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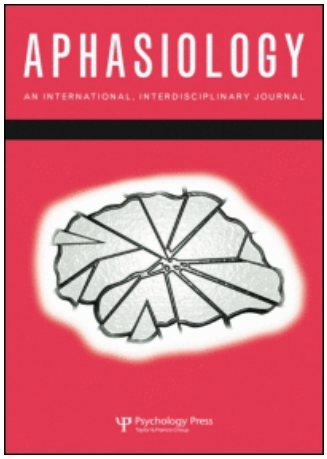

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Towards theory-driven therapies for aphasic verb impairments: A review of current theory and practice

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Review

Towards theory-driven therapies for aphasic verb impairments: A review of current theory and practice

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Background: This review is intended for both theoretically and clinically motivated audiences with an interest in aphasic verb impairments.
Aims: Building from previous reviews, our aim is to provide a concise summary of the relevant theoretical research and perspectives on verbs, and from this theoretical foundation to explore which aspects have been incorporated and tested in therapy studies.
Main Contribution: In the theoretical domain, the review first considers the patterns of verb and noun impairments in aphasic syndromes. Second, an overview of the linguistic differences between verbs and nouns is provided, differences that occur at various levels of linguistic analysis: phonological, morphological, semantic, and syntactic. This is followed by a detailed account of the psycholinguistic perspective on verb–noun differences. Specifically, this section examines the role of variables such as imageability and frequency, and the issue of depiction of actions in static picture versus dynamic video format. Evidence from neuroimaging studies as well as neurodegenerative conditions such as semantic dementia is also reviewed. Finally, the psycholinguistic account further discusses the question of whether verbs (and nouns) serve as primary ordering principles in the cognitive architecture of language processing or whether they should be more accurately viewed as points on an overarching psycholinguistic continuum. Also within the psycholinguistic discussion, event perception is described as a theoretical account with implications for verb processing. Despite the importance of verbs in their pivotal role in connected speech, there is a very limited body of literature on verb therapies and only a small number of the theoretical issues/perspectives have penetrated approaches to treating verb impairments. Ten published papers are described. Two of these directly compare verb and noun therapies, reflecting the many comparisons of noun vs verb impairments in the theoretical literature. The remaining eight consist of purely verb-focused therapies, which also examined the effects of increased verb retrieval skills on related sentence production (reflecting the pivotal role of verbs in connected speech). These eight studies are subdivided between four that targeted verb retrieval only and four that also investigated aspects of verb argument structure and sentence production.
Conclusions: The general discussion notes possible new approaches to the treatment of verb deficits that arise from the many factors noted in the theoretical literature which are yet to be fully explored in therapy studies.

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A substantial body of aphasia research—both investigating the nature of deficits shown by people with aphasia and studies of therapies—has focused on anomia and, specifically, on noun production or object naming. Some attention, although considerably less, has been paid to verb production and action naming. This is, perhaps, somewhat surprising given (a) that verbs tend to be morphologically richer than nouns and (b) that verbs play a pivotal role in sentence production and thus connected speech. Consequently, there are clear and strong theoretical and clinical motivations for improving our understanding of the processes and representations underlying verbs, as well as using this knowledge to improve interventions for verb production and connected speech.

The principal goals for this review are, therefore, to summarise theoretical research and perspectives but then to use this information as a backdrop to the few verb therapies published in the literature. Accordingly, the review is split into two sections reflecting each of these aims. These aims have not been previously explored in other reviews. However, reviews of closely related topics have been carried out. In particular, previous reviews have documented the role of verbs and nouns within aphasiology (Druks, 2002) and investigated the mapping hypothesis and mapping therapies (mapping between the semantic and syntactic levels of the nouns in verbs' argument structure: Marshall, 1995).

THE NATURE OF VERBS

Verbs and nouns: Patterns of impairments in aphasia

A considerable amount of effort has been expended on comparing verb performance against other word types in people with aphasia—both for aphasia classification systems and theoretical explorations. This work has tended to examine selective impairments between major content-word classes on the one hand (nouns, verbs, adjectives) and minor word classes such as grammatical function words (determiners, prepositions, pronouns) on the other (Berndt, Mitchum, Haendiges & Sandson, 1997). Relative impairments within the major class of content words, particularly between nouns and verbs, have also proved a useful descriptive and diagnostic tool in aphasiology. The early Boston aphasia classification system, for instance, included the relative profile of nouns and verbs as one of the criteria for defined aphasia syndromes (Goodglass & Kaplan, 1983). Much of the contemporary literature continues to use the Boston classification in describing profiles of noun and verb patterns in aphasic speech. For example, in agrammatism, a subtype of nonfluent Broca's aphasia characterised by absent or reduced use of function words (e.g., articles and prepositions: Morris, 1988), patients' speech exhibits a lower rate of verbs than nouns, as well as a reduced number of function words and grammatical inflections as the term suggests (Miceli, Silveri, Villa, & Carramazza, 1984).

The relationship between noun–verb production and aphasia classification is not absolute, however. In Berndt et al.'s (1997) comprehensive analysis of 11 participants' comprehension and production of nouns and verbs, three of the five verb-poorer speakers were agrammatic and nonfluent as expected. Two of the five, however, displayed symptoms of Wernicke's aphasia (an aphasic disorder marked particularly by a comprehension deficit, with fluent speech but often jargon-like content: Morris, 1988). Berndt et al. also noted that one of their participants who showed no difference between noun and verb production was classically agrammatic.

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As we will review below, verbs relative to other word types have a number of intrinsic factors that make them more vulnerable to impairment: English verbs "carry" more complex grammatical morphology compared to nouns, and are less rich semantically (lower imageability, etc.). Despite this, some people with aphasia show strong verb performance relative to nouns (e.g., Breedin, Saffran, & Coslett, 1994; Zingeser & Berndt, 1988). This then raises the question of the proportions of people with aphasia who show relative verb over noun, or noun over verb impairments. This was the aim of the comprehensive study conducted by Luzzatti, Raggi, Zonca, Pistarini, Contardi, and Pinna (2001). They tested 58 Italian people with mild-to-moderate aphasia on an array of object- and action-naming tasks. Nouns and verbs were elicited by picture naming and the picture materials were controlled for word frequency, age of acquisition, familiarity, and imageability. At the group level, Luzzatti et al. found that there was no significant difference in noun vs verb impairments in the fluent aphasic participants. Naming was significantly worse for verbs than nouns in the nonfluent participants as a whole and for agrammatic speakers in particular. However, at the single case level a more complex picture emerged from this study: 26 aphasic speakers (45% of the whole group) showed noun–verb dissociations, with 20 performing more poorly with verbs and 6 exhibiting the reverse pattern. Five of the six agrammatic speakers showed more impaired verb naming as expected. The pattern for the fluent cases was more mixed. Of the 13 anomic participants, 2 had a relative verb deficit and 5 were worse with nouns. From the Wernicke's group of 23 participants, 7 showed a noun superiority and 1 had better performance on verbs. When frequency and imageability effects were partialled out, noun–verb differences were removed for 18 of the original 26 who showed a dissociation. Noun superiority remained for five participants and verb superiority for three.

