (Gourlay, Joffe & Levin, 2005). However, Gourlay, Joffe and Levin state that a barrier to using the psycholinguistic approach in everyday practice has been the lack of specifically designed tasks with normal control data. The compendium of assessment tasks presented in this volume aims not only to fill this gap, but also to indicate which procedures can predict speech and literacy outcome. It is hoped that this will facilitate the use of a psycholinguistic approach in practice and research.

Summary

- Young children with speech difficulties make up a high proportion of speech and language therapists' caseloads and need to be prioritised for management, in order to prevent long-term and associated difficulties.
- Persisting speech difficulties are complex in nature and require careful investigation and management.
- This chapter summarises the three components of the psycholinguistic framework: the speech processing profile, the box-and-arrow model and the phase model.
- The speech processing profile is a useful way of systematically ordering a child's assessment results and can be repeated for comparison over time.
- Referring to the box-and-arrow and phase models adds another dimension to our theoretical understanding of a child's needs.
- The aims of a psycholinguistic assessment are to identify a child's processing strengths and weaknesses; the impacts these have on communication and literacy development; and how they can be used in the child's intervention programme and to predict children at risk for persisting speech and literacy difficulties.
- Completing a speech processing profile on a child allows two comparisons to be made: (a) intra-child – the child's own strengths and weaknesses and (b) inter-child – how well the child performs in comparison to typically developing peers.
- The psycholinguistic framework can be used to monitor progress in intervention and to uncover hidden difficulties beyond surface speech errors and diagnostic labels.
- Although this volume (Book 4) revises principles of the psycholinguistic approach, it is assumed that readers will already have some knowledge of the approach, as presented in Books 1–3 in this series.
- If the psycholinguistic approach is unfamiliar to readers, they should refer to Book 1 before trying to use and interpret findings from the procedures in this volume.