Towards a 'bucket' theory of language disability: taking account of interaction between linguistic levels

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ABSTRACT

Models of language which recognize a series of levels are commonplace in clinical language studies, but less attention has been paid to how they interact, and the effect these interactions have on the linguistic performance of language handicapped people. Several relevant studies which seem to demonstrate the existence of restricted linguistic processing capacity are reviewed, from which it is concluded that there are a number of types of interaction which have not been sufficiently considered. A sample of spontaneous speech from a language-delayed child of 4;7 illustrates the effects of four of these interactions (syntax/nonsegmental phonology, segmental phonology/other levels, syntax/semantics, pragmatics/other levels). It is concluded that there is a need for detailed description of the error-patterns of language-handicapped people, with particular reference to prosodic factors (especially those entering into the definition of fluency) to determine which kinds of interaction are most in evidence. A model of limited linguistic processing which is based on a notion of hierarchy is premature. Rather, a simpler model, referred to here as the 'bucket' model, in which the different levels exercise mutual influence without priorities, is more appropriate in our present state of knowledge.

> The question of levels is relevant indeed. Too often, attempts to treat the linguistic aspect of aphasia suffer from inadequate delimitation of the linguistic levels. One could even say that today the most important task in linguistics is to learn how to delimit the levels. The various levels of language are autonomous. Autonomy doesn't mean isolationism; all levels are interrelated. Autonomy does not exclude integration, and even more—autonomy and integration are closely linked phenomena. But in all linguistic questions and especially in the case of aphasia, it is important to approach language and its disruption in the framework of a given level, while remembering at the same time that any level is what the Germans call *das Teilganze* and that the totality and the interrelation between the different parts of the totality have to be taken into account. (Jakobson, 1971/1980, pp. 94–95.)

But how to take all this into account? In the past 15 years, there have been many applications of the notion of levels in clinical language studies. Today, delimitation of levels is no longer a major goal. Innumerable clinical linguistic tests, profiles, and

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other procedures show how clinicians have found the notion of levels fruitful, both theoretically and practically. And the problems of delimitation have been frequently addressed (though by no means resolved) within the theoretical linguistics literature. But little more than lip-service has been paid to the question of integration, either theoretically or in terms of specific procedures of assessment and intervention. The current orthodoxy is to break a patient's language down into levels, giving each as full an analysis as is practicable, and making the occasional informal unsystematic bow in the direction of other levels. We do indeed 'remember at the same time', as Jakobson put it, that the other levels are there; but it seems to me that so far very little has been done to 'take them into account'.

Investigating the notion of interaction, of course, presupposes that some decision has been made about the number of levels it is useful to recognize, and how best to define them. This continues to be a controversial issue. Models of linguistic enquiry operate with varying numbers of levels, from simple three-level approaches (such as *phonology—grammar—semantics*), through five- or six-level approaches (such as *phonetics—phonology—morphology—syntax—semantics*), to approaches which recognize a dozen or more levels (introducing such notions as *segmental* versus *non-segmental* phonetics and phonology, *morphophonology*, and *grammatical* versus *lexical* versus *discourse* semantics). *Pragmatics* is also often referred to as a level, though of a rather different kind. Likewise, people talk of *cognitive*, *neurological*, and other levels (which will not be investigated in this paper, although the issues are the same in principle). And there are the complications which arise when the notion is extended, as it frequently is, to refer also to the different levels of abstraction which can be recognized as operating *within* a level, in the above sense—such as word, phrase, clause and sentence 'levels' within grammar, or syllable, foot, and tone unit 'levels' within phonology. Terminology varies in all this, adding a further complication. But there is nonetheless no doubting the fruitfulness of the basic insight underlying the notion of level—the recognition of simultaneously-operating dimensions of structural organization capable of being analysed in independent terms from those used elsewhere in language study. And everyone continues to make use of this insight, despite the complications.