Overall, Luzzatti et al.'s study provides an accurate summary of the findings found elsewhere in the literature. Relative performance in noun and verb naming corresponds loosely with aphasia classification; nonfluent aphasic speakers show a fairly strong tendency to perform more poorly in verb naming, while performance is more mixed in fluent aphasia (anomic and Wernicke's) with a weaker propensity for them to be worse with nouns The study also highlights the danger of regarding verbs as a unitary lexical class in that relative strengths and weaknesses for particular types of verbs were found. In particular, nonfluent participants had more difficulty with ergative verbs (i.e., verbs whose patient is the subject, e.g., "I understand" or "I see") than intransitive verbs (i.e., verbs with just one argument, that of the subject as agent, e.g., "he sneezed" or "they escaped"). This latter point echoes previous findings: Thompson, Shapiro, Ballard, Jacobs, Schneider, and Tait (1997b) found that their group of agrammatic participants had greater difficulty producing verbs with more arguments, while Jonkers and Bastiannse (1996) found a double dissociation between naming transitive and intransitive verbs. Likewise nouns and verbs vary on a range of different linguistic and psycholinguistic factors, which can account for the noun–verb differences in a large proportion of participants. Whether or not these variables are the cause of the patients' noun–verb differences is a matter of debate in the literature (see Berndt, Haendiges, Burton, & Mitchum, 2002; Bird, Howard, & Franklin, 2003; Shapiro & Carramazza, 2003), but the fact that verbs vary across these factors may provide important pointers towards the most appropriate therapies and interventions for treating verb impairments. Accordingly, the following sections look at these various factors in more detail.

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Verbs and nouns: Linguistic and psycholinguistic differences

Before describing the linguistic variations across verbs it is worth noting that most research on verb impairments in aphasia has been carried out in Romance and Germanic languages (particularly Italian, French, English, and German), which tend to display greater morphological complexity in verbs as opposed to nouns (Bak & Hodges, 2003). Studies in languages with more complex noun morphologies such as Russian or Greek would redress this balance. Nevertheless, it is interesting to note that word class effects have been reported in languages with no morphological differences between verbs and nouns, such as Chinese (Bates, Chen, Tzeng, Li, & Opie, 1991).

Aside from morphology, verb and noun differences are often ascribed to either syntactic or semantic sources. However, Black and Chiat (2003a) argued that the distinction between nouns and verbs cannot be reduced to either syntax or semantics alone. Rather these authors described the distinction as "a continuum or convergence of properties at the conceptual-semantic and phonological levels" (p. 231). At the phonological level, there is variation on at least three factors:

1. *Stress pattern*: English bisyllabic nouns have a strong tendency to place stress on the first syllable, while bisyllabic verbs tend to have second-syllable stress (e.g., *window* vs *depart*). This difference has been found to influence processing in normal subjects (Mattys & Samuel, 2000) and some people with aphasia (Nickels & Howard, 1999). In some homophonic pairs, stress pattern is the distinguishing feature between the verb and nouns forms (e.g., *to reject* vs *a reject; to refuse* vs *the refuse*).
2. *Duration*: Nouns tend to be of longer duration than verbs even in homophonic pairs (e.g., *coach* and *coach*: Sorenson, Cooper, & Paccia, 1978).
3. *Syllable length*: Nouns tend to contain a greater number of syllables than verbs (Kelly, 1992).

These factors mean that verbs are less strongly marked in connected speech in acoustic terms. This clearly disadvantages verbs for people with aphasia in terms of both perception and comprehension on the input side, and phonetic complexity on the output side.

At the semantic and syntactic level, Black and Chiat (2003a) also described a number of diverging properties of nouns and verbs:

1. *Sensory richness* is greater in nouns than verbs. This echoes the argument made by Bird, Lambon Ralph, Patterson, and Hodges (2000b) that, on average, verbs have lower imageability ratings than nouns. Given that many aphasic patients are influenced by imageability, it follows that some or all of the relatively poor verb performance may be due to this factor (Bird et al., 2003). Likewise imageability influences ease of acquisition in development, and age-of-acquisition is also known to influence patients' performance (Cuetos, Monsalve, & Perez, 2005).
2. *Tightness of conceptual–semantic fit*: As nouns depict entities and often physical entities, they occupy an "individuated, relatively atemporal region in conceptual semantic space" (Black & Chiat, 2003a, p. 240). Thus there is a "tighter fit" between a noun and its meaning. In contrast, verbs depict actions, processes, events, and states that involve temporal relations and so there is a "looser fit" between verbs and the meaning they are representing. Black and Chiat (2003a)

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provide a cross-linguistic example to support this assertion: the English verb "put" cannot be directly translated in all its senses into Korean. In its place, the Korean child must acquire four separate verbs depending on the location to which objects are being put.

3. *Number of arguments*: Comparison of aphasic versus non-impaired participants' performance on picture naming of actions has found the number of arguments entailed by a verb to be a significant variable (Thompson, Lange, Schneider, & Shapiro, 1997a). Therefore, for people with Broca's aphasia, for example, one-argument verbs are easier to name than two-argument verbs, which in turn are easier to name than three-argument verbs (Druks & Masterson, 2003). The number of arguments relates to a verb's core meaning, in that the verb encodes an event and in doing so dictates the necessary components or arguments in the event (Marshall, Chiat, & Pring, 1997). So, for example, the verb "fall" requires an agent argument only (e.g., "the clown fell"), whereas "kick" requires an agent and a patient (e.g., "the horse kicked the jockey"), while "send" requires three arguments: an agent, theme, and goal, as in "she sent the ticket to her uncle". This highlights the fact that syntactic properties of a verb influence its retrieval at the single word level, and is also a significant point when considering the mechanisms through which verb retrieval may benefit sentence production, as is discussed later.
4. *Perspective differences*: Verbs allow for a wide range of perspectives on a scene or an event to be adopted. We do this by foregrounding some aspects of a scene relative to others (e.g., the thief was chased by the woman; the woman ran after the thief). It seems likely that, as a consequence, verbs will demand much greater executive control in production than other word types, a point to which we will return in the next section on neuropsychology and neuroimaging.

Black and Chiat (2003a) concluded that a relative deficit in either verbs or nouns could derive from a variety of underlying impairments to phonology, semantics, or syntax, or in the connections between these. Given the consistency of the above factors in making verbs more onerous in processing terms, the likelihood is that verbs are especially vulnerable to impairment in aphasia. Black and Chiat's view is echoed by many other researchers (Marshall, 2003; Shapiro & Caramazza, 2003). When selecting an approach for the treatment of verb impairments, therefore, it seems critical to consider this full range of linguistic factors.

We note that all these factors may contribute to the relative lack of ease of verb acquisition in childhood (Marshall, 2003), which may have secondary effects in aphasia (age-of-acquisition related phenomena: Ellis & Lambon Ralph, 2000; Lambon Ralph & Ehsan, 2006). For example, target nouns tend to be located at the end of utterances, which can facilitate "motherese" for demonstrating word meaning (Aslin, Woodward, Lamendola, & Bever, 1996). Verbs typically have more variable sentence position and hence are less demonstrable in parent–child interactions. Similarly, for some of the same reasons noted above, Black and Chiat (2003b) argued that dealing with verbs is more laborious and guess-ridden relative to nouns in the acquisition process. This was underlined in a study conducted by Gleitman and Gilette (1995) in which participants watched silent videos of mothers and children playing. When a beep sounded, people were asked to guess the word the mother had said at that point. The rate of correct guesses for nouns (50%) was much higher than for verbs (15%).

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In addition to the multiple ways in which nouns and verbs differ in terms of linguistic factors, the same is true for other psycholinguistic variables (some of which have already been mentioned—syllable length, stress pattern, age-of-acquisition, and imageability). Whether or not noun–verb differences can be reduced to the influences of these various factors on aphasic performance is subject to considerable debate (for a review, see Bak & Hodges, 2003; Marshall, 2003) but the fact that there is systematic variation in the psycholinguistic qualities of verbs may be important when considering therapeutic interventions. The debate is characterised by two polarised views. Berndt et al. (2002), for example, argued that dissociations between noun and verb production are evidence of the reality of grammatical class as a feature of lexical representation. The alternative view suggests that nouns, verbs, and other types of word are supported by a shared set of language representations (and underlying neural network) but that intrinsic, quantitative variation in the psycholinguistic qualities of these representations can produce word class differences (Bird, Howard, & Franklin, 2000a). Bird et al. noted that many people with aphasia are influenced by imageability and that this factor varies for nouns and verbs. They argued, in turn, that the verb deficit of patients reported in the aphasia literature essentially reflects an artefact of the lower imageability of verbs. Word frequency has also been implicated as a psycholinguistic variable that could contribute to the appearance of a word class effect. Bird et al. (2000b) analysed the frequency and imageability of the content words found in normal Cookie Theft descriptions (Goodglass & Kaplan, 1983). They found that nouns tend to occupy the low end of the frequency range irrespective of imageability (all concrete and abstract nouns tend to be low frequency) while the two factors were negatively correlated for the verbs included in the narratives (the more concrete action verbs are low in frequency while the abstract, light verbs have high frequencies, much higher than any of the nouns included in the narratives). When patients' language is governed by frequency (as it is, for example in semantic dementia—progressive fluent aphasia), therefore, an apparent verb sparing can occur because light verbs are so much more frequent than any types of noun. However, as notes above, some studies have controlled for variables such as frequency and imageability, and have still found word class effects (Luzzatti et al., 2001).

