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Is there a causal link from phonological awareness to success in learning to read?

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Abstract

In this review, we re-assess the evidence that phonological awareness represents a skill specific to spoken language that precedes and directly influences the process of reading acquisition. Longitudinal and experimental training studies are examined in detail, as these are considered most appropriate for exploring a causal hypothesis of this nature. A particular focus of our analysis is the degree to which studies to date have controlled for existing literacy skills in their participants and the influence that these skills might have on performance on phonological awareness tasks. We conclude that no study has provided unequivocal evidence that there is a causal link from competence in phonological awareness to success in reading and spelling acquisition. However, we believe that such a study is possible and outline some ideas for its design and implementation.

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Keywords: Phonological awareness; Learning to read; Phonemic awareness; Reading acquisition; Dyslexia

The importance of the concept of *phonological awareness* in theorizing about reading acquisition and dyslexia can hardly be overestimated. Since the seminal work by Liberman and colleagues in the 1970s (Liberman, 1973; Liberman, Shankweiler, Fisher, & Carter, 1974), this skill has been seen as key to unlocking the complex process by which children learn the relationship between spoken and written words. To draw on one impact indicator, a *PsychInfo* search in January 2003 using either “phonological awareness” or “phonemic awareness” as keywords produced 945 hits, of which 855 pertained to material published since 1990. Some recent quotes also point to its impact:

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... perhaps the most important single conclusion about reading disabilities is that they are most commonly caused by weaknesses in the ability to process the phonological features of language. (Torgesen et al., 1999, p. 579)

... the specification of the role of phonological processing in the earliest stages of reading acquisition is one of the more notable scientific success stories of the last decade. (Stanovich, 1991, p. 78)

Some 20 years ago, Isabelle Liberman initiated a branch of reading research that later turned out to become a scientific success story. A wealth of clear evidence from many countries has now been accumulated to demonstrate the critical importance of phonological awareness in the process of learning to read. (Lundberg, 1991, p. 47)

To my mind, the discovery and documentation of the importance of phonemic awareness ... is the single most powerful advance in the science and pedagogy of reading this century. (Adams, 1990)

In this review, we re-visit the issue of the role of phonological awareness in reading acquisition, with the aim of returning to some of the original questions that motivated this work. We begin with a broad overview of the research reporting an association between phonological awareness and reading, and of the various interpretations that have been put forward of this association. As this literature has been reviewed many times before, we deal with it relatively briefly. We then pose the question: *Given all that we now know about the complex relationship between performance on phonological awareness tasks and reading, what is the status of the original hypothesis that phonological awareness represents a distinct set of spoken-language skills that (a) precede and (b) directly influence the process of reading acquisition?* To answer this question, we propose a set of requirements that would need to be fulfilled in order for empirical work to be capable of providing support for such a hypothesis. A detailed analysis of the current state of the literature in relation to these requirements is then presented.

1. Introduction: phonological awareness and its association with reading

Broadly defined, phonological awareness refers to the ability to perceive and manipulate the sounds of spoken words (Goswami & Bryant, 1990; Mattingly, 1972). It encompasses awareness of the most basic speech units of a language – phonemes – as well as larger units such as rimes and syllables. The “awareness” component of the term is as important to the definition as the “phonological” component, for the skill is proposed to involve, not simply unconsciously discriminating speech sounds (such as in speech perception), but explicitly and deliberately processing and acting upon them.

Beyond this basic definition, phonological awareness has been understood primarily by the tasks that have been used to measure it. The first task developed, and one that is still widely used, was the *phoneme deletion* task of Bruce (1964). Here, a subject is

presented with a spoken word (e.g. “*fan*”) and is required to mentally delete a particular sound (e.g. /f/) and say what remains (“an”). Other tasks measuring awareness at the phoneme level include *phoneme counting* (e.g. “Tap out each sound in *sing*”), *phoneme blending* (e.g. “What does /t/ /i/ /p/ say?”) and *phoneme reversal* (e.g. “Say the sounds of *skin* backwards”). Awareness of larger speech units is assessed with tasks such as *syllable segmentation* (e.g. “Say each syllable of *pencil*”), *rhyme oddity* (“Which is the odd one out: *fin*, *win*, *sit*”) and *rhyme judgement* (e.g. “Does *sheep* rhyme with *keep*?”).

It is important to distinguish at the outset between phonological awareness, as we have defined it here, and other processes that have been explored under the broad umbrella term of *phonological processing*. [Wagner and Torgesen \(1987\)](#) identify three main bodies of research in phonological processing: *phonological awareness*, as defined above; *phonological recoding in lexical access*, which refers to the process of converting written symbols into a sound-based code for visual word recognition; and *phonetic recoding to maintain information in working memory*, which involves recoding written symbols into a sound-based representational system for the purpose of holding information in working memory. Of these three categories, it is clear that only the first is defined purely in terms of spoken-language processing; the other two both necessarily involve some interaction with written language. As our interest in this paper is in examining whether a spoken language skill that is *independent* of the reading process can play a causal role in its acquisition, we have restricted our focus only to phonological awareness.

That there is a relationship between performance on phonological awareness tasks and reading ability is undisputed. A large amount of evidence has now been accumulated to show that the more knowledge children have about the constituent sounds of words, the better they tend to be at reading (for reviews see [Adams, 1990](#); [Brady & Shankweiler, 1991](#); [Goswami & Bryant, 1990](#); [Wagner & Torgesen, 1987](#)). This evidence has been in the form of concurrent correlations, where phonological awareness and reading have been measured at the same time, and also predictive correlations, where phonological awareness has been assessed at one point in time and reading at some later stage.

A dominant interpretation of this well-documented relationship has been that phonological awareness plays a causal role in reading acquisition, enabling, or at least assisting, the acquisition of early reading skills. The original formulation of this theory focused on the phoneme level. It was argued that, since letters usually represent individual phonemes in alphabetic languages, a child needs to be aware of the phonemic segments in spoken words before going on to learn about their correspondences with letters and graphemes ([Gough & Hillinger, 1980](#); [Mattingly, 1972](#)). More recently, others have argued that awareness of higher level speech units, such as rimes, will assist children in mapping these sounds onto frequently occurring letter sequences such as *ight* or *ing* (e.g. [Goswami, 1993](#); [Goswami & Bryant, 1990](#)).

Importantly, the proposal in both cases is not that the awareness of phonological units will cause children to be *able* to read but that it will cause them to be better at *learning* to read at some later date: it is a distal, not a proximal, cause of reading ability. What we mean by the proximal cause of any feature of cognitive performance is the actual property of the relevant cognitive processing system that is responsible for performance within this cognitive domain; what we mean by a distal cause is any factor which was involved in causing that system to become the way it is (for further discussion of this distinction see

[Jackson & Coltheart, 2001](#)). If a child is poor at reading, the mental information-processing system that is used for reading is abnormal in that child (that is the proximal cause of the poor reading); the factors which have prevented acquisition of a normal reading system are distal causes of the poor reading. Phonological awareness is not a skill used on-line as we read (that is, it is not a component of the reading system), so if phonological awareness were implicated in reading it would be as a distal cause of reading, not as a proximal cause.

In addition to the view that phonological awareness assists the process of reading acquisition, there are, of course, other ways of interpreting the correlational relationship between phonological awareness and reading ability. Firstly, perhaps, as several theorists have proposed, it is the process of learning to read itself that alerts the beginning reader to the relevant phonological segments in a language ([Ehri, 1989](#); [Morais, 1991](#); [Morais, Alegria, & Content, 1987](#)). In support of this proposal, Morais and colleagues showed that Portuguese adults who were illiterate performed much more poorly on phonological awareness tasks than comparable people who had been illiterate as adults but had subsequently learned to read ([Morais, Cary, Alegria, & Bertelson, 1979](#)). Similarly, [Read, Zhang, Nie, and Ding \(1986\)](#) found that Chinese readers who had not encountered their language's alphabetic script (pinyin) performed more poorly on phonemic awareness tests than those who had.

Recent cross-linguistic data are also consistent with this interpretation. [Mann and Wimmer \(2002\)](#) compared the phonemic awareness skills of American kindergartners, who are taught letters and sounds prior to schooling, with those of German kindergartners, who are not. The American children excelled on phonemic awareness tasks compared to their German counterparts, leading the authors to conclude that phoneme awareness develops primarily as a consequence of literacy exposure. Poor performance on phoneme awareness tasks in German kindergarten children has been documented in other studies ([Schneider, Roth, & Ennemoser, 2000](#); [Wimmer, Landerl, Linortner, & Hummer, 1991](#)) and Lukatela and colleagues report a similar pattern of relationship between phonological awareness and literacy for Serbo-Croatian illiterates with varying levels of letter knowledge ([Lukatela, Carello, Shankweiler, & Liberman, 1995](#)). Findings such as these have supported the conclusion that, at the very least, there is a reciprocal causal relationship between phonological awareness and reading achievement ([Perfetti, Beck, Bell, & Hughes, 1987](#); [Stanovich, 1986](#); [Tunmer & Rohl, 1991](#)).

In a recent paper ([Castles, Holmes, Neath, & Kinoshita, 2003](#)) we have argued that it is also possible that the acquisition of reading skills does not actually change the level or nature of phonological awareness itself. Rather, it influences *the way in which children perform phonological awareness tasks*. As reading and spelling skills develop, phonological awareness tasks can increasingly be carried out using orthographic information as opposed to purely phonological information and hence, not surprisingly, success on these tasks is correlated with reading ability. This possibility therefore relies on a distinction being made between phonological awareness as a process and as a task: rather than reading development affecting the process of phonological awareness, it simply affects performance on tasks typically regarded as measuring phonological awareness. On this view also, both reading tests and phonological awareness tests are, to a certain degree, measures of orthographic ability; the former is direct; the latter indirect: tasks labelled as

phonological awareness tasks may be performed without requiring the use of the putative cognitive ability labelled “phonological awareness”.