Proliferating levels has serious consequences for anyone wishing to make sense of the notion of interaction, however. Obviously, the more levels that are recognized, the more interactions between levels there will be. A three-level model posits only three interactions, whereas a six-level model posits 15, and a nine-level model 36. If one expects the direction of interaction to vary, as we might in a neurolinguistic or psycholinguistic processing theory (for example recognizing different paths from phonetics to phonology and from phonology to phonetics), then these totals double. Table 1 shows an eight-level model incorporating 28 (or 56) possible types of two-way interaction. Is the systematic investigation of these interactions of clinical significance?

My view is that the interactions between levels are of considerable clinical import. Indeed, a good case can be made to say that the traditional preoccupation with levels has led us to ignore what may well be a central issue in the investigation of language disabilities. Because we have traditionally seen levels as the main means of identifying disability, there is a natural tendency to think of interactions as somehow 'marginal' factors—as 'additional complications' (see figure 1[a]). But it is possible to reverse this viewpoint, and see (as a theoretical position) the interactions as central. There are various ways in which this can be modelled. We could recognize a single system of analysis which operates regardless of the number and nature of the levels in-

Table 1.   Possible interactions between linguistic levels.

	Phonetics	Segmental phonology	Non-segmental phonology	Morphology	Syntax	Lexical semantics	Grammatical semantics	Pragmatics
Phonetics	n/a	x	x	x	x	x	x	x
Segmental phonology	(x)	n/a	x	x	x	x	x	x
Non-segmental phonology	(x)	(x)	n/a	x	x	x	x	x
Morphology	(x)	(x)	(x)	n/a	x	x	x	x
Syntax	(x)	(x)	(x)	(x)	n/a	x	x	x
Lexical semantics	(x)	(x)	(x)	(x)	(x)	n/a	x	x
Grammatical semantics	(x)	(x)	(x)	(x)	(x)	(x)	n/a	x
Pragmatics	(x)	(x)	(x)	(x)	(x)	(x)	(x)	n/a

n/a = Not applicable.