Verbs and nouns: Information from neuropsychology and neuroimaging

A parallel debate can be found in the literature dedicated to the neural basis of noun and verb processing. By comparing behavioural dissociations to underlying brain regions, Damasio and Tranel (1993) found that two participants with relatively poor noun production had lesions to the left anterior and middle temporal lobe regions, while a contrasting case with poor verb performance had a left frontal lesion. More recently, Cappa and Perani (2003) reviewed the neuropsychological and neuroimaging studies of noun and verb processing. While the literature contains a number of exceptions to the original Damasio and Tranel cases, Cappa and Perani concluded that object (noun) naming was generally associated with regions in the anterior, inferior temporal lobes, while action (verb) naming was supported by frontal and parietal regions of the left perisylvian territory. What does this tell us, though, about noun and verb processes? Perhaps the most obvious interpretation is that distinct neural regions imply separate processes for each word type. This does not necessarily

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follow, however. In all cases, verb vs noun differences are always relative; i.e., the patients' temporal lobe damage is associated with a *relative* deficit for nouns over verbs and vice versa for verbs<nouns with frontoparietal lesions. Accordingly, it is possible that language processes are supported by a combination of these various left hemisphere regions but the word types vary in their reliance on each specific region. This would follow, for example, if each region were associated with one or more of the many linguistic and psycholinguistic factors noted above (e.g., concrete meanings associated with temporal lobe regions and phonology/semantic control with inferior frontal regions: Devlin, Matthews, & Rushworth, 2003; Wise et al., 2000).

Other researchers have even called into question the conclusion that nouns and verbs are represented in distinct neural regions (Randall, Kherif, Longe, & Tyler, 2005; Tyler, Bright, Fletcher, & Stamatakis, 2004; Tyler, Russell, Fadili, & Moss, 2001). Tyler et al.'s PET studies, which focused on semantic tasks, found nouns and verbs to be represented within an undifferentiated cortical network. Interestingly, these researchers also investigated whether this pattern changed when the words were morphologically marked (which, as noted above, is more variable and complex for verbs than nouns). Using fMRI, Tyler et al. (2004) examined this possibility directly by requiring participants to process regular morphologically inflected nouns and verbs (e.g., "dogs", "hitting"). As before, they found that nouns and verbs activate the same distributed fronto-temporal network, yet, when inflected, verbs evoked significantly more activation in the left inferior frontal gyrus than nouns. Tyler et al. noted that the left ventrolateral prefrontal cortex is associated with tasks involving selecting between competing contenders. Accordingly, this same mechanism may be invoked more by verbs than nouns as a result of their greater morphological complexity (see Randall et al., 2005, for a replication of this finding using verb–noun homophones).

The greater influence of cognitive control mechanisms for verbs than nouns has also been highlighted in some recent neuropsychological investigations. Silveri, Salvigni, Cappa, Della Vedova, and Puopolo (2003) conducted a large-scale study comparing verb processing in participants with frontotemporal dementia, Alzheimer's disease, and control participants. This study set out to demonstrate that the non-linguistic variable of executive dysfunction (related to frontal lobe damage) can impair the lexical skill of verb processing. The authors offered three different explanations of the verb deficit evident in frontotemporal dementia, each linked to one of its three variants. In the dysexecutive variant, reduced information processing as a symptom of limited executive skills was proposed. In the nonfluent variant, a grammatical deficit would account for a verb deficit, which echoes Tyler et al.'s (2004) argument for the left inferior frontal gyrus and its role in inflectional morphology selection. Lastly, the semantic dementia variant clearly shows a verb deficit because of degraded semantic knowledge for actions. With respect to the verb deficit in Alzheimer's disease, a similarly semantic account is offered, evidenced by a strong correlation between verbal fluency scores (thought to predominantly tap semantic knowledge) and depleted verb naming scores. Overall, Silveri et al. concluded that any reduction in cognitive efficiency will cause some depletion in verb processing, given their claim that verbs are more dependent on executive resources. Furthermore, a verb deficit can result from either of two causes: reduction in executive resources, or specific damage to the linguistic domain (where either a verb or noun deficit could emerge).

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Bak and Hodges (1997) noted that, given nearly all studies use picture naming to assess noun (object) and verb (action) production, some apparent language deficits may actually be due to non-linguistic impairments. An example of this, which also implicates executive dysfunction, can be found in the single case study reported by d'Honincthun, and Pillon (2005). Their participant, JB, presented with frontal-variant frontotemporal dementia (marked by executive dysfunction) and worse verb than noun performance on picture-based naming and word–picture verification tasks. However, the noun–verb dissociation disappeared when video stimuli were used; critically the video sequences allow actions to be depicted in real time rather than in static form as they are in pictures. d'Honincthun et al. concluded that JB was not impaired in verb processing per se, but rather had greater difficulty with decoding the static pictures of actions (because unlike objects—which are generally static in nature—actions are dynamic and thus key information is missing when they are depicted in static pictures). This study, therefore, lends support to those researchers who advocate the use of video sequences as a preferable method for assessing verb processing (Webster & Bird, 2000).

Event perception

Before concluding this review of theoretical perspectives on verb processing, we will summarise the pertinent points within a linguistic theory that views verb processing within the context of the wider thought processes required for event perception. Event perception describes a theory of the cognitive architecture of event conceptualisation, and therefore of verb semantics, that has been informed by specific aphasic symptoms. For example, Dipper (1999) carried out a detailed assessment of the event perception skills of six participants with nonfluent aphasia. Through data derived from implementing novel, carefully controlled assessment materials, Dipper proposed five levels within event perception that are vulnerable to disruption in aphasia. These levels are described because they offer one well-defined hypothesis was to what event processing may entail.

These levels are, first, distinguishing an event from a non-event such as a static scene (e.g., washing up versus a washing line), which was demonstrated through an event video task. Second, identifying event type was investigated through an event photograph odd-one-out task, in which participants attempted to show recognition of actions belonging to the same event type (BE, HAVE, ACT, GO) by identifying the odd one out from photo sequences (e.g., *have a toothache*, *have a broken arm*, *drinking*, where the ACT event *drinking* is the odd one out from the two HAVE events). The third layer of event conceptualisation proposed—identifying relationships between entities within an event—and the fourth layer—identifying the roles played by the participant entities—are theoretically distinct, although Dipper's clinical data did not support this unequivocally. The role video task originally used by Marshall, Pring, and Chiat (1993) was used to identify deficits at these levels. Here, participants watched a scene on video and then chose between three photographs of potential outcome scenes, designed to test their appreciation of the entities participating in the events and their precise roles. For example, the video scene showing a woman burning a paper would be followed by a choice of three photos: a burnt paper (target); a torn paper (event distractor); and a burnt box (role distractor) (Marshall et al., 1993, p. 186). The final layer of event conceptualisation proposed by Dipper was perspective taking: conceptualising information about the

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perspective from which to describe an event. Impairment at this level was demonstrated through a perspective video task in which participants chose one of three written verbs to best describe a video scene. For example, a video scene biased towards the verb *push* by focusing on the actions of the "pusher", was followed by the choice of PUSH, LIFT, FALL.