Consistent with this theory are several reports of orthographic influences on phonological awareness task performance. [Ehri and Wilce \(1980\)](#) showed that fourth grade children tended to report that there were more phonemes in a word such as *pitch* than in one such as *rich*, although the number of phonemes was the same in both cases. It was argued that the children evoked the words’ spellings, and the extra letter in words like *pitch* interfered with their phonological judgements. This result has since been reported in children as young as first grade ([Tunmer & Nesdale, 1985](#)). Also using a phoneme counting task, [Treiman and Cassar \(1997\)](#) found that syllables containing letter names were reported by both children and adults to contain fewer sounds than syllables that did not contain letter names, and [Stuart \(1990\)](#) found that, when attempting to remove the sound /n/ from a word like *bind*, 9-year-old children were just as likely to produce an orthographically-based response which changed the pronunciation of the vowel (“bid”) as they were to produce a purely phonological one (“bide”). At the rime level, [Seidenberg and Tanenhaus \(1979\)](#) and [Donnenwerth-Nolan, Tanenhaus, and Seidenberg \(1981\)](#) showed that adults were faster to decide that spoken words like *cot* and *pot* rhymed than words like *yacht* and *pot*. Finally, orthographic influences on phonological awareness are demonstrated, in a slightly different manner, by data from regular orthographies such as German. The correlation between phoneme awareness and reading in German early readers appears to be much weaker than is the case with American and English children, suggesting that the complexity of the orthography to be learned plays an important role in any relationship observed between these two factors ([Mann & Wimmer, 2002](#); [Naslund, Schneider, & Van Den Broek, 1997](#)).

A final, fourth, alternative interpretation of the correlation between phonological awareness and reading is that, at least to some degree, the association does not reflect a causal relationship in either direction, but instead reflects the influence of some third factor. This third factor could be a cognitive skill that is independent of both processes but which influences the development or functioning of both, such as general processing efficiency or learning ability (see e.g. [Byrne, Fielding-Barnsley, & Ashley, 2000](#); [Wesseling & Reitsma, 2000](#)).

Given these various alternative accounts of the correlation between phonological awareness task performance and reading, the question arises as to the status of the original hypothesis that led to the explosion of interest in this field in the first place: that phonological awareness represents a set of purely spoken language skills that precede, are independent from, and directly facilitate the acquisition of reading skills. It seems clear that this interpretation cannot account for all of the reported association, but does it account for any of it? And, if so, how much? To explore this issue would seem important, since much of the appeal of the concept of phonological awareness surely lies in its status as a non-reading precursor to reading and in the potential it therefore provides for uncovering the process by which children apply their existing cognitive and linguistic abilities to the novel task of learning to recognize, comprehend and read aloud written words. The potential benefits for early detection and remediation of potential reading-acquisition difficulties are also obvious. Therefore, in this paper, we would like to return to this hypothesis, with a view to gauging its current status.

The existence of so many alternative conceptualizations of the relationship between phonological awareness and reading might lead one to conclude that a “straw man” was being set up in proposing a specific causal hypothesis such as the one above. We do not believe that this is the case. In fact, we would argue that a causal mechanism of this nature is implicit in much of the research on phonological awareness and reading, and that it is explicit on a significant proportion of occasions. Even though reciprocity is frequently acknowledged, some causal connection from phonological awareness to reading acquisition is widely assumed. Again, some quotes from prominent commentators in the field illustrate the dominance of this view:

Research has shown that phonological awareness appears to play a causal role in reading acquisition ... that it is a foundational ability underlying the learning of spelling–sound correspondences. ([Stanovich, 1993](#), p. 288)

... providing training in phonological awareness results in improved reading scores, leading researchers to conclude that the relationship between phonological awareness and reading is a causal one. ([Chaney, 1998](#), p. 433)

By providing strong support for the idea that individual differences in phonological skill in kindergarten (before reading instruction began) are causally related to individual differences in subsequent growth of reading skills, we provide important confirmation of phonological deficits as a possible cause of early reading failure. ([Torgesen, Wagner, & Rashotte, 1994](#), p. 284)

The empirical case – that in order to learn to read in an alphabetic writing system, awareness of the phonemic structure of speech is necessary – has been developed convincingly in recent years. ([Perfetti, 1991](#), p. 73)

However, some caveats are required before proceeding. First, in focusing on phonological awareness as a purely spoken language skill and its putative causal role in reading acquisition, we do not wish in any sense to undermine the important role of alphabetic skills, or the knowledge of *relationships* between letters and sounds, in learning to read. There is a vast amount of educational and psychological research to suggest that knowledge about letter–sound correspondences is a primary building block to reading, providing children with the tools to sound out new words and assisting with the formation of lexical representations (see e.g. [Adams, 1990](#); [Share, 1995](#)). To find that there was insufficient evidence for an independent causal role of the explicit ability to perceive and manipulate speech sounds in reading acquisition would not in any way challenge these findings. It would suggest, however, that it is the learning of relationships between letters and sounds in the context of reading instruction, rather than the ability to reflect upon speech sounds in isolation prior to reading, that is vital for progress in literacy.

A second point to note before proceeding is that we have chosen to test a specific (though we believe widely-held) rendition of the way in which phonological awareness might cause reading acquisition, which takes the form that phonological awareness skills

are the foundation of reading and precede it developmentally. Other, weaker versions of this casual hypothesis could potentially be forwarded, such as that phonological awareness operates by altering the nature or course of reading acquisition. The present analysis will not necessarily provide data relevant to such alternative theories.

A strong causal hypothesis such as the one proposed here is not easily assessed by cross-sectional correlational data. Instead, as [Wagner and Torgesen \(1987\)](#) also argue in their review, it can receive support largely from two broad types of evidence. Firstly, *longitudinal studies* could demonstrate that phonological awareness measured prior to the acquisition of reading ability predicts subsequent reading performance. Secondly, *training studies* could reveal that instruction in phonological awareness facilitates the process of reading acquisition. We will therefore concentrate on these two lines of enquiry.

2. Longitudinal studies

Longitudinal studies of the relationship between phonological awareness and reading involve measuring phonological awareness at Time t_1 and correlating it with reading and/or spelling performance at Time t_2 and beyond. No such longitudinal correlational design can ever conclusively establish a causal link between two factors, because of the much-cited third variable problem (see e.g. [Bryant & Goswami, 1987](#); [Macmillan, 2002](#)). For example, although phonological awareness at Time t_1 might be found to be significantly correlated with reading ability at Time t_2 , we can never be sure that some third, unmeasured, and perhaps unknown, factor is not the underlying causal element influencing both variables.

Does this mean, therefore, that longitudinal studies of this type have no place in the current review? Although, technically, the answer to this question might be yes, we feel that to ignore the wealth of longitudinal data that consider causal questions about the relationship between phonological awareness and reading would be counter-productive and overly limiting. An analogous decision might be to disregard the enormous amount of suggestive longitudinal data on the relationship between smoking and lung cancer because no correlational study can definitively establish a causal connection. Instead, we have chosen to include these studies, but to examine them with the aim, not of confirming a causal link, but of formulating and refining hypotheses about what the likely nature and extent of such a link might be. These more specific causal hypotheses will then be put to a rigorous test in the examination of the experimental training data.

There is an extremely rich field of research available to us: over 40 longitudinal studies of the relationship between phonological awareness and reading have been published since the late 1970s (see [Table 1](#)). For the present purposes, we have selected for detailed examination those studies that meet certain requirements that we feel are necessary for the data to be relevant to questions about causal relations. We wish to emphasize that fulfilment or otherwise of these criteria is not intended as an evaluation of the overall merit of the research: many of the above studies were never specifically intended for the purpose to which we are putting them. We seek only to select those studies that are most appropriate for the causal question of interest here.

Table 1
Longitudinal studies of phonological awareness and reading acquisition

Badian (1998)	Bradley and Bryant (1983, 1985)
Bryant, MacLean, Bradley, and Crossland (1990)	Byrne, Freebody, and Gates (1992)
Burgess and Lonigan (1998)	Casalis and Louis-Alexandre (2000)
Calfee (1977)	Caravolas, Hulme, and Snowling (2001)
Cardoso-Martins (1995)	Cataldo and Ellis (1988)
Chaney (1998)	Cronin and Carver (1998)
Demont and Gombert (1996)	de Jong and van der Leij (2002)
Duncan, Seymour, and Hill (1997)	Ellis and Large (1987)
Elbro, Borstrom, and Petersen (1998)	Foorman, Francis, Novy, and Liberman (1991)
Hulme et al. (2002)	Jorm, Share, Maclean, and Matthews (1984)
Juel, Griffith, and Gough (1986)	Juel (1988)
Lonigan, Burgess, and Anthony (2000)	Lundberg, Olofsson, and Wall (1980)
Maclean, Bryant, and Bradley (1987)	Mann and Liberman (1984)
Mann (1984)	Muter, Hulme, Snowling, and Taylor (1998)
Passenger, Stuart, and Terrell (2000)	Perfetti, Beck, Bell, and Hughes (1987)
Rohl and Pratt (1995)	Share, Jorm, Maclean, and Matthews (1984)
Stanovich, Cunningham, and Cramer (1984)	Stuart (1995)
Torgesen, Wagner, and Rashotte (1994)	Torgesen, Wagner, Rashotte, Burgess, and Hecht (1997)
Torn��us (1984)	Tunmer, Herriman, and Nesdale (1988)
Tunmer (1989)	Vellutino and Scanlon (1987)
Wagner, Torgesen, and Rashotte (1994)	Wagner et al. (1997)
Wimmer, Landerl, Linortner, and Hummer (1991)	Wimmer, Mayringer, and Landerl (2000)

Our first requirement was that, ideally, phonological awareness at t_1 needed to have been measured prior to the children having *any reading or spelling skills whatsoever, including knowledge of letter–sound correspondences*. As discussed earlier, if this was not done, it cannot be ruled out that the children were using their already existing literacy skills to assist their performance on the phonological awareness tasks at Time t_1 and that it was these literacy skills that in fact drove any subsequent correlation with literacy skill measured at t_2 and later. The vast majority of the papers listed above do not fulfil this requirement. In many instances, the children had already begun school and the presence of some level of literacy in at least some of them was not in question. In other studies, attempts were made to minimize existing literacy skills by assessing pre-schoolers, but the complete absence of such skills was not explicitly ensured. For example, [Bryant, MacLean, Bradley, and Crossland \(1990\)](#), in a study mainly concerned with comparing the predictive value of rhyme- versus phoneme-awareness, tested 64 children prior to school and again several times over the succeeding 2 years. Although the effects of age, the mother's educational level, general language ability and IQ at t_1 were all carefully partialled out, early literacy was not measured or controlled for. Given that the children were, on average, over four and a half years old at t_1 , it seems likely that many would already have possessed at least some reading and spelling skills. Similar issues arise in the pre-school studies of [Chaney \(1998\)](#) and [Demont and Gombert \(1996\)](#).