x = Two-way interactions.
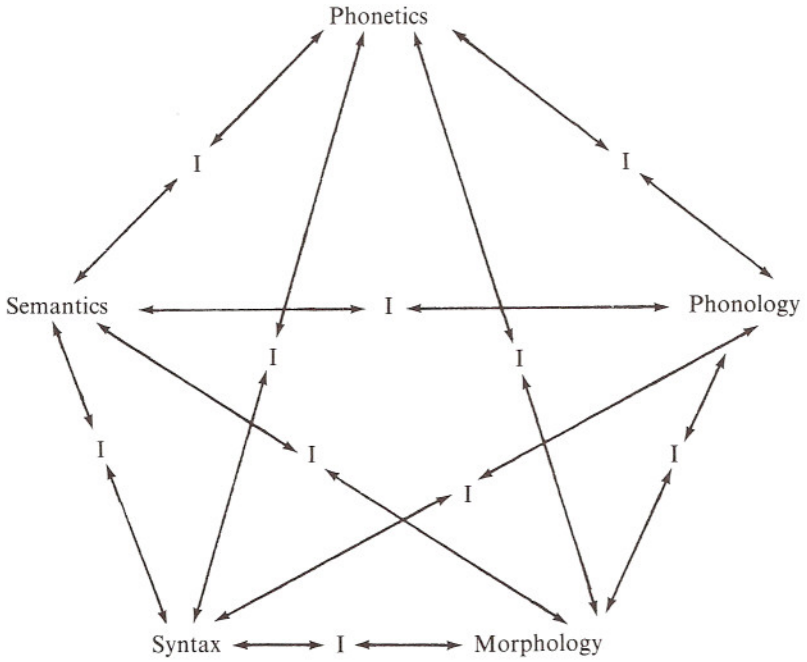
(x) = Required if interaction is directional.
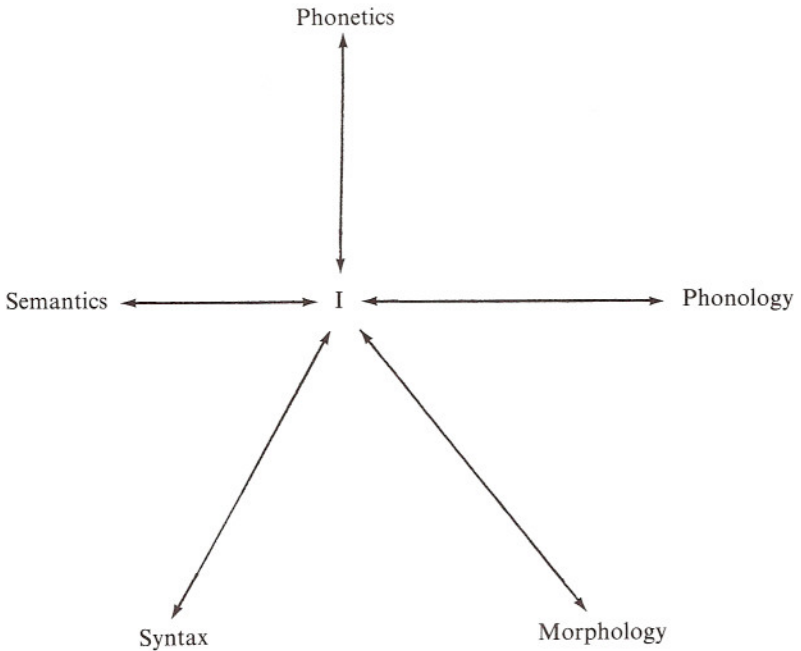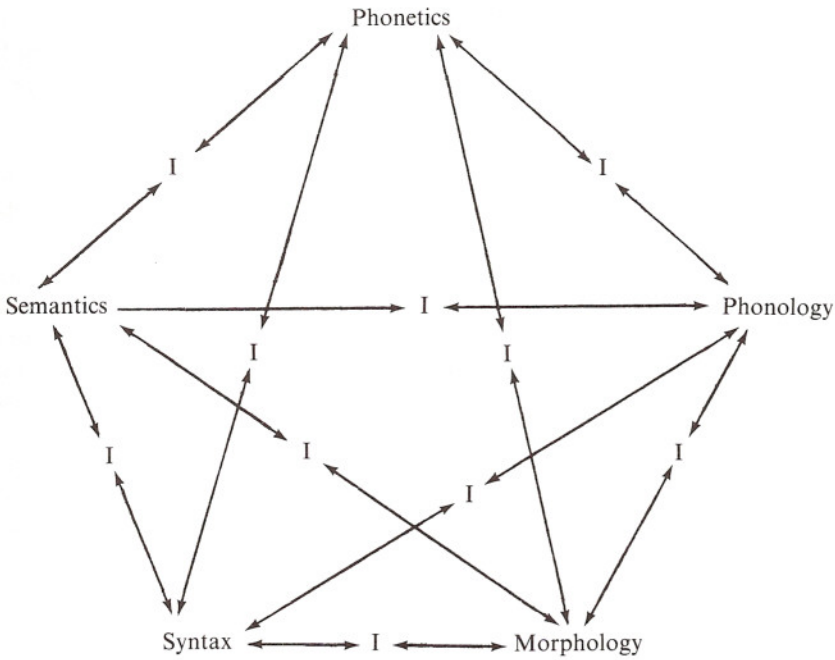
Figure 1(a).