The significance of such a detailed theory of event perception processing lies partly in its potential clinical application. Dipper and Marshall (2000) described this in terms of differing perspectives on sentence production therapy. A structural perspective implies a focus on target sentence structures in order to expand the sentence types that can be produced by an aphasic person. The alternative perspective of increasing the range of events and states that can be communicated by an aphasic person requires a greater emphasis on the cognitive preparations for language, i.e., levels of event perception. The results of this latter approach (also known as "thinking for speaking") will be less prescriptive in terms of language output. For example, treatment at the level of event perception may entail better use of word order, combination of word order and gesture, or a systematic use of other nonverbal means of communication such as drawing. In other words, a pre-linguistic focus in an event perception therapy could result in linguistic and non-linguistic gains in communication. Further examples of targeting thinking for speaking within therapy are described in Marshall and Cairns (2005). The participant's gains noted in Marshall and Cairns' two therapy programmes are significant because they suggest that improved verb retrieval, as well as greater use of verb argument structures, can be derived from improving participants' preverbal thinking about actions and events. In many ways, this echoes the neuropsychological evidence regarding the executive resources demanded by verb processing. Further research is required to examine the relationship between these two strikingly similar accounts of the nonverbal cognitive preparations for language.

Interim summary

In this first section we have given a brief overview of the research relating to the status of verb processing in aphasia, the linguistic and psycholinguistic differences between verbs and other word types (predominately nouns), and information arising from neuropsychological and neuroimaging literatures. In summary, this shows that many patients have poor verb processing. Agrammatic nonfluent aphasia is associated with relatively poorer verb than noun production. The reverse pattern (nouns<verbs) is traditionally associated with the fluent aphasias (anomic and Wernicke's) but this relationship is not as strong as for verb impairment and nonfluent aphasia. Using neuroimaging results and lesion analyses of aphasic participants, some researchers have argued that verb processing is dependent on frontoparietal, perisylvian regions, while nouns reflect specific processing in the temporal lobes. This is disputed by other researchers who find that nouns and verbs are dependent on a combination of these various regions. These alternative results would seem to be consistent with the observation that nouns and verbs (a) are not absolute, undifferentiated entities, and (b) vary quantitatively along a number of different psycholinguistic, linguistic, and cognitive factors.

Although various issues are still debated, this research provides a rich set of findings about the nature of verbs and how these are affected in aphasia. In the next section, we review the relatively sparse literature on therapies for verb impairments

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and relate the approaches taken in these interventions back to the theoretical findings summarised in this section. Before doing so, we would like to consider the potential treatment implications that emerge from the above account of verb processing in aphasia. As mentioned, verbs relative to other word types such as nouns have a range of intrinsic factors that make them especially vulnerable to impairment. Specifically, verbs display greater complexity of phonological, morphological, and syntactic encoding than nouns. Semantically, in contrast, they are less rich in sensory features compared to nouns, which derives from verbs representing dynamic events through a "loose fit" between word form and meaning. This presents two problems from the point of view of therapy. First, the greater processing loads demanded by the complexity at these various linguistic levels will mean that verbs are inherently more difficult words for many people with aphasia to progress with, for instance in naming. Second, verb impairments in aphasia could well arise from multiple linguistic and or metalinguistic sources, such as thinking for speaking, and possibly nonlinguistic cognitive sources, such as executive dysfunction. Similarly, this compounds the potential difficulty for people with aphasia trying to improve these impairments through therapy. Our therapy approaches must address these issues.

The semantic contrasts between verbs and nouns (with respect to sensory richness and tightness of conceptual–semantic fit) would lead one to speculate that various visual cues could well show greater support for verb over noun naming. We have already noted that presenting actions through dynamic video format in real time instead of static picture format can improve verb naming in participants with executive dysfunction. As a visual cue for participants with aphasia, this could be expected to help participants home in on the salient features of the action and select more quickly from the competing semantic contenders. This might be particularly beneficial with specific verb types, such as verbs of movement like "throwing" or "catching", "pushing" or "pulling". Similarly, a therapist miming or gesturing an action would promote visual analysis of the action whereby the salient features can be extracted from three dimensions as opposed to the two on a video format. A visual-kinaesthetic cue would be the aphasic participant generating or copying an action through gesture to ensure optimal processing of the visual-tactile components of the action. As we shall see, elements of this visual aspect of therapy have influenced some of the studies to be found in the literature (e.g., Marshall, 1999; Pashek, 1998).

Obviously, difficulty with verbs can arise at the phonological, morphological, and syntactic levels as well. Another potential treatment approach would be to use more intact levels of processing to bolster up a more markedly impaired level. For example, Silveri et al. (2003) proposed a grammatical deficit as the source of a relative verb impairment in nonfluent fronto-temporal dementia. If we take this to be primarily a morphological impairment, then hypothetically, providing the required tense, for example in a naming task, supported by a sentence frame with its prosodic and syntactic information, could facilitate retrieval of the verb. This principle has been used in therapy studies; for example, Marshall et al. (1997) (and arguably all "mapping therapies": see Marshall, 1995) utilised their participant's intact syntactic skills, with regard to the appropriate subcategorisation frame for a specific verb (see Marshall, 1997, p. 856), to home in on more impaired thematic role knowledge.

Another consideration with regard to potential therapy approaches that might emerge from the above discussion relates to the possible benefit of minimising errors

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in the learning process in therapy. The cognitive demands required for verb processing, in terms of frontal executive skills in selecting, for example, between competing conceptual and morphological contenders, may be critical for participants with impairments in this domain. Accordingly, it may be important to adjust the nature of the therapies used in order to minimise the requirement for executive control through, for example, using errorless learning techniques (Fillingham, Hodgson, Sage, & Lambon Ralph, 2003; Fillingham Sage, & Lambon Ralph, 2005a, 2005b, 2005c). Pure errorless learning techniques in aphasia therapy tend to use word repetition in the presence of the target picture and the written target as orthographic cue. However, vanishing or decreasing cues can also be used to minimise errors, whereby the traditional hierarchy of increasing cues is reversed and lesser cues only given with continued successful naming (Abel, Schultz, Radermacher, Willmes & Huber, 2005).

Finally, by utilising a case-series design of the same therapy replicated across a number of aphasic participants, it would be possible to contrast between aphasic participants directly and also to relate their therapy results back to their underlying aphasiological, neuropsychological, and neurological profiles.

VERB THERAPY STUDIES

Given the prevalence of apparent verb deficits in aphasia and the wealth of interdisciplinary research on the processes underlying verbs and nouns, it is surprising to find a relative dearth of verb therapy studies in the aphasia literature (especially when compared with the extensive body of noun therapy research, e.g., as reviewed in Nickels, 2002a). This may reflect the fact that nouns represent a more straightforward starting point in terms of evaluating the efficacy of word retrieval therapy studies, given that they are more independent of grammatical and sentence structure. Similarly, it may seem artificial to clinicians and researchers to treat verbs as isolated entities and to implement therapy studies on verbs as single words, when they are so central to grammatical and structural features of sentences.

In this section we review some of the few verb therapy studies. The papers reviewed were selected on the basis of two criteria: they consisted of a therapy primarily targeted at verb naming and they had an experimental design. The studies reviewed do not constitute an exhaustive list of the published studies; rather they are intended to give a representative sample. The studies were collated through searches in prominent journals on aphasiology and related topics, or were well-known studies to be found in other seminal sources. They are split into two types: (a) those that have targeted verb and noun naming; and (b) those that have targeted verb naming and also examined the effect of verb therapy on sentence production The basic design and outcome of the 10 therapy studies reviewed is contained in Table 1.