It is possible, however, that this requirement is simply too difficult to meet: children who are young enough to have no literacy skills at all might also be unable to cope with the cognitive demands of phonological awareness tasks. Therefore, also included for

consideration were those studies that partialled out reading and spelling abilities at t_1 when examining the correlation between phonological awareness at t_1 and reading and spelling performance at t_2 and beyond. Evidence exists that including such a control indeed alters the strength of the correlation reported between phonological awareness and reading. [Wagner and Torgesen \(1987\)](#) performed a post-hoc analysis of the significant associations between kindergarten phonological awareness scores and first grade reading performance reported by [Lundberg, Olofsson, and Wall \(1980\)](#). The partial correlations when kindergarten reading was held constant dropped substantially, with only two of the original nine significant correlations remaining significant at the 0.05 level.

We are certainly not alone in emphasizing the importance of controlling for pre-existing literacy abilities in longitudinal studies – many others have also made this recommendation (e.g. [Bowey & Francis, 1991](#); [Elbro, Borstrom, & Peterson, 1998](#); [Wagner, Torgesen, & Rashotte, 1994](#)). Most, however, have discussed this requirement in the context of controlling for the autoregressive effects of reading ability on itself. That is, it is argued that the best predictor of future behaviour is past behaviour, and that the effects of prior reading ability on subsequent reading ability should therefore be partialled out before other, non-reading, variables are considered. We would add to this a second reason, which is that pre-existing literacy skills may artificially inflate phonological awareness scores measured at t_1 , because orthographic information can be used to assist performance. These inflated phonological scores may then be associated with higher reading scores at t_2 and beyond, not because the phonological skills were good predictors, but because the orthographic skills were.

Our second requirement was that, in acknowledgement of the third-variable problem discussed above, some attempt should have been made to rule out at least the most likely alternative accounts of any relationship found between the key variables. In practice, this would often involve controlling for age, general language ability and IQ, but it might also involve partialling out other skills the authors considered likely to be involved in the tasks concerned. For example, a working memory measure, such as digit span, would be a useful control to include if the phonological awareness or reading tasks being used appeared to place a high memory load on participants. A requirement such as this is conservative in that, to the degree that phonological awareness and these other variables are correlated, it may potentially lead to an underestimate of the magnitude of the influence of phonological awareness on reading. However, in order to make the case that phonological awareness *per se* makes an independent contribution to success in learning to read, we nevertheless feel it is necessary at the outset to show significant effects *above and beyond* those of any correlated variables. Subsequent to this demonstration, questions of magnitude of effect can be explored.

Based on these criteria, we identified a set of longitudinal studies whose data seemed directly relevant to questions about the causal link between phonological awareness and reading acquisition: [Badian \(1998\)](#), [Bradley and Bryant \(1983, 1985\)](#), [Burgess and Lonigan \(1998\)](#), [Cardoso-Martins \(1995\)](#), [Caravolas, Hulme, and Snowling \(2001\)](#), [Cataldo and Ellis \(1988\)](#), [de Jong and van der Leij \(2002\)](#), [Duncan, Seymour, and Hill \(1997\)](#), [Elbro et al. \(1998\)](#), [Hulme et al. \(2002\)](#), [Muter, Hulme, Snowling, and Taylor \(1998\)](#), [Perfetti et al. \(1987\)](#), [Stuart \(1995\)](#), [Torn  us \(1984\)](#), [Tunmer, Herriman, and Nesdale \(1988\)](#), and [Wagner et al. \(1994, 1997\)](#). We then examined these studies in

relation to specific questions about what the nature of such a causal connection might be. Specifically, we asked (a) what aspects of phonological awareness predict subsequent reading and spelling acquisition, and (b) what size phonological unit or units appear to play a significant role.

2.1. What aspects of phonological awareness predict reading and spelling acquisition?

Although phonological awareness is widely treated as a unitary construct, several theorists have noted that there are at least two different subprocesses involved in performing the various phonological awareness tasks that are regularly in use (e.g. [Fox & Routh, 1976, 1984](#)). The first involves being able to break whole words down into their constituent sounds, such as in segmentation or deletion tasks, and the second involves being able to combine isolated sounds together to form whole words, such as in blending tasks. The question arises as to whether one, the other, or both of these subskills is related to later reading and spelling development.

Most relevant to this issue is the evidence from a comprehensive longitudinal study of phonological awareness and reading by Wagner and colleagues ([Wagner et al., 1994, 1997](#)). Based on a previous confirmatory factor analysis ([Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993](#)), [Wagner et al. \(1994\)](#) identified two latent phonological awareness variables and compared their success in predicting the reading and spelling of 244 children from kindergarten to second grade. The first latent variable was referred to as *phonological analysis*, and included measures of sound deletion, categorization and segmentation; the second was labelled *phonological synthesis* and included measures of sound blending. They found that the two variables were highly correlated. However, when both were entered into a single structural equation model, with pre-existing reading ability and spoken vocabulary controlled for, only phonological analysis had a unique influence on first grade reading and only phonological synthesis had a unique influence on second grade reading.

These results might be interpreted as supporting the hypothesis that segmentation skills are important early in reading acquisition and blending skills later on. However, the authors urge caution in drawing this conclusion, noting that when two variables are highly correlated the one with just slightly more predictive power can receive a substantial boost in a structural equation model. Furthermore, these findings need to be considered against those of [Perfetti et al. \(1987\)](#), who appear to have observed a somewhat contradictory result. They used partial time-lag correlations to examine the relationship between two phonemic awareness subskills – deletion and synthesis – and learning to read in a group of 82 first grade children. This method involved measuring both the two phonemic awareness skills and reading skills at four points throughout the year and then comparing the partial correlations in each direction in time. By this logic, if a phonemic awareness test at Time t_1 predicts reading success at Time t_2 (controlling for the effects of reading at t_1) better than reading at Time t_1 predicts a phonemic awareness test at Time t_2 (controlling for phonemic awareness at t_1), then it can be inferred that the phonemic awareness test is more strongly causally linked with subsequent reading than vice versa. Using this method, they found that

phoneme deletion skills appeared to be largely a *product* of reading ability, while phoneme synthesis skills seemed to enable later reading.

In summary, there does not appear to be a strong argument for focusing specifically on either phonological analysis or phonological synthesis skills as causal factors in reading acquisition in the present review. Both subskills have been found to make a contribution to literacy acquisition in different studies and, perhaps more importantly, the two skills appear to be highly correlated (Burgess & Lonigan, 1998; Wagner et al., 1994, 1997; see also Yopp, 1988). We will therefore include studies of both types of processing in our examination of possible causal connections with reading acquisition.

2.2. *What size phonological units predict reading and spelling acquisition?*

Although few researchers have doubted the central role of some form of phonological awareness in the acquisition of reading, considerable controversy has surrounded the question of the relative importance of small versus large phonological units. At the subsyllabic level, some theorists have argued strongly for a predictive role for awareness of the rime (the phonological unit corresponding to the vowel and any subsequent phonemes in the syllable), while others have stressed the importance of the phoneme. Other research has examined phonological awareness at the level of the syllable itself. Of course, it is quite possible that more than one of these units plays an important role (Bryant, 2002; Goswami, 1999). We will examine how the longitudinal studies we have selected for analysis have contributed to this debate in the following sections, proceeding from the largest through to the smallest phonological units.

2.2.1. *Syllabic awareness and reading and spelling acquisition*

The syllable is a natural phonological unit, that some have argued is even more salient than the word (Adams, 1990). It would therefore seem likely that the ability to perceive and segment words into syllables might play an important role in the early stages of reading acquisition. Indeed, some early longitudinal research provided strong support for this hypothesis. Mann and Liberman (1984) tested 62 children on a syllable segmentation task in kindergarten and then examined their reading achievement one year later. There was a strong and significant positive correlation between the two skills. However, as Wagner and Torgesen (1987) also note, pre-existing reading ability and other extraneous variables, such as IQ, were not controlled for in this study, so it would be unwise to infer a causal relationship from these results.

Moving to the studies we have selected as being suitable for examining causal hypotheses, we find that the evidence for a unique role for syllabic awareness is very limited. Badian (1998) examined syllabic segmentation skills in 238 pre-school children using a syllable tapping task (adapted from that used by Mann & Liberman, 1984). They found that performance on this task accounted for no independent variance in reading ability in first or second grade once verbal IQ, socio-economic status (SES), pre-existing reading ability and chronological age had been controlled for. Similarly, Elbro et al. (1998), in a study of Danish pre-school children at risk for dyslexia, found that neither syllable deletion nor syllable identification contributed independently to the prediction of

dyslexia in second grade, while phoneme identification and a measure of the distinctness of phonological representations did.