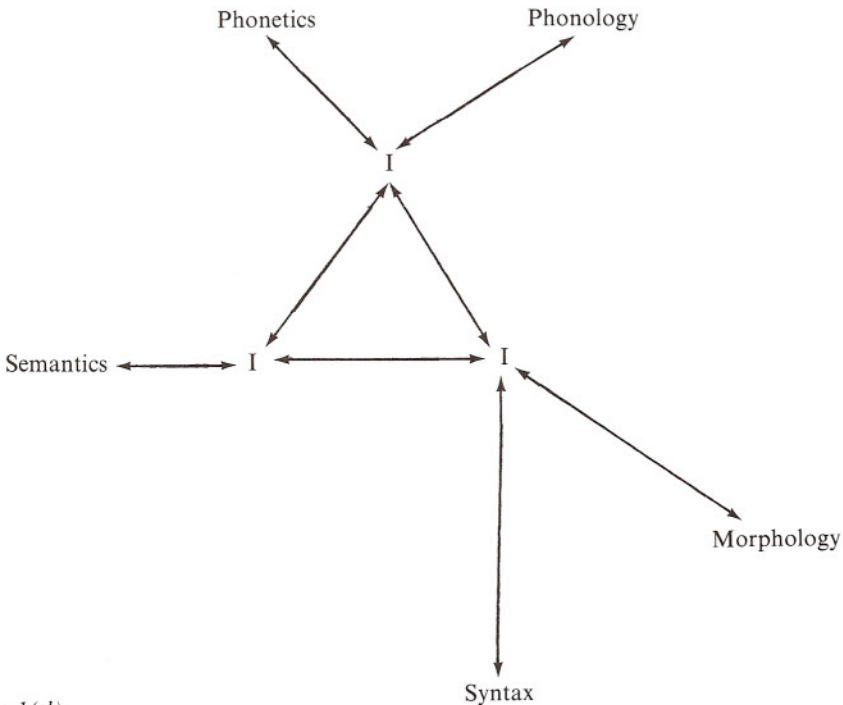*Figure 1(b).*

Figure 1(c).

Figure 1(d).

Figure 1. Four models of the relationship between linguistic levels and interactions: (a) Levels central, interactions marginal; (b) Levels marginal, a single interaction; (c) Levels marginal, individual interactions; and (d) Levels marginal, grouped interactions.

volved (figure 1[*b*]). Or perhaps different systems operate between different levels (figure 1[*c*]), or between different groups of levels (figure 1[*d*]). Doubtless the truth lies in some 'mixed' model, in which levels and their interactions both play their part. But the present paper looks only at the question of interaction.

More sophisticated interactionist models can, of course, be conceived of—for example, by introducing the notion of *hierarchy*. A hierarchy is a series of levels in which adjacent members have a subordinate/superordinate relation. Some levels are conceived as 'higher-order' in relation to others which are 'lower-order'. For instance, it is common to see psycholinguistic and neuropsychological investigations of language disability—especially those which focus on 'processes' rather than 'products'—referring to semantics and syntax as 'higher-order' levels, and phonetics and phonology as 'lower-order' levels. The assumption seems to be that the higher levels, involving more abstract or complex processing, will influence or constrain the lower ones. But there is no reason why the reverse direction of influence should not obtain, and no reason to think that a single hierarchical dimension can incorporate all the relationships which have to be explained. Any conceptualization in terms of 'higher' and 'lower' is an unnecessary complication, at the present stage of the enquiry. We certainly need to work towards a notion of hierarchy such as that propounded by Cromer (1978, p. 127): 'the analysis of a complex behaviour into its component parts in which the performance of some parts is postponed while performance of other parts takes priority'. But we are not yet at the stage where we can motivate any such theory. An empirical case for an interactionist theory needs to be made, and for this we need assume no more than a model of language in which a series of levels is simultaneously organized, leaving open the question of the hierarchical relationships which may exist between them.