Verb and noun naming studies

One selection of therapy studies builds on aphasiological research in which verbs are considered in isolation as single words. Accordingly, much of this work compares verbs against other word types—nearly always nouns—and borrows interventions that have been commonly used for improving single noun production. Two such studies are summarised here.

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TABLE 1
Summary of verb therapy studies

Type of therapy study	*No. of participants*	*Type of participants*	*Therapy type*	*Therapy results*	*Generalisation*
1. Verb & noun therapies					
Wambaugh et al., 2001, 2002	3	Anomic aphasia; Wernicke's aphasia; Conduction aphasia	Semantic cueing therapy; phonological cueing therapy	Varied according to patient, therapy, and word class	None to untreated verbs
Pashek, 1998	1	Averbia	Verbal only (VO) or Gesture plus verbal (GPV)	GPV better for verbs, VO for nouns; both effective	No untreated control items used
2. Verb therapies					
Marshall et al., 1998	1	Broca's aphasia	Written verb to picture matching; written odd one out; verb naming from noun cueing, and spoken scenario	Treated verbs significantly improved	Non-significant gain in naming of control items; sentence production using treated and control items both significantly improved
Edwards et al., 2004	3	Fluent aphasia	Picture naming to graded cues; naming to definition; sentence completion	Significant gains in naming treated verbs (speed & accuracy)	Limited in naming untreated verbs; gains in sentence use in connected speech
Raymer & Ellsworth, 2002	1	Transcortical motor aphasia	Phonological & semantic cues, word repetition	All similarly effective for trained verbs only	Gains in sentence production containing treated verbs
Mitchum & Berndt, 1994	1	Mixed aphasia	Repeated picture naming	Significant for treated verbs only	No gains in sentence production

(Continued)

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TABLE 1
(Continued)

Type of therapy study	*No. of participants*	*Type of participants*	*Therapy type*	*Therapy results*	*Generalisation*
3. Verb and argument structure therapies					
Fink et al., 1992	1	Agrammatic Broca's aphasia	Picture naming; identifying agents & themes; sentence production	Significant for treated verbs only in direct training (not in priming)	Gains in sentence production in connected speech
Murray & Karcher, 2000	1	Wernicke's aphasia	Written naming of actions with anagram and graphemic cues; writing sentences	Significant gains in written retrieval of treated verbs and sentence production with these verbs	Gains in written and spoken discourse
Webster et al., 2005	1	Hesitant speech with word-finding difficulties and sentence fragments	As Marshall et al., 1998; identifying agents & themes; sentence production	Significant for treated verbs only	Significant gains in measures of constrained sentence production and spoken discourse
Schneider & Thompson, 2003	7	Broca's aphasia	Semantic & argument structure verb therapies	Significant comparable effects for treated items only from both	Significant gains in producing sentences with treated verbs; non-significant gains in spoken discourse

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Wambaugh and colleagues implemented two word retrieval therapies, one focused on phonological and semantic cueing treatments (PCT and SCT respectively) of nouns and a second on action naming (Wambaugh, Doyle, Martinez, & Kalinyak-Fliszar, 2002; Wambaugh, Linebaugh, Doyle, Martinez, Kalinyak-Fliszar, & Spencer, 2001). Both studies evaluated the effects of these two treatments in three people with chronic aphasia. Participants 1 and 2 displayed mixed semantic and phonological-level lexical retrieval deficits, and participant 3 displayed a phonological deficit. The action-naming treatment carried out with these participants was a typical hierarchical cueing approach, in which initially minimal cues were gradually increased until an action or object picture was named correctly. Participant 1, who received SCT, showed improved post-treatment action picture naming. Participant 2, who received PCT, did not show lasting treatment gains in action picture naming. Participant 3, who received both SCT and PCT, showed strong, comparable gains in action picture naming from both treatments. Because the same three participants were included in both studies (2001 and 2002), their responses to treatment can be compared across grammatical class. Participant 1 showed a similar response to SCT for nouns and verbs in that he rapidly improved but showed little generalisation from treated items. Participant 2 is noteworthy in that he initially showed a more marked impairment in verb retrieval. He then went on to demonstrate a positive response to PCT for nouns but not for verbs. Participant 3, on the other hand, had shown a strong treatment preference for SCT during noun treatment but responded equally well to both SCT and PCT for verbs. These contrasting treatment responses suggest that both treatment approach and target word grammatical class may be significant factors in the outcome of such interventions.

The second verb and noun comparative study examined the treatment effects of verbal-only versus verbal plus gestural facilitation in a single participant, WT (Pashek, 1998). WT was described as displaying averbia across various tasks (picture naming, picture description, reading aloud, and in conversation), with spoken output characterised by single nouns only. Pashek placed her study in the context of Bak and Hodges' (1997) suggestion that verb deficits may derive from a deficit to semantic knowledge of actions caused by motor cortex damage. In line with some the conclusions about potential therapy procedures from the theoretical discussion above, WT demonstrated a markedly improved treatment effect when given the verbal plus gestural facilitation. Nouns, on the other hand, showed a greater treatment effect with the verbal only approach. Generalisation from the therapy task to use in connected speech was different for nouns and verbs, however. Nouns showed some generalisation when WT was tested on a composite picture description task, while the verbs showed no such carryover. Pashek speculated that the retrieval context for verbs, i.e., naming versus sentence context, is a significant variable and sentence frame construction deficits may separately restrict the use of verbs in the sentence context. Pashek argued that the greater treatment effect of verbs to verbal plus gestural facilitation supports the view of Bak and Hodges (1997) in that gestures can provide some semantic redundancy, which has been lost in the action-semantics deficit causing "averbia".

These two investigations show that certain, but by not means all, aspects highlighted in the verb impairment literature (see the first section of this paper) have been incorporated or tested in therapy studies. Comparisons with noun performance highlight key differences and similarities between the two word classes (Wambaugh

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et al., 2001, 2002) while notions from neuroscience/neurology have been tested directly via a specific therapy intervention (Pashek, 1998). Clearly though, the many factors highlighted in the basic studies on the nature of verbs and verb impairments are yet to be integrated into, or to motivate, therapy studies. For example, there is a clear consensus that verbs and nouns vary along a number of continuous, graded linguistic and psycholinguistic dimensions, but this knowledge does not appear to have influenced therapy interventions. Likewise, the neuroscience research on verb processing has had little impact on therapy approaches to date (with Pashek's study being an interesting counterexample). One might hope that, in addition to aphasiological assessment, information about the location of infarction and regions that support verb processing (or the factors that underpin it) in unimpaired as well as aphasic participants might begin to inform the therapy approach to be taken (see Wise, 2003, for a wider discussion of this issue). In addition, it may also be important to consider the participants' more general neuropsychological profile when planning therapies (Fillingham et al., 2003, 2005a, 2005b, 2005c). For example, a number of researchers have highlighted the fact that verbs may demand more processing control than nouns along a number of different dimensions (i.e., given verbs' less tight conceptual fit, their requiring more executive resources, their typically lower imageability scores, their phonological and grammatical differences: see the first section of this paper). Accordingly, the status of the participants' more general language and nonlanguage executive control may be a critical factor. In turn, it is possible that interventions may need to be tailored to adjust the control demands placed on the participant. It could be, for example, that gestural facilitation (Pashek, 1998) may be more beneficial for verbs than nouns because it provides a form of additional constraint on activating the correct verb meaning.

The relationship between verb therapy and connected speech

As noted above, it is important to see if single word therapies generalise in such a way that people with aphasia are able to use the target words in their spontaneous, connected speech. The motivation for exploring this issue after verb therapies is even higher given that verbs play such a pivotal role in sentences (Bastiaanse, Edwards, Maas, & Rispens, 2003). Four studies are discussed in this section. They share a combined focus on the results of verb therapy and their effects on sentence production.