The only research to provide some evidence for an independent contribution of syllabic awareness is a longitudinal study of 105 Brazilian children by [Cardoso-Martins \(1995\)](#). She tested the children prior to school on a syllable detection task, in which they had to detect the odd one out among three words, one of which either began or ended with a different syllable (an *oddity* task; see later discussion). Performance on this task made a small but significant independent contribution to reading and spelling ability at the middle and end of the school year, even after key extraneous variables had been controlled for. However, there are two points to note here. First, these results apply to the Portuguese language, which has many multisyllabic words, and may not generalize to English or other languages. Second, the authors themselves question whether their syllabic oddity task was actually tapping syllabic awareness or whether it was being performed using a global judgement of phonological similarity. Given that the words involved were multisyllabic, it is also possible that the oddity task was placing considerable demands on short-term working memory and that it was this skill that was associated with reading and spelling acquisition.

Based on these results, we would conclude that there is little evidence for an independent relationship between syllabic awareness and subsequent reading or spelling acquisition, at least in the English language. We will therefore turn to the role of subsyllabic units, which have received considerably more research attention than syllables and which, as we will see, have been the subject of strenuous debate.

2.2.2. Rhyme awareness and reading and spelling acquisition

A dominant proposal, associated most strongly with the work of Goswami and colleagues (e.g. [Goswami, 1993, 1999](#); [Goswami & Bryant, 1990](#)), has been that the phonological unit that has a direct causal link with reading acquisition is the rime. Awareness of smaller phonological units such as phonemes is argued to be associated only indirectly with reading acquisition, and possibly even to be a product of learning an alphabetic script. On this theory, the awareness of onset and rime provides children with a strategy for linking spoken rime segments with printed rime units, which are the most consistent components of written words in English. These links can then be used to make inferences or analogies about new words. At a more advanced stage of reading acquisition, the rime units are segmented, leading to a more fine-grained letter–sound reading process.

Indeed, there is strong suggestive evidence of a causal link between rhyme awareness and reading acquisition. In a novel study, [Maclean, Bryant, and Bradley \(1987\)](#) found that knowledge of nursery rhymes at age 3 was significantly related to the subsequent development of phonological skills and early reading ability. Then, in a more direct test of this hypothesis, [Bryant et al. \(1990\)](#) used path analyses to provide support for a causal model in which alliteration ability at 4 years old was indirectly linked to the development of phonemic awareness, and directly linked to the acquisition of reading and spelling, at age 6. However, as noted earlier, pre-existing reading ability was not controlled for in the [Bryant et al. \(1990\)](#) study. Furthermore, as noted by [Hulme et al. \(2002\)](#), phonemic awareness measures were not always taken at the same time as the rhyme measures in this

study, so it is not possible to determine which of the two was the better predictor of later success in reading.

How, then, does the proposal that rhyme awareness is a significant independent predictor of reading acquisition fare when we scrutinize the longitudinal studies we have selected as being appropriate for the exploration of causal hypotheses? Here, the results appear to be much more mixed. Strong support for a causal link comes from the landmark longitudinal study of [Bradley and Bryant \(1983, 1985\)](#). In this study, a large number of 4- and 5-year-old children, none of whom could read any words, were tested for their sensitivity to rhyme and alliteration.¹ The specific tasks used were oddity tests: the experimenter read out three or four words, all but one of which had a sound in common, and the children were asked to judge which word was the odd one out (e.g. “pin”, “win”, “sit” and “fin”). Performance on these tasks was found to be strongly correlated with reading and spelling more than 3 years later, and these correlations remained significant even when IQ and memory ability were controlled for.

Two other relevant studies, also using oddity tasks, have reported some evidence for a significant contribution of rhyme awareness to early reading. In a longitudinal study of 166 Dutch children, [de Jong and van der Leij \(2002\)](#) found that rhyme awareness at the end of first grade predicted later reading achievement, even when nonverbal intelligence, vocabulary, verbal working memory and pre-existing reading ability were controlled for. Surprisingly, however, rhyme awareness measured in these same children in kindergarten did not make an independent contribution to their reading performance in first grade. Given that rhyme awareness is proposed to exert its influence at the very early stages of reading acquisition, it is difficult to know how to interpret this pattern of results. Moreover, floor effects in the tasks used meant that phoneme awareness scores were not included in this analysis, so it is not possible to determine whether rhyme awareness made an independent contribution to reading, above and beyond that provided by phoneme awareness. A second piece of research to find a significant influence of rhyme awareness was the Brazilian study of [Cardoso-Martins \(1995\)](#) mentioned previously. She found a small but significant effect of rhyme awareness measured at the beginning of kindergarten on reading (but not spelling) performance at the middle of the year, even after age, IQ, letter knowledge and spelling ability had been controlled for. However, this association was no longer significant by the end of the year. In contrast, phonemic segmentation ability continued to be a strong predictor of both reading and spelling performance.

Against these findings in support of some influence of rhyme awareness on later reading or spelling are several studies that have failed to report a significant relationship. [Stuart \(1995\)](#) examined rhyme detection, alliteration and phonemic segmentation in a group of 30 children in their first term at school. Neither rhyme detection nor alliteration significantly predicted the children’s reading performance at the end of the year once initial reading ability had been controlled for. Initial and final phoneme segmentation, on the other hand, continued to be significant predictors. [Duncan et al. \(1997\)](#) report the results of some innovative research, in which they tested rhyme and phoneme awareness in 60 pre-school children and then attempted to uncover the mechanism by which these

¹ It should be noted that the children scored zero on the Schonell reading test, but that it is not actually established that they could read zero words in English.

phonological variables influenced reading acquisition in the first year at school, rather than simply their predictive value. They report many interesting findings but, for the present purposes, a key result was that there was no residual relationship between rhyming ability and subsequent nonword reading once the relevant extraneous variables had been controlled for.

Finally, a series of recent studies by Hulme and colleagues ([Hulme et al., 2002](#); [Muter et al., 1998](#)) have directly asked the question of whether rhyme- or phoneme-awareness is the better predictor of reading acquisition. [Muter et al. \(1998\)](#) tested phonemic segmentation and rhyme awareness in 38 4-year-old children and compared their relationship with reading and spelling performance over the subsequent 2 years. Rhyming failed to predict either reading or spelling skills at the end of the first year at school, while phoneme segmentation abilities were highly predictive of both reading and spelling acquisition. The only significant effect of rhyming, which was on spelling performance, occurred later, at the end of the second year of school. Although there has been some controversy surrounding these results and the methods used (see [Bryant, 1998](#); [Hulme, Muter, & Snowling, 1998](#)), the basic conclusions of this study would appear to be borne out by the results of a recent short-term longitudinal study by [Hulme et al. \(2002\)](#). Here, awareness of four phonological units (initial phoneme, final phoneme, onset and rime) was examined in 5- and 6-year-old children, with reading being assessed concurrently and then 7–14 months later. In an important advance on previous research, the tasks used were kept consistent across all conditions, with only the size of the phonological unit varying. Once reading ability at t_1 and other extraneous variables had been controlled for, rhyming ability accounted for no significant additional variation in word reading, while phoneme segmentation ability continued to account for unique variance.

How, then, are we to reconcile the mixed pattern of findings regarding the predictive value of rhyme awareness in reading acquisition? One potential resolution, suggested also by [MacMillan \(2002\)](#), is that those studies that have reported a significant role for rhyme awareness have used different, and perhaps less pure, measures of this skill than those that did not find an effect. The oddity tests originally developed by Bryant and colleagues ([Bradley & Bryant, 1978, 1985](#)), and also used in the studies above that reported significant effects of rhyme awareness, have been criticized on the basis that they may in fact measure phonemic awareness in addition to rhyme awareness ([MacMillan, 2002](#)). This is because a child can potentially obtain the correct answer on many items, not by noticing that one word does not sound the same overall (a rhyme judgement), but by noticing that one word does not end in the same final sound (a phonemic judgement). Indeed, [Carillo \(1994\)](#) found that scores in the rhyming condition of the oddity task in which the final phoneme of the items differed correlated more highly with phonemic segmentation scores than with scores in the other rhyme conditions. Furthermore, [Hulme et al. \(2002\)](#) report that the reliability of the oddity measures used in their study was extremely low.

On balance, therefore, we feel that there is not a strong case to be made for rhyme awareness being a significant independent predictor of reading and spelling acquisition. Those studies that have reported an independent contribution may be subject to measurement problems (for further discussion, see [MacMillan, 2002](#)), and the one study that proponents of both sides of the debate agree represents a definitive test ([Hulme et al.,](#)

2002; see Bryant, 1998; Hulme, 2002) has failed to find a significant independent role for rhyme awareness. If rhyme awareness does play a causal role, the evidence to date would suggest that its effects occur somewhat later in the literacy acquisition process, and that they may be particularly relevant to spelling acquisition (Muter et al., 1998). Although this possibility deserves further exploration, such a role for rhyme awareness makes it less interesting in the context of the present focus on phonological awareness as a putative non-reading precursor to reading and spelling acquisition. We will therefore turn our attention to the possible causal role played by the smallest phonological units – phonemes.

2.2.3. *Phonemic awareness and reading and spelling acquisition*

In contrast to large unit theories, small unit theories propose that acquiring an alphabetic orthography primarily requires gaining access to and awareness of a phonemic level of speech representation. That is, learning to read involves developing the understanding that letters (or graphemes) represent the most basic sounds in speech (Gough & Hillinger, 1980; Mattingly, 1972). Once this alphabetic principle is understood, a child can then use it as a basis for sounding out words and ultimately for acquiring lexical knowledge (see e.g. Share, 1995).

Several of the studies described above as finding little support for an influence of syllable or rhyme awareness on reading acquisition do report evidence for a unique contribution of phonemic awareness. In the Stuart (1995) study, segmentation of both initial and final sounds significantly predicted reading ages at the end of the year, even when reading ages at the beginning of the year were controlled. Muter et al. (1998) found that phonemic segmentation, defined by measures of phoneme identification and phoneme deletion, was strongly correlated with attainment in both reading and spelling at the end of the first year at school. Similarly, Hulme et al. (2002) found that their combined measures of phonemic awareness were highly significant concurrent and longitudinal predictors of reading skill when the effects of age, spoken vocabulary and initial word reading ability were partialled out. A significant unique contribution of prior phonemic awareness to subsequent reading and spelling is also reported by Cardoso-Martins (1995), Caravolas et al. (2001), Cataldo and Ellis (1988), Elbro et al. (1998), Perfetti et al. (1987), Tornéus (1984; Study 1), Tunmer et al. (1988) and Wagner et al. (1994, 1997).

2.3. *Summary*

In summary, our review of the relevant longitudinal data leads us to the conclusion that, if phonological awareness indeed plays a causal role in reading and spelling acquisition, the nature of that awareness is most likely to be the ability to perceive and manipulate phonemes. No study that we selected for close scrutiny and that included phonemic awareness measures failed to find evidence for a significant unique contribution to subsequent reading or spelling. This stands in strong contrast with the results for syllabic and rhyme awareness. We will therefore narrow the focus of our review to phonemic awareness from this point on.

As noted at the beginning of this section, although data from longitudinal studies can and have provided support for hypotheses about causal relations between phonemic

awareness and literacy, they can never conclusively establish such links; it is always possible that a third and unmeasured factor accounts for the relationship between the two skills. Furthermore, although there is support in the above literature for the hypothesis that phonemic awareness enables, or at least assists, literacy acquisition, there is also considerable support for the proposal that the causality flows in the reverse direction ([Perfetti et al., 1987](#); [Tunmer et al., 1988](#); [Wagner et al., 1994](#)). At the very least, there would clearly seem to be a complex reciprocal relationship between the two sets of skills. It is our view that the nature of this complex relationship is best untangled by examining experimental, as opposed to correlational, data and we will therefore now turn our attention to phonological awareness training studies.

3. Training studies

Numerous phonological awareness training studies have been conducted, with a huge variety of aims, methodologies and outcomes (as clearly evidenced in the recent meta-analysis by [Bus & van Ijzendoorn, 1999](#)). In assessing these studies for the present purposes, we once again established a set of requirements that would need to be fulfilled if clear support for the strong causal hypothesis were to be obtained. Some of these requirements concern aspects of the design or methodology of the studies, while others relate to the nature of the findings themselves. Many have been discussed before, in a variety of contexts, by other researchers (e.g. [Bryant & Goswami, 1987](#); [Bus & van Ijzendoorn, 1999](#); [MacMillan, 2002](#); [Troia, 1999](#)).

Our first requirement was that in at least one condition of the study *only* phonological awareness should have been trained. While clearly there are strong theoretical and practical reasons for teaching phonological awareness along with other reading-related skills (e.g. letter–sound correspondences), such designs compromise the ability to infer a direct causal link between phonological awareness as an independent variable and reading as a dependent variable. Our second requirement was that any facilitation from training should not apply only to phonological awareness measures but must transfer to reading-related measures. Without this, we are restricted to the conclusion that training in phonological awareness improves phonological awareness; the link with reading is not established. Our third requirement was that, ideally, the effect on reading should be specific; it should not transfer, or not transfer as much, to other non-reading skills such as mathematical ability. Otherwise, the facilitation could be reflecting improvements in some non-reading-specific skill such as attentional capacity or working memory. Of course, any benefits in reading will eventually carry through to other academic abilities. However, it would seem reasonable to expect that, if the causal effect of phonological awareness is indeed specific to reading, there should be a point in time where the effects on reading are present but *not* the flow-on effects to other academic abilities and that, when those flow-on effects do occur, they should be weaker than those on reading. Our fourth requirement was that this specificity of outcome should also apply to the *nature* of the improvement in reading-related skills. As discussed previously, the hypothesized link between the ability to perceive and manipulate phonemes and reading is via its facilitation of the acquisition of letter–sound correspondences. Improvements from phonemic awareness training should

therefore always be shown on measures of this ability, either on their own, or in addition to improvements in other reading-related measures (which might occur as a flow-on effect from improvement in letter–sound skills). Our final criterion requires that, in those studies that meet the above criteria, it needs to be established that the children who benefited from training had *no* pre-existing reading or spelling skills, since, without this, the effects could be attributable to the implicit reinforcement of such skills during training.

3.1. Was training specific to phonological awareness?

The reading research field has benefited from a proliferation of phonological awareness training studies in recent years, resulting in over 30 published papers. However, as can be seen from [Table 2](#), the number of studies in which instruction was given only in phonological awareness is somewhat smaller. For good reasons, many studies specifically focused on teaching phonological awareness together with letter names and sounds, while others combined the phonological training with a range of other reading and/or writing exercises. We wish to emphasize, once again, that these studies have been highly successful in assisting reading acquisition in normally-developing readers and in serving as an important intervention for poor readers. They demonstrate the highly significant role that alphabetic skills play in the process of reading acquisition (for further discussion, see the report of the US National Reading Panel on the teaching of reading; [National Reading Panel, 2000](#)). However, they cannot be used to evaluate the hypothesis that pure

Table 2
Training studies in phonological awareness and reading acquisition

PA trained with letter names/sounds	PA trained with other reading/writing skills	PA trained alone in at least one condition
Ball (1997)	Goldstein (1976)	Bradley and Bryant (1983, 1985)
Ball and Blachman (1991)	Haddock (1976)	Brady, Fowler, Stone, and Winbury (1994)
Blachman, Ball, Black, and Tangel (1994)	Hohn and Ehri (1983)	Brennan and Ireson (1997)
Bus (1986)	Hurford et al. (1994)	Content, Morais, Alegria, and Bertelson (1982)
Byrne and Fielding-Barnsley (1991, 1995)	Olson, Wise, Ring, and Johnson (1997)	Cunningham (1990)
Lovett, Barron, Forbes, Cuksts, and Steinbach (1994)	Torgesen et al. (1999)	Duncan and Seymour (2000)
Tangel and Blachman (1992)	Vadasy, Jenkins, Antil, Wayne, and O'Connor (1997)	Fox and Routh (1976, 1984)
Whitehurst et al. (1994)	Vandervelden and Siegel (1997)	Hatcher, Hulme, and Ellis (1994)
	Vellutino and Scanlon (1987)	Kozminsky and Kozminsky (1995)
	Williams (1980)	Lie (1991)
	Wise, Ring, and Olson (2000)	Lundberg, Frost, and Petersen (1988)
		O'Connor, Jenkins, Leicester, and Slocum (1993)
		Olofsson and Lundberg (1983, 1985)
		Schneider, Kuespert, Roth, and Vise (1997)
		Schneider, Roth, and Ennemoser (2000)
		Treiman and Baron (1983)
		Torn��us (1984)
		Weiner (1994)

phonological awareness assists reading acquisition. Therefore, for the present purposes, we will not consider these papers further and will focus on those published studies in which at least one condition involved training purely in phonological awareness.

The nature of the phonological awareness training given in these studies varies considerably, both in terms of (a) the manner in which it was taught and (b) the phonological units that were focused on. With regard to (a), some studies have trained children in specific subskills such as blending speech sounds ([Fox & Routh, 1976](#)) or segmenting them ([Rosner, 1974](#)), while others have explicitly compared the success of teaching different types of subskill ([Lie, 1991](#); [O'Connor, Jenkins, Leicester, & Slocum, 1993](#)). However, most have attempted to induce phonological awareness through training in a combination of such skills ([Brennan & Ireson, 1997](#); [Cunningham, 1990](#); [Hatcher, Hulme, & Ellis, 1994](#); [Kozminsky & Kozminsky, 1995](#); [Lundberg, Frost, & Petersen, 1988](#); [Schneider et al., 2000](#); [Treiman & Baron, 1983](#); [Weiner, 1994](#)). Based on the longitudinal data presented earlier showing that these phonological subskills are highly intercorrelated, we will not make a distinction between them for the present purposes.

With regard to (b), some researchers have concentrated specifically on the phoneme level ([Content, Morais, Alegria, & Bertelson, 1982](#); [Cunningham, 1990](#); [Lie, 1991](#); [Weiner, 1994](#)), while many others have trained awareness of syllables ([Brady, Fowler, Stone, & Winbury, 1994](#); [Hatcher et al., 1994](#); [Lundberg et al., 1988](#); [Schneider, Kuespert, Roth, & Vise, 1997](#)) and/or rimes ([Bradley & Bryant, 1983, 1985](#); [Hatcher et al., 1994](#); [Kozminsky & Kozminsky, 1995](#); [Lundberg et al., 1988](#); [Schneider et al., 1997](#)) in addition to phonemes. Ideally, given the present focus on a causal role for phonemic awareness, we would restrict our examination to those studies which instructed children *only* at the level of phonemes. However, many of the most substantial and carefully-conducted training studies in the field have included training at the syllable or rime level as well as the phoneme level, and to exclude these studies altogether on this basis seems unreasonable. As well, we have good reason to believe, based on the longitudinal data, that training in higher level units would be unlikely to produce significant effects (also borne out by the meta-analysis of [MacMillan, 2002](#)). So, instead, we have chosen to include for consideration all studies that included *at least one* phonemic training task in their battery, with the caveat that, in some cases, the specificity of any effects to phonemic awareness training will not have been conclusively established. For clarity, we will refer to those studies that trained phonemes plus other sound units as having conducted *phonological* awareness training, and those that trained only phonemes as having conducted *phonemic* awareness training, even though in both cases our focus of interest is at the phonemic level. Studies that involved training only in higher level units (e.g. [Duncan & Seymour, 2000](#)) have been excluded from further examination.

3.2. *Did the effects of training transfer to reading or spelling?*

Some of the studies referred to above were specifically concerned with the successful training of phonological awareness itself and so did not examine transfer to reading or spelling skills ([Content et al., 1982](#); [O'Connor et al., 1993](#); [Olofsson & Lundberg, 1983](#)). Therefore, although of interest, these studies cannot assist in exploring the link between

phonemic awareness and reading. Let us turn then to those studies that specifically included reading and/or spelling tasks as outcome measures.