Marshall, Pring, and Chiat (1998) implemented a detailed single-case verb therapy study that considered the relationship between verb retrieval and sentence production. Their participant, EM, displayed a typical agrammatic speech pattern. A finer assessment showed that EM had greater problems with verbs in spoken naming, while verb comprehension was intact, as was written naming and reading aloud of verbs. Prior to the therapy programme, Marshall et al. implemented a cued sentence production task with EM in which frequency-matched nouns and verbs were provided in written form. EM's sentence production was better after the written verb than noun cues: 84% of verb-cued sentences were semantically and syntactically correct versus only 34% after written noun cues. Then Marshall et al. devised a therapy programme in which 35 verbs were treated using three semantic tasks: word to picture matching; odd one out; and producing verbs from a spoken scenario. These tasks required EM to process the meaning of the verbs and then to link this

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semantic knowledge to each verb's phonological form. No explicit practice of sentences was involved.

The verb treatment programme improved EM's naming for the treated verbs without significantly improving performance on the control items. Consistent with EM's marked responsiveness to verb-cued sentence production, EM's therapy gains generalised to sentence production, particularly for the treated verbs. Interestingly, there were very few instances of post-treatment use of verbs not used within complete and correct sentences.

This study provided support for the notion that there is a necessary (unidirectional) relationship between verb retrieval and sentence production. Marshall et al. suggested that their data supported the lexical hypothesis of agrammatic speech (Saffran, Schwartz, & Marin, 1980). According to this theory, information encoded within verb meaning is crucial to sentence production. This would include the thematic roles (e.g., agent, goal, theme for the verb) without which sentence formation cannot proceed. This means that a verb impairment (i.e., to verb meaning or in transmitting the information to speech production) will always give rise to a deficit in sentence construction. The relationship is unidirectional though, in the sense that while verb impairments may cause sentence construction impairments, sentence-level problems do not necessarily imply a verb deficit but can be due to a number of other factors. In this context, EM's apparent sparing of verb meaning with impaired access to verb phonology may seem inconsistent with this proposal, but Marshall et al. argued that EM's profile suggested that both the semantics and phonology of a verb are necessary to construct a sentence. The explanation, of course, depends on exactly where EM's deficits were. A breakdown between semantic and phonology/sentence generator might produce the same result because although critical verb information may be intact (alongside the semantic representation) it may not have been able to influence phonological access and sentence generation. Alternatively, more recent work (in the noun domain) suggests that subtle semantic problems are often missed in standard comprehension tasks but are shown up more readily in naming (Gainotti, Silveri, Villa, & Miceli, 1986; Lambon Ralph, McClelland, Patterson, Galton, & Hodges, 2001; Lambon Ralph, Moriarty, & Sage, 2002).

Although many verb therapy studies focus on agrammatic participants, a few do not. Edwards, Tucker, and McCann (2004), for example, reported the results of a verb therapy for three fluent aphasic participants. The study aimed to establish whether gains at the single verb level would positively influence related sentence construction through more accurate and efficient access to the target verb form. The therapy tasks included picture naming with graded cueing, naming to definition, and sentence completion. The therapy resulted in significant improvements both in terms of the accuracy and speed of target verb retrieval. Like most other therapies, generalisation from treated to untreated verbs was weak. The consequent effects of verb therapy on sentence construction were generally positive. Specifically, scores on a sentence production test (from Bastiaanse et al., 2003) showed improvement for all participants. Two of the three exhibited improvements, in terms of increased verb usage and grammatical utterances, found in an elicited speech sample (Cookie Theft Picture Description Task: Goodglass & Kaplan, 1983), story re-telling, and conversational data, although the authors were unable to specify which aspects of therapy had been effective given the profile of results.

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As with the single verb naming data, Edwards et al. found no generalisation from untreated verbs to their increased use in sentence production; instead only the treated verbs showed generalisation to sentence production. When taken together, the Marshall et al. and Edwards et al. studies suggest that, irrespective of aphasia type (fluent or nonfluent, agrammatic), therapy targeted to single verbs does generalise into the participants' connected speech as one would hope. However, the exact mechanisms by which this is achieved are somewhat unclear. Perhaps the simplest explanation is that by reinforcing the link from meaning to word form, the target words are more likely to be available within the demanding time-window required for connected speech. It is also possible that a side-effect of the single verb therapies is the strengthening or restoration of argument structure, thus enabling the use of these target verbs in connected speech. Clearly the merit of such secondary effects of therapy would require specific investigation.

Raymer and Ellsworth (2002) attempted to tease out somewhat further the issue of single-word verb treatments and their effects on sentence production. They related this paper to some of the findings from noun retrieval studies in terms of comparing semantic and phonological treatment (e.g., Howard, Patterson, Franklin, Orchard-Lisle, & Morton, 1985), where noun retrieval was argued to show greater improvement following semantic treatment rather than phonological treatment. However, this has been disputed by other commentators (e.g., Hillis, 1993). Raymer and Ellsworth's study therefore sought to compare different treatment effects within one participant, WR. In the phonological and semantic therapies, WR was required to name pictures and provided with question cues to give prompt lexical access. So, for example, a phonological question cue for the target verb "pay" would be "does it rhyme with 'way'?". A semantic question cue for the target verb "baking" would be "is it similar to grilling?". Following these question cues, WR repeated a target word three times, rehearsed silently and then re-attempted naming, and finally repeated the word three times again, In rehearsal therapy, WR carried out the latter stages of the phonological and semantic therapies only; i.e., repetition three times, silent rehearsal and naming attempt, and repetition three times, all with the picture present. In directly comparing semantic, phonological, and rehearsal treatments, these authors found no difference in the effects between the three treatments, with significantly improved naming of trained verbs only following all three.

Raymer and Ellsworth also considered the issue of generalisation from a trained verb at the single-word level, to sentence production incorporating these trained items. Here, they were testing out the hypothesis put forward by Mitchum and Berndt (2001) that where verbs are trained with semantic treatment, thought to engage information concerning the verb argument structure central to sentence production, improved sentence production will result. This, however, was not supported by the data from WR. She showed improved sentence production for items trained with all three treatments. Also, sentence production improved to a moderate degree only, with criterion levels for sentence production not reached. Again, similar to the one participant in the Edwards et al. (2004) study, these authors speculated that WR had other impairments restricting sentence production that limited the boosting effects of the verb retrieval gains. They also queried whether the distinction between phonological, rehearsal, and semantic treatments effectively disappears if picture materials are used, where semantic processing will invariably become activated.

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The only exception to the pattern that emerges from these studies comes from one of the original verb treatment studies (Mitchum & Berndt, 1994). In this single case study, the participant ML showed improved verb naming for treated items without corresponding gains at the simple sentence level. So, despite successful training with the verb "ride", ML then produced sentences to picture description such as "the little girl was takin' on the bike". Because these were unconnected case studies, it is almost impossible to diagnose why this participant, unlike the variety of different aphasic participants reviewed above, failed to show generalisation to connected speech. A case-series approach to verb therapy would certainly help with understanding why apparently most, but by no means all, participants demonstrate this kind of generalisation.

In summary, these four studies offer robust evidence that verb retrieval is amenable to various therapies and in most cases this does generalise from the single word therapy to production in connected sentences. The results are more equivocal on other aspects of generalisation (e.g., to untreated items). This probably relates to differences between the participants across the four studies (in terms of underlying impairments) and also between the treatments used.

Verb and argument structure therapies

The four studies reviewed in the previous section examined the effects of improved verb retrieval on sentence production skills. Another group of studies has taken a complementary, yet distinct, approach to this issue through incorporating an added element of training participants' awareness of the relationship between verbs and key nouns in sentences. In other words, they have focused on both verb retrieval and highlighting verbs' argument structures. Typically, they ask participants to identify which noun is the agent of the verb in an action picture and which is the theme (or recipient of the action), and then, crucially, ask participants to use this knowledge to construct a sentence containing the treated verb. This immediate focus on sentence production is what distinguishes these therapies from mapping therapies (see Marshall, 1995, for an overview). The aim is to maximise the possibility of carryover to sentences through highlighting the relationship between the treated verb and the nouns in its argument structure. Four therapy studies that adopt this approach are described in this section.