The first major study that examined transfer to reading and spelling was that of [Bradley and Bryant \(1985\)](#) who trained 5- to 7-year-old children on phonological awareness using sound categorization tasks.² In one condition, the children received the training in the absence of any written material. In a second, “concrete sound categorization” condition, the children received the same training but in the presence of plastic letters, which could be manipulated to illustrate shared sounds among words. Bradley and Bryant found significant transfer of their training to reading and spelling performance for the latter group but not for the former. As discussed at length in previous reviews (e.g. [Wagner & Torgesen, 1987](#)), these findings certainly illustrate that phonological awareness training together with training in letter–sound correspondences enhances reading and spelling development, but they do not establish the efficacy of phonological awareness training on its own. As well, given there was no condition in which letter–sound correspondences were trained in the absence of sound categorization, it is not possible to determine which of the two was responsible for producing the effects.

The Bradley and Bryant study is certainly not alone in finding no transfer of pure phonological awareness training to reading and spelling measures. [Olofsson and Lundberg \(1985\)](#) trained kindergarten children for 6–8 weeks in rhyme, segmentation and blending. The children who participated in the training significantly outperformed control children on a phoneme blending test, but the effects on reading skills were non-significant. [Weiner \(1994\)](#) attempted to train low- and middle-achieving readers from first grade on a range of phonemic tasks for a similar period, with some children receiving the phonemic awareness training on its own and others receiving it in combination with instruction in word and nonword reading. Although all of the training groups significantly outperformed a control group on a subsequent measure of phoneme segmentation ability, there were no significant transfer effects to any other measures of phonemic awareness or to measures of word or nonword reading ability. [Hatcher et al. \(1994\)](#) also compared training in phonological awareness alone with conditions in which 7-year-old children received instruction in either reading alone or in both reading and phonological awareness. Although various transfer effects were found in the two conditions that included reading instruction, the phonological awareness alone group did not differ significantly from the control group on any measure of reading (including word reading, nonword reading and comprehension) or spelling. [Brady et al. \(1994\)](#) found that kindergarten children who received an 18 week training programme in metaphonological skills made significantly greater gains in phonological awareness than a control group but showed only a non-significant trend towards better reading skills. Finally, [Brennan and Ireson \(1997\)](#) found that a kindergarten programme that included explicit training in phonemic awareness produced better scores on various phonemic tests than a control programme that contained only incidental phonemic awareness instruction, but that it did not produce significantly better reading or spelling scores.

Other studies have found no effects of training overall, but have reported some transfer to reading-related skills in particular subsets of their samples. [Torn  us \(1984;](#)

² Although this study primarily focused on rhymes, onsets were trained as well, making the data potentially relevant to phonemic awareness.

[Experiment 2](#)) found that a group of first grade children trained on phoneme segmentation and blending for approximately 8 weeks outperformed a control group on various phonemic awareness measures, but showed no significant advantage on either reading or spelling tests. However, a subset of the sample who had shown the lowest pretest scores on the phonemic measures did show significant improvements over the control group (although only in spelling). While potentially of interest for the treatment of at-risk children, this finding needs to be interpreted with caution, since only eight of the original 38 trained children were included in the subgroup and there was no *a priori* rationale for applying the criteria that were used to select them. As well, this finding seems somewhat at odds with the results of [Fox and Routh \(1976\)](#), who also found training effects only in a subset of their sample. In the Fox and Routh study, 20 4-year-old children who were above average at segmenting showed significant transfer of blending training to the reading of new words, while 20 children who were below average showed no such effects. So in this case, it was the children who were initially *good* at phonemic analysis that benefited from training. Finally, [Schneider et al. \(1997; Study 1\)](#) found beneficial effects of a 6-month kindergarten metalinguistic training programme on first grade reading and spelling performance, but only for the subset of children who appeared to have received the most consistent training. Although interesting and important, all of these sub-sample results need to be considered against the background of findings of no significant training effects overall.

In some cases, the experimental design of a training study does not allow the effects of phonemic awareness training on reading-related abilities to be determined. In their recent study, [Schneider et al. \(2000\)](#) compared the reading and spelling performance of a reading-impaired group who received training only in phonological awareness with groups who received training either only in letter–sound correspondences or in both phonological awareness and letter–sound correspondences. The combined training group performed significantly better on spelling (but not reading) than both of the other two groups, but the two pure training groups did not differ from each other on any reading-related measure. This result argues in some ways against the efficacy of pure phonological awareness training, as those instructed in these skills on their own fared no better than those instructed about links between letters and sounds. However, the actual effect on reading of the pure phonological awareness training cannot be established, as a reading-impaired control condition that received training in neither skill was not included. Although the fact that the combined training group did better on spelling than the pure letter–sound group could be seen as arguing for a specific effect of phonological awareness training, this could, as [Olson \(in press\)](#) points out, be due to the fact that the combined group received double the amount of training overall.

In contrast to these less conclusive findings, there are several reports of successful transfer of phonemic awareness training to reading-related measures, with significant group differences being found between treatment and control conditions ([Cunningham, 1990](#); [Fox & Routh, 1984](#); [Kozminsky & Kozminsky, 1995](#); [Lie, 1991](#); [Lundberg et al., 1988](#); [Schneider et al., 1997; Study 2](#); [Treiman & Baron, 1983](#)). We will therefore consider these studies in more detail, examining them in relation to the other requirements we have identified for establishing a causal link between phonemic awareness and reading and spelling acquisition.

3.3. Were the training effects specific to reading or spelling?

A definitive demonstration of a direct causal relationship between phonemic awareness and reading would require, not just that training in phonemic awareness improve reading-related skills, but also that it improve *only* reading-related skills. Several of the successful training studies did not include conditions that allow this question to be directly addressed. [Cunningham's \(1990\)](#) study was concerned primarily with examining the difference between explicit metalinguistic training and a more implicit “skill and drill” approach to instruction. She found significant transfer of both types of training to reading performance in kindergarten, but only effects for the explicit training in first grade. However, given that no outcome measures other than phonemic awareness and reading achievement scores were included, it is not possible to assess whether the training, and particularly the explicit metalinguistic instruction, may have been stimulating the development of more general learning abilities in the children (an aptitude test was given at pre-test but not repeated at post-test). Similar points can be made about the studies of [Lie \(1991\)](#) and [Kozminsky and Kozminsky \(1995\)](#). The Lie study focused on comparing the benefits of phoneme isolation or “positional” treatment with those of phoneme segmentation or “sequential” treatment. Both types of training produced significant transfer to reading and spelling performance in first grade children, but no non-reading-related outcome measures were included. Kozminsky and Kozminsky found that an 8-month kindergarten training programme in a battery of phonological awareness skills produced significant advantages in reading comprehension in first and third grade, but, again, the degree to which these advantages were specific to reading cannot be determined.

Two large-scale studies, however, have directly tested the hypothesis of specificity to reading-related skills. [Lundberg et al. \(1988\)](#) gave Danish pre-school children daily training in a combination of phonological awareness skills over a period of 8 months. When the children were assessed in first and second grade, they showed significant improvements in phonological awareness and in reading and spelling performance but, importantly, showed no significant effects on mathematics or on functional linguistic skills such as comprehension of oral instructions or vocabulary. [Schneider et al. \(1997; Study 2\)](#) followed this up by examining whether phonological awareness training generalized to other phonological processing skills such as phonological working memory or speed of lexical access. Once again, after training German kindergartners for 6 months on a battery of phonological awareness skills, they found improvements in tests of phonological awareness, reading and spelling at the end of first and second grade, but no improvements in the other phonological processing measures or in vocabulary or letter knowledge. Therefore, although it has rarely been assessed directly, a specific relationship between phonological awareness training and reading does seem to be demonstrable. As well, although neither of the above studies conducted pure *phonemic* awareness training, it would seem likely from our previous analysis that awareness of units of this size would have produced the effects.

3.4. Did the training affect the acquisition of letter–sound relationships?

The strongest test of the causal link between phonemic awareness and reading would require that the particular reading processes affected by training should be those that are

hypothesized to benefit from the growth in awareness of speech sounds. As outlined earlier, these processes have most frequently been proposed to be alphabetic, or letter–sound conversion skills (e.g. [Gough & Hillinger, 1980](#); [Treiman & Baron, 1981](#)). However, other somewhat different mechanisms can also be proposed, such as the idea that phonemic awareness may be involved in the formation of the segmental phonological representations that are a foundation of a phonological and semantic reading system ([Harm and Seidenberg, 2001](#)). Therefore, although we focus on evidence for a link with alphabetic skills in this section, we have not ruled out any studies from consideration on the basis of *not* documenting such a link and we do not preclude the possibility that the influence of phonemic awareness may operate by an alternative causal mechanism.

Alphabetic skills, or the links between orthographic and phonological units, can be specifically assessed by nonword reading tests, or by reading-analogue tasks, in which new letter–sound links must be learned. Therefore, we would argue that, ideally, training in phonological awareness should improve children’s subsequent ability on tasks such as these. In proposing this, we differ from [Bryant and Goswami \(1987\)](#), who argue that the appropriate outcome measure in training studies is a “genuine test of reading” (p. 214) consisting of real words. Our view is that a nonword reading test or a reading analogue task is a perfectly genuine test of reading if the process of interest is letter–sound conversion. And we would argue that ecological validity is not sacrificed either, since many of the real words with which beginning readers are confronted are effectively nonwords to them anyway. Therefore, we will now examine to what extent the specificity of the relationship to alphabetic skill acquisition has been established in the successful phonemic training studies.

Again, much of the data available do not allow us to directly assess this question. In some cases, the literacy measures used were composite scores from standardized tests tapping a range of skills, so the specific influence on particular subskills cannot be determined (e.g. [Cunningham, 1990](#)). In others, measures of comprehension were used, which again may reflect the functioning of a combination of reading subskills ([Kozminsky & Kozminsky, 1995](#); [Lie, 1991](#); [Lundberg et al., 1988](#); [Schneider et al., 1997](#)). A further complicating factor is that many of the successful training studies were conducted in countries with relatively transparent orthographies, such as Denmark and Germany. Here, it can be much more difficult to construct tests that distinguish between different components of the reading process than is the case with deeper orthographies such as English.

This difficulty is exemplified by the reading tests used in the [Lundberg et al. \(1988\)](#) and [Schneider et al. \(1997\)](#) studies. These two studies used similar tests, in which children were required to pick a picture from three or four alternatives that matched presented written words. Reading performance was expressed as the number of correct responses during a set time period. As all of the words would have been relatively regular in these languages, increased scores here could reflect improved letter–sound translation skills or improved word-level lexical processing. As well, in the Lundberg et al. study, only a total correct score is given, so it is not possible to determine whether the children who were performing better did so because they completed more items but made the same proportion of errors as the children performing worse, or because they completed the same number of items but made

a smaller proportion of errors. To be able to examine these components separately may assist in identifying the precise locus of the beneficial effects found in this important study.

A direct relationship between phonemic awareness and letter–sound translation has been established much more effectively by the carefully controlled experimental studies of [Treiman and Baron \(1983\)](#) and [Fox and Routh \(1984\)](#). Treiman and Baron used a within-subjects design, in which kindergartners received segmenting and blending training on one set of spoken syllables and were simply instructed to repeat a second set of syllables. The children were then introduced to printed items that corresponded to these spoken syllables. In one condition, the pronunciation of the syllables could be deduced from those of other printed items in the set (e.g. the pronunciation of “HEM” could be deduced from having learned the pronunciations of “H” and “EM”), while in the other condition it could not. A significant interaction between instruction type and item type was found, suggesting that children were better able to learn spelling–sound relations for syllables that had been phonemically analyzed than for those which had not. In a similar vein, [Fox and Routh \(1984\)](#) found that ten kindergarten children who had received segmenting and blending training performed better on a subsequent reading-analogue task (involving paired-associate learning of letter-like forms and words) than did either a control group, which had received no training, or a segmenting-only group.

In summary, evidence can be found that phonemic awareness training is specific to reading-related skills and that it is associated with the acquisition of letter–sound correspondences. However, this evidence must be drawn together from a range of sources. The two studies that have established most convincingly the specificity of phonological awareness to reading-related abilities ([Lundberg et al., 1988](#); [Schneider et al., 1997](#)) have not been so illuminating as to the particular aspects of reading that are benefited, and have not established specificity to purely phonemic training. Conversely, the two studies that have drawn close links between phonemic awareness and the acquisition of alphabetic skills have tended to be narrower in scope and not to have addressed issues of specificity (e.g. [Fox & Routh, 1984](#); [Treiman & Baron, 1983](#)). Nevertheless, given their combined success on the criteria so far, we will now examine these four studies in relation to our final criterion.

3.5. *Did the children have no pre-existing reading or spelling skills?*

Although *explicit* reading instruction was not given as part of the training in any of the above studies, there remains the possibility that some implicit reinforcement of pre-existing reading skills may have been provided by the phonemic awareness instruction. As [Lundberg et al. \(1988\)](#) have also noted, once a certain level of reading ability has been acquired, there is the potential for this ability to interact with phonemic awareness training in a range of ways.

We can identify two ways in particular in which this implicit reinforcement of reading-related skills might occur. The first operates at the whole word level: children who have certain words in their sight vocabularies might visualize and reflect upon the spellings of those words when they are presented to them aurally during phonological awareness training. As is clear from the study by [Tunmer and Nesdale \(1985\)](#) described previously,

even very young children show influences of written-word knowledge on their responses to purely sound-based tasks. If children are able to invoke the spellings of even some of the words that they hear during phonemic awareness training, this could assist them in strengthening links between the spoken and written forms of those words and subsequently both in reading and spelling those words in follow-up tests. As well, it could assist them in inducing relationships between frequently occurring spelling patterns and their pronunciations, thus generalizing to other written words. Such effects of training would not be purely phonemic, but would reflect the formation and reinforcement of links between spoken words and their written forms.

A second way that phonemic awareness training could implicitly reinforce pre-existing reading-related skills is at the sublexical level. Children who have some knowledge of sound–letter relationships (presumably quite a large proportion if the children are of school age) may rehearse such relationships in a phonemic awareness task. For example, although being instructed only to segment phonemes, they may retrieve the corresponding letters mentally and manipulate both in the segmentation process, thus reinforcing the connection between them. Given that, in most cases, there will be a direct correspondence between sounds to be acted upon and individual letters, the children might even adopt a letter-based strategy to assist in performing the tasks (consistent with the findings of [Stuart, 1990](#)). Some indirect support for the idea that reading-related skills may be being implicitly trained in this way comes from the results of the study by [Cunningham \(1990\)](#). She found much stronger effects of training in groups of kindergarten and first grade children when phonemic awareness instruction was given in a metalinguistic context where the “skill was taught and linked explicitly ... to the activity of reading” (p. 435) than when the link with reading was not made apparent. It is possible that emphasizing this link encouraged these children to draw on any early literacy skills they had and to strengthen connections between the sounds being taught and the letters that they knew.

Given these possibilities, we feel that, on the most stringent test of the causal link hypothesis, it is not sufficient simply to *match* treatment and control groups on pre-existing reading and spelling abilities. For even if the groups are matched, the phonemically trained group may receive reinforcement of their reading and spelling skills through the course of their training that the control group do not. Rather, we would argue that reading and spelling skills should be pre-tested and those subjects with any knowledge excluded. What knowledge should be tested for specifically? The lexical level effects described above would require that the subjects not be able to read aloud or spell any of the words in the test set. The sublexical level effects would require that they could not produce the letter corresponding to any spoken sound or produce the sound corresponding to any written letter. We will now examine our four remaining studies in relation to this requirement.

[Treiman and Baron \(1983\)](#) appear to have ensured that no effects could be occurring at the lexical level. Firstly, any child in their participant group (averaging about 5 years old) who could read any of the items was disqualified. Secondly, the training items were all nonwords, so any lexically-based reading reinforcement would have been precluded. However, no information is provided about whether any of the children knew any correspondences between letters and sounds, or between sounds and letters, so some reinforcement of this knowledge in the analysis condition (but not the control condition)

cannot be ruled out. Sublexical reinforcement effects also cannot be ruled out in [Fox and Routh's \(1984\)](#) study. They matched their training and control groups on performance on the *Reading Recognition* subtest of the *Peabody Individual Achievement Test*, but did not exclude children who scored above zero. As this subtest assesses knowledge of letter names and sounds, as well as single word reading, and the children scored an average of about 60 (out of a possible 100), it is clear that they had some pre-existing reading and spelling skills.

The reading and spelling skills of the children in the [Lundberg et al. \(1988\)](#) and [Schneider et al. \(1997; Study 2\)](#) studies were much more limited. Indeed, to train children prior to their acquisition of these skills was a stated aim of both studies. The children appeared to have virtually no pre-existing lexical skills: in neither study could they read aloud any simple short words. In relation to sublexical skills, letter–sound and sound–letter knowledge was not directly assessed, but in both studies children's recognition of letters was tested (by asking for the names of all 26 presented letters). It would seem reasonable to assume that children who do not recognize a particular letter will not know anything about its correspondence with a sound. In both cases, the children were found to recognize about 4–5 letters on average. While these two studies come closest to meeting our fifth criterion, the requirement that children with *any* reading and spelling skills be excluded was not strictly fulfilled. Although the children recognized only about 4.5 letters on average, the standard deviations were quite high (between 5 and 7). Therefore, some children in the samples must have known substantial numbers of letter names (and possibly letter sounds) and the mean training effect might have been coming from that subgroup of children. It would be extremely informative to examine whether the significant training effects reported in these two studies persist when children with letter recognition scores above zero are removed.

3.6. Summary

In summary, on the basis of our review of the training study literature, what are we to conclude about the demonstration of a direct causal link from the ability to perceive and manipulate the most basic units of spoken language to the acquisition of alphabetic reading skills? If the stringent criteria for establishing causality that we established at the outset are applied, we feel that it must be concluded that no single study has conclusively established that phonemic awareness training assists reading or spelling acquisition. While the studies of [Lundberg et al. \(1988\)](#) and [Schneider et al. \(1997\)](#) come closest to doing so, their positive results cannot establish causality unequivocally until it is shown that they are still obtained when children with above-zero reading and spelling skills are removed from the sample. As well, it would be preferable to demonstrate the same results after pure phonemic awareness training, rather than after training in a range of speech units.

In reaching this conclusion, we do not wish to undermine the value of these training studies from a wide range of research and educational standpoints, or to conclude that a causal link between the variables in question definitely does *not* exist. We simply wish to argue that alternative accounts need to be completely excluded if claims of a causal link between phonological awareness and literacy acquisition are to continue to be made, and that such alternative accounts have not yet been completely excluded. We also wish to

emphasize once again that the evidence for the value of teaching *letter–sound correspondences* is overwhelming. There would appear to be no question that assisting children in their mastery of the alphabetic principle provides them with a key tool for acquiring literacy; the questions we raise concern only whether there is evidence that teaching an explicit awareness of phonemes in isolation from graphemes assists reading acquisition.

4. Discussion

In this review, we sought to scrutinize the huge and varied body of research on phonological awareness and literacy acquisition in the context of a single, fairly specific question: Does phonological awareness encompass a set of purely spoken language skills that precede and directly affect the process of reading and spelling acquisition? We felt that this question deserved re-examination given that, in our view, the major significance of phonological awareness lies in its status as a possible non-reading precursor to reading and spelling acquisition. To the extent that phonological awareness fulfils this role, it may provide the much sought-after link between spoken and written language acquisition; to the extent that it does not do so, it must be thought of as one of the many interesting, but not necessarily causally-connected, cognitive correlates of reading and spelling achievement.