One of the first therapy studies to specifically target verb retrieval was reported by Fink, Martin, Schwartz, Saffron, and Myers (1992). This was a single case study with participant GR who displayed severely agrammatic Broca's aphasia. Following a programme of mapping therapy designed to improve sentence comprehension and production, GR continued to show poor verb retrieval and would consequently use a tongue click or gesture in place of a verb in a sentence. Crucially, the sentence would be well structured with regard to noun arguments around the missing verb. This led Fink et al. to conclude that GR had reduced access to verb phonology as the cause of his poor verb retrieval.

Two therapy procedures were directly compared: direct verb training and verb priming. Direct verb training consisted of naming of action pictures with different tokens or exemplars of the same action. GR was then asked to identify the agent and theme of the depicted action, and then construct a sentence using the named verb and noun arguments. Verb priming required GR to listen to sentences within which a target verb was embedded, and then use this verb in a different sentence describing

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an action picture. Two sets of five verbs were treated, matched for frequency and argument structure complexity, one set per therapy. A crossover therapy design showed direct verb training to be the superior approach with significant improvement in naming the treated verbs. However, priming did act as a short-term facilitator of verb naming. Two interesting patterns of generalisation were noted by the authors. First, although no carryover to untreated verbs was evident, GR showed improved retrieval of semantically related alternatives to picture targets. Second, a quantitative analysis of GR's narrative speech revealed both increased verb retrieval in discourse and increased use of well-formed sentences.

A comparable therapy method was utilised in a writing therapy study by Murray and Karcher (2000). This single case study was implemented with HR, who displayed moderate Wernicke's aphasia marked by a paucity of verbs in spoken and written output. Murray and Karcher used a cueing hierarchy to move from verb retrieval to related sentence production. Although this approach did not make explicit use of concepts such as agent or theme, the cueing hierarchy provided HR with question cues such as "what is the girl breaking?", which guided HR's attention to the semantic roles of nouns and served to underline the verb's argument structure in an indirect way. Interestingly, the authors justified this bridging approach from verb retrieval into sentences arguing that previous studies had found "little improvement in productive syntax following verb retrieval training at the single word only" (p. 590) which appears to be in conflict with findings such as those reported by Edwards et al. (2004), for instance. The therapy results were direct positive effects on treated verbs and sentence forms only. However, some generalisation effects were noted. In particular, HR showed post-therapy error patterns on nontrained verbs and sentences that were closer to targets, which the authors contended suggests improved functioning in the graphemic buffer. Also, a modest improvement in the verbal (as opposed to written) naming of treated verbs was noted.

A further example of a broadly similar verb and argument structure therapy has been reported in the literature more recently. Webster, Morris, and Franklin (2005) described a single case therapy study with NS, who had hesitant speech characterised by word-finding difficulties and sentence fragments. NS's difficulties in output were ascribed by the authors to multiple sources but they particularly highlighted impaired access to semantic representations for verbs and nouns, as well as difficulties in producing the necessary noun arguments for a specific verb and in the mapping of semantic and syntactic roles (see Schwartz, Fink, & Saffran, 1995). A three-step therapy was carried out with NS, which focused on 48 verbs. These steps were, first, verb-naming tasks adapted from Marshall (1998) (as described above). Second, NS was asked to identify agents and themes in an action picture from a written array of nouns. Third, a sentence generation task required NS to construct a sentence around a specific verb. However, picture materials were not used at this stage; instead, question cues (Where? What to? What with? Who?), again in a written array, prompted NS to use both obligatory and optional noun arguments. So, for example, the verb "wash" can in certain contexts have an agent and theme as obligatory arguments (e.g., "George washed the dog"), while optional adjuncts such as place can be added (e.g., "… in the garden"). Therefore, NS was asked to consider more broadly the necessary and possible constituents with which to construct a sentence.

The results obtained by Webster et al. are very consistent with many of the findings reported above. They provide more detail, however, especially with regard

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to the benefits of verb retrieval for sentence production: treated items improved significantly with no generalisation to non-treated verbs. Sentence production showed gains on the three specific measures taken. First, NS showed increased use of more complete argument structures in constrained sentences, as well as a wider range of verbs. Second, sentence generation showed decreased omission of obligatory arguments. Lastly, a narrative discourse task revealed the proportion of sentences containing a verb to have increased from 15% pre-therapy to 43% post-therapy, with a marked gain in the occurrence of two-argument verb structures also.

The final paper reviewed in this section falls less clearly under the heading of a verb and argument structure therapy. However, it is included here because it shares with the above three studies an attempt to effect change in sentence use through verb-centred therapy tasks. Schneider and Thompson (2003) examined whether training on specific semantic properties of verbs impacts on the extent of generalisation to sentence production. This detailed study used a within single subjects, crossover design. Seven aphasic participants were given verb therapy using two specific techniques: (i) semantic treatment attempted to reinforce semantic information about the action (e.g., for motion verbs such as ''pass'', the concept of movement from one place to another was demonstrated); (ii) argument structure treatment, on the other hand, conveyed information about the number and nature of the arguments a verb entails (e.g., that the verb ''jump'' involves someone doing the jumping and jumping over something). With both, the participants also heard the word, so had exposure to the verbs' phonology. Despite their different therapy aims, both treatments improved naming of the treated verbs to the same degree. These approaches echo some of the considerations as to potential therapy approaches that followed on from the theoretical discussion above, through supporting conceptual identification of the components of an action through visual demonstration.

Some interesting patterns with regard to generalisation also emerged. The researchers had hoped that specifically increasing awareness of conceptual and argument-structure information would promote generalisation within or between verb categories (e.g., motion verbs, change of state verbs, two-argument verbs, three-argument verbs). Unfortunately, they found no such generalisation. With regard to generalisation from single verb therapy to use in connected speech, more positive results (like the other studies reviewed above) were found. An overall improvement was found in constrained sentences, with higher production accuracy for trained than untrained verbs. The researchers' explanation for these results followed the same lines as that noted above. Specifically, it is assumed that poor verb retrieval can be one of a number of causes of poor sentence production. Thus by improving verb retrieval, sentence production will also benefit. Again it would seem possible that this might follow from improvements simply in terms of retrieval efficiency. Schneider and Thompson also argued that improved verb retrieval might also promote the activation of the appropriate syntactical information associated with the target verb and thus support improvements at the sentence level.

Another reason why improving verb retrieval may directly benefit production of sentences and, by extension, discourse, follows from the suggestion that for certain groups of people with aphasia, those with agrammatism for instance, impairments in connected speech derive from a performance deficit. Agrammatism, therefore, is thought to reflect a costly expenditure of resources in retrieving key words, when the system is depleted in such resources (Linebarger, McCall, & Berndt, 2004). As a consequence, performance of other linguistic processes such as sentence formation

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can suffer. Freeing up processing resources through, for example, therapy making retrieval of specific verbs easier, and possibly also quicker, can then manifest itself in revealed syntactic and grammatical competence. A further explanation of the verb therapy to sentence-production link is described by Webster et al. (2005) where, in considering their participant's generalised gains from predicate argument structure therapy, they suggested that these derive from a strategy, based on improved awareness of the role of verbs, to specify the arguments around the verbs he could produce.