Of course, we are not alone in being interested in the possible causal role played by phonological awareness in reading and spelling acquisition. Indeed, many theorists have specifically posed the question of whether phonological awareness causes literacy acquisition, literacy acquisition causes phonological awareness, or whether the two share a reciprocal causal relationship (e.g. [Perfetti et al., 1987](#); [Wagner et al., 1994](#)). However, all of the possibilities above still assume a causal link between phonological awareness and reading in one direction or another. We have been at pains to emphasize in the present review that it is also possible that at least some of the documented association between phonological awareness and reading may not reflect a causal relation in either direction. Instead, it may reflect the fact that, once children acquire reading and spelling skills, they change *the way in which they perform phonological awareness tasks*, using their orthographic skills, either in addition to or instead of their phonological skills, to arrive at a solution (see also [Castles et al., 2003](#)). So, on this account, the ability to perceive and manipulate the sounds of spoken language does not assist literacy acquisition, nor does the acquisition of reading and spelling ability affect phonological awareness. Rather, the association between the two arises because both are, to a greater or lesser degree, indices of orthographic skill. For this reason, we have argued that it is vitally important that studies of the casual relationship between phonological awareness and reading and spelling acquisition control for pre-existing literacy skills in their participants.

We began by examining longitudinal correlational studies. As research designs of this type cannot, by definition, establish causality, we used them instead to refine hypotheses about what the nature of any causal relationship between phonological awareness and literacy acquisition might be. Our analysis indicated that the ability to perceive and manipulate phonemes (in both segmenting and blending tasks) is the aspect of

phonological awareness that is most strongly predictive of later reading and spelling success. In fact, we found little support for any significant independent predictive role for syllable or rhyme awareness, at least on the initial stages of reading and spelling acquisition.

The specific causal hypothesis that the ability to perceive, segment and blend phonemes assists the acquisition of sublexical reading and spelling skills was then put to the test in the examination of experimental training studies. To our surprise, we found that, once explicit criteria for establishing a causal link between the two variables were set, there were relatively few studies that provided direct evidence for such a connection. In fact, no single study established definitively that the stimulation of phonemic awareness in completely pre-literate children resulted in them subsequently acquiring specifically alphabetic reading or spelling skills better than children who did not receive such training.

Of course, the conclusion that no one study has definitively established such a link does not mean that it does not exist. And certainly there are many studies that are strongly suggestive of a causal connection ([Fox & Routh, 1984](#); [Lundberg et al., 1988](#); [Schneider et al., 1997](#); [Treiman & Baron, 1983](#)). How then might we confirm these suggestive findings? In our view, a study with the following basic features might settle the issue: pre-school children would be selected and pretested for (a) their knowledge of the sounds that correspond with all the letters of the alphabet, (b) their knowledge of the letters that correspond with all the sounds of the alphabet, and (c) their ability to read aloud all of the words in the training and test sets. Those children who had any such knowledge whatsoever would be removed from the sample. The remaining children would then be randomly allocated to experimental and control groups, the former of which would be trained on perceiving, segmenting and blending phonemes, and the latter of which would receive training of a different nature, but of comparable difficulty, on the same items. After receiving the phonemic awareness training, the children in the two groups would then begin to be taught grapheme–phoneme correspondences. If the phonemically-trained group were found to acquire grapheme–phoneme correspondences at a faster rate than the untrained group, this would provide strong evidence for a causal link between pre-literate phonological awareness and sublexical reading acquisition. Although experimental control would be compromised at this point, it would then be informative to follow the children's progress on entering school, testing them regularly on their phonemic awareness, their reading and spelling of both nonwords and irregular words, and their performance on an unrelated task such as mathematical reasoning. Continued support for our causal hypothesis would be provided if the trained children performed significantly better than the control group on phonemic awareness and nonword reading or spelling, but not mathematical reasoning. Irregular word reading might also differ significantly between the groups, reflecting the use of newly acquired alphabetic skills as a self-teaching mechanism ([Share, 1995](#)), but the difference between the groups should not be as great as for nonword reading.³

In proposing a study such as this, a practical issue arises. Is it actually possible to identify children who are young enough to have no literacy skills at all but who are still

³ Our proposal here is purely theoretically-driven, and does not take into account potential ethical issues involved with conducting such research. Ethics committees, concerned about long assessment batteries, and focused on maximizing the benefit to the child, may potentially object to some aspects of this design.

capable of being assessed and trained on phonemic awareness? Indeed, it may well be that such children do not exist. Johnston, Anderson, and Holligan (1996) examined the frequency of children exhibiting phonemic awareness as a function of their alphabet knowledge. They found that, of the seven children in their sample who had no alphabetic knowledge at all, only one had any phonemic awareness, and he was a child who refused to attempt the alphabet tasks. The other six children who knew no letters of the alphabet never deleted or segmented a phoneme correctly in any of the tasks they were administered. Stahl and Murray (1994) and Wimmer et al. (1991) have also noted that phonemic awareness is rarely in evidence in children prior to their having any alphabetic skills. On the positive side, however, the fact that children do not generally have such skills prior to literacy does not mean that they cannot be trained, and the painstaking efforts of researchers such as Byrne and Fielding-Barnsley (1991, 1995) suggest that such training may indeed be possible in these very young children. Given that attempting to train phonemic awareness in older poor readers, with potentially impaired phonological systems, is arguably not a fair way of testing our causal hypothesis, more work of this nature would seem strongly to be called for.

Aside from the difficulties it poses for our proposed study, the finding that phonemic awareness skills are rarely in evidence in the absence of alphabetic skills would seem to raise a broader question. Given that completely pre-literate children appear not to have any phonemic awareness, and given that even early readers show orthographic influences on phonemic awareness task performance (Tunmer & Nesdale, 1985), what evidence is there that phonemic awareness *ever* exists as a separate pure language skill, independent of the graphemic knowledge to which it is linked? One might instead propose that the explicit awareness of a particular phoneme is only ever gained at the point at which its connection with a corresponding grapheme is formed. To make such a proposal is not greatly divergent from some current theories about the role of phonemic awareness in reading acquisition. Hatcher et al. (1994) have proposed the *phonological linkage* hypothesis, in which they argue that training in phonological skills is most effective when provided in the context of explicit links between children's orthographic and phonological representations. Similarly, Byrne and Fielding-Barnsley (1991) have provided evidence that both phoneme awareness and knowledge of letter identity are needed in order for children to grasp the alphabetic principle. Also in a sympathetic vein, Ehri and Soffer (1999) have emphasized the term *graphophonemic awareness* as opposed to purely phonemic awareness. We would go beyond these theorists in suggesting that it may not be possible for phonemic awareness to be acquired at all in the absence of instruction on the links between phonemes and graphemes.

Of course, some ability to perceive and parse phonemes is necessary for basic speech perception, and this ability is clearly acquired in children prior to reading and spelling acquisition. However, here we must make the distinction, made also by several others, between implicit and explicit awareness of phonological units (e.g. Ball, 1997; Cunningham, 1990; Ellis & Cataldo, 1990; Hatcher & Hulme, 1999). Although some implicit perception of phonemes is a precondition of spoken language acquisition, we would argue that the explicit awareness of this information is an independent skill which may be both unnecessary for, and independent from, the implicit knowledge. Such a distinction does not seem unreasonable: we would not, for example, automatically

propose that children must possess “graphemic awareness” on the basis of the fact that they can read aloud nonwords, even though clearly the ability to parse graphemes is a prerequisite for success on this task. In an article which raises many similar issues to those raised in the present paper, [Marshall and Cossu \(1991\)](#) draw this distinction nicely:

Our point ... is that there is a crucial difference between acquiring grapheme–phoneme (phoneme–grapheme) transcoding skills internal to a dedicated, “automatic” and partially encapsulated module, and having conscious access to a level of representation within that module ... The former are part of the ontology of literacy; the latter capacity is irrelevant. (p. 137)

The hypothesis that *explicit* phonemic awareness may not exist independently of graphemic knowledge also relies on making a distinction, made previously in this paper, between phonemic awareness as a *task* and phonemic awareness as a *process*. It would seem to be clear that some skill or set of skills tapped by phonemic awareness tasks is closely related to reading acquisition, and that those who do not read well are lacking in the same skill or set of skills. The question at issue concerns precisely what the skills are that are being tapped and, specifically, whether they necessarily include such a process as explicit phoneme awareness, with its own distinct psychological reality.

How might one adjudicate between a theory of reading acquisition in which phonemic awareness is a pre-existing skill that is then used to assist the formation of links with graphemes, and one in which explicit awareness of phonemes is acquired only at the point at which their link with graphemes is learned, and not before? It is likely that the window of time in which these two possibilities will be distinguishable will be very small. One clear prediction, however, is that knowledge of letter–sound connections, and possibly letter names in those cases where the name of a letter is very similar to its sound (e.g. “b” or “l”), will be at least as good, or even a better predictor of subsequent reading and spelling achievement than phonemic awareness on its own. There is considerable evidence that this is the case ([Bond & Dykstra, 1967](#); [Burgess & Lonigan, 1998](#); [Chall, 1967](#); [Muter et al., 1998](#); [Share, Jorm, Maclean, & Matthews, 1984](#); [Stuart, 1995](#)). A second prediction might be that item-based effects in phonemic awareness should be demonstrable: children may be able to perform phonemic manipulations on those sounds for which they know the corresponding letter, but may not be able to do so for those sounds for which they have not yet acquired a graphemic link. To our knowledge, such a prediction has not yet been empirically tested (although the data may be derivable from [Byrne and Fielding-Barnsley \(1991\)](#) if the children in that study who knew no letters could be selected out for closer examination).

In conclusion, then, our contention is as follows: while it is possible to design and carry out a study which could provide unequivocal evidence that there is a causal link from competence in phonological awareness to success in reading and spelling acquisition, we do not think that such a study exists in the literature. We hope that this review will provide the stimulus for just such a study.

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