All of these accounts indicate that effective verb therapy may result in graded changes in the overall language processing system. This raises the question of the sensitivity of the measures available through which to tap such altered processing. Ideally, a comprehensive account of the effects of improved verb retrieval would need to examine numerous levels of production. These would begin at assessing naming of different exemplars of verbs acquired in therapy. It would also include sentence production with the picture materials used in therapy (e.g., "describe the scene in this picture" instead of "what is this person doing?") as well as with other exemplars. We would then need to consider possible sentence-production generalisation effects within specific classes of verbs, such as verbs taking two versus three argument structures, or within a semantically related group of verbs such as movement verbs ("walk", "run", "catch", "throw", "pull", "push" etc.). Furthermore, we would need to consider increasing executive processing demands, or the sophistication in thinking for speaking, with a hierarchy of discourse tasks from composite picture description, through action naming in real-time video sequences, story sequences depicted in ordered picture format, to videoed narrative sequences. Lastly, we would expect discourse gains to be evident in conversation, so data from this sphere would also be required. The fact that different studies, including those we have reviewed above, utilised different measures of sentence and discourse effects, tapping different parts of the possible range of skills, makes it difficult to derive a clear consensus from the literature on the effects on improved verb retrieval on sentence and discourse production This highlights the importance of further research into these questions. Similarly, the case-series design may allow us to make more firm conclusions about the mechanisms of any such generalisation effects and how broadly they apply across subgroups of people with aphasia.

SUMMARY AND CONCLUSIONS

This review of verb impairments and verb therapies found a number of areas of consensus and has highlighted a range of issues over which there is less agreement and, consequently, a need for further research. In this general discussion, we will briefly summarise the findings and then consider, in more detail, the relationship between the verb impairment and therapy literatures.

In the first section, we noted that some participants do show differential impairment to verb production and comprehension (when compared with other word types—most commonly nouns). This is related to aphasia type to a certain degree: people with nonfluent aphasia tend to be the ones with worse verb than noun production. Evidence for the complementary pattern (poor noun production with fluent aphasia) is much weaker. The approach to explaining noun–verb differences is debated within the aphasiological, neuropsychological, and neuroimaging fields. One set of researchers argue that noun–verb differences reflect specific representation

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for each of these word types in different brain regions—that is to say, nouns and verbs have separate representations which can be damaged independently after brain damage or are highlighted as differential distributions of activation in functional neuroimaging studies. The opposing view is that, at both the behavioural and neural levels, the distinctions between nouns and verbs are not categorical but are underpinned by variation along a number of different linguistic, psycholinguistic, and cognitive factors. Whether or not these various factors can explain noun–verb dissociations in patients and different neuroimaging results is still a matter of debate. The more important point, perhaps, is that nouns and verbs vary in a graded manner along a number of different dimensions and these may be critical for understanding the correct approach to treating verb impairments.

The second section summarised studies of verb therapy: verb and noun naming compared, and then therapy for verbs as single words with the expectation of generalisation to connected speech. A number of studies have approached verbs as single words and have treated them in a similar fashion to nouns. Such studies suggest that verbs respond in broadly similar ways to traditional graded cueing therapies. There is variation in the results of different therapies (e.g., semantic vs phonological) across different participants, but it is hard to draw any general conclusions because it is impossible to compare therapies and participants directly from one study to another (or even, sometimes, within a study).

A specific drawback of the current therapy literature is worth highlighting. In addition to its small size, the current literature is dominated by single case studies. Clearly, these can be useful in exploring and developing novel therapies for the first time. They are, however, more frustrating when trying to extract generalisable findings for patients of a certain kind. Two specific issues arise in this context. First, it is difficult to determine what kind of therapy (e.g., semantic or phonological cueing) to give a new patient. As mentioned, Wambaugh et al.'s studies are very interesting in that different therapies were compared across the three participants, but it is impossible to be confident about the cause of the varying therapy outcomes. These might be due to different efficacies for the methods, or differences in the participants, or a combination of the two (certain therapies may be beneficial for different subgroups of people with aphasia). Second, single case studies make it difficult to determine the influence of impairment severity on performance. For example, therapy outcomes for nouns and verbs may vary because baseline performance is worse for verbs than nouns (or vice versa). Likewise, the variation in therapy outcome across participants (e.g., Wambaugh et al., 2001, 2002) may simply be due to the severity of impairments (either global aphasic severity, or different levels of impairment within certain representations/processes, e.g., phonology, semantics, syntax, etc.) Both of these problems can be tackled by adopting a case-series approach in which a selection of participants are studied individually but using identical assessments and therapy interventions. This permits direct comparisons across participants (to look at the influence of severity) and also enables therapy results to be related to the underlying status of their language, neuropsychological, and neurological profiles. This approach is becoming more common in aphasiological studies (Lambon Ralph et al., 2001, 2002; Nickels, 2002b). There are a smaller number of case-series therapy studies (e.g., Fillingham et al., 2005a, 2005b, 2005c; Schneider & Thompson, 2003).

Greater consensus can be found in the studies that have focused on improving verb retrieval and measuring the consequent carryover to verb use in connected

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speech. In the vast majority of cases, irrespective of aphasia type, single verb therapy would appear to generalise to connected speech. The exact cause of this generalisation is less clear. One possibility is that the therapies improve the efficiency and accuracy of retrieval for the target verbs, and this makes them more likely to be activated within the demanding time-course pressures required in fluent, connected speech production. This account would best explain apparent generalisation gains from treatment at the level of the verb only to sentence and discourse levels. An additional possibility is that, as well as reinforcing the link between meaning and the verb's phonological form, the therapies have the side-effect of improving retrieval of the verb's associated morphological and syntactical features. The therapies that combined verb retrieval tasks with tasks requiring identification of thematic roles connected to verbs and their use as the foundation for sentence production aim more explicitly to bridge these levels of linguistic processing. Further research could usefully compare verb retrieval therapy with verb retrieval plus argument structure therapy directly, to determine the specific contribution of the latter, additional component, particularly with respect to generalisation effects at the sentence and discourse levels.

By looking at the verb impairment literature alongside the therapy studies, it becomes clear that only fragments of the information arising from the studies of verb characteristics has been used in the therapy interventions. Indeed, there are a disappointing number of verb therapy studies in comparison to the relative wealth of investigations of noun impairments. Some of the studies reviewed here show that not only aphasiological information but also neuroscience hypotheses can be incorporated and tested in verb therapy studies. Clearly, there is considerable potential for incorporating more of this information into future verb therapies. For example, it should be possible to test whether people with aphasia are sensitive to the various psycholinguistic factors over which nouns and verbs vary and then to see if this predicts therapy outcome for the two word types. As described, the cognitive demands arising for verb processing and production may be critical for patients with impairments in this domain. So it may be beneficial to adjust the nature of the therapies used with such patients in order to minimise the requirement for executive control (for example, using errorless learning techniques: Fillingham et al., 2003, 2005a, 2005b, 2005c).

The application of visual cues in the therapy process for verbs such as gesture and demonstration of actions through drawing also shows some promise (e.g., Pashek, 1998; Schneider & Thompson, 2003) and could be more narrowly defined and applied. Such strategies are theoretically underpinned both by the notion of controlling executive and attentional resources to the most salient and conceptually pertinent aspects of an action (Silveri et al., 2003), and by the event perception idea of external facilitation of thinking for speaking (Marshall & Cairns, 2005). Similarly, utilising more intact levels of linguistic processing to provide scaffolding for verb production, such as phonology or syntax for some participants, as demonstrated in some mapping therapies such as Marshall et al. (1997), warrants further research. Furthermore, utilising a case-series approach will enable us to contrast between participants directly and also to relate their therapy results back to their underlying aphasiological, neuropsychological, and neurological profiles. The case-series approach would also allow systematic examination of the issue of generalisation gains. Although the therapy studies reviewed suggest some broad points of consensus regarding the potential generalisation gains from verb retrieval therapies,

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there is little detailed and specific agreement. Again, this could be achieved through analysing any such changes across various speech tasks (single word naming, related sentence production, unrelated sentence production, narrative, etc.) and across a varied set of participants undergoing the same therapy. By building up this kind of multidisciplinary database, we should then be in a much stronger position to understand the neural and behavioural underpinning for verb processing, and to use this information for effective verb therapy.

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