The clinical relevance of this approach should be clear. From a diagnostic point of view, it is possible to conceive of types of disability defined in terms of interaction— where a diagnosis is not simply made in terms of, for example, 'grammar' or 'phonology', but in terms of the interaction between grammar and phonology, as the patient tries to increase the complexity of utterances. And in relation to assessment and intervention, the interaction between levels could perhaps go some way towards explaining the erratic, unbalanced nature of language learning so often observed in the handicapped patient, when features being acquired are found not to be learned 'across the board', or where an ability present one moment is found to be absent the next. We too readily attribute such variation to 'individual differences', 'fatigue', 'attention problems', 'carry-over', and the like, without first considering whether the erratic behaviour is not a systematic consequence of an interaction between levels.

Empirical evidence

Evidence is slowly accumulating to motivate an interactionist theory of language disability, but to date the studies have been very selective in the interactions explored, and no overall theoretical linguistic framework has been introduced. References can be adduced in the literature both on normal language acquisition and on language disability. The vast majority of the studies have referred to the interaction between syntax and phonology, and the transition between one- and two-word utterances has attracted particular attention. Among early observations on normal children we find Scollon (1976) noting that when words occurred in his child's 'vertical constructions', his phonology tended to regress to that of an earlier stage. A similar point is made by

de Villiers and de Villiers (1978), who noted reduced phonetic accuracy when the child tried two-word utterances, and also by Waterson (1978), who saw a 'trade-off' in complexity between syntax and phonology at this stage. Waterson makes a general comment which bears directly on the main theme of this paper (1978, p. 416):

> if there was progress at one level, there was often little or no progress at another. This suggests that the child's overall organization for language was such that it was not possible for him to cope with growth at all the levels at the same time.

Donahue (1986) showed a consonant harmony constraint across morpheme boundaries, which delayed the onset of two-word utterances and influenced the selection of words that could occur in combination. Her child could not have two consonants in one utterance if they were at different places of articulation; the child would readily name or imitate such sequences as *big book* [bɪbʊp] or *big bird* [bɪbæb], but would refuse to produce *big dog, big cookie* etc. Nelson and Kamhi (1984) make a more general point: trade-offs between syntax and phonology, they claim, are most apparent during periods of transition or reorganization between syntactic stages (see also Ferguson, 1979).

Given the existence of these effects in normal children, the occurrence of similar effects in language handicapped children should come as no surprise. For example, Faircloth and Faircloth (1970) studied a child who made more articulatory errors in sentences than in isolated words; Schmauch, Panagos and Klich (1978) found children who made more articulatory errors in sentences than in isolated noun phrases (and see also Panagos, Quine and Klich, 1979), where a combination of syntactic and phonological factors was found to have a similar effect). Whereas these studies illustrate a 'top-down' factor—the demands of syntax processing disrupt phonology—Panagos and Prelock (1982) found evidence to support a 'bottom-up' factor as well (see also Shriner, Holloway and Daniloff, 1969; Whitacre, Luper and Pollio, 1970). When words of greater syllabic complexity were introduced into the sentences of language disordered children, the sentences contained significantly more syntactic errors. They conclude: 'During sentence production syntactic and phonological structures influence one another such that complexity added on either level disrupts performance on the other and cumulative complexity disrupts performance on both' (*ibid.*, p. 176).

Syntax has not been the only level thought to interact with phonetics and phonology; different aspects of semantics have also been proposed. Vocabulary size has been implicated at early ages. As more words enter the lexicon, some degree of phonological reorganization must take place, and this can lead to regression in the phonetic accuracy of word production (Ingram, 1976; Ferguson and Farwell, 1975). Semantic complexity has also been suggested. Camarata and Schwartz (1985), in particular, have proposed an 'increasing semantic complexity—decreasing phonetic accuracy' hypothesis, illustrating this from a notion of action versus object complexity based on Gentner (1982). Action words are thought to have greater semantic complexity, and thus to place more demands on a person's processing ability; these words will therefore be pronounced with a poorer phonological structure. Their study, which took into account word familiarity and position in the sentence, showed that a group of normal and language handicapped children did pronounce object words more accurately. This finding was reinforced in a follow-up study of normal children (aged 1;8 to 2;1) by Camarata and Leonard (1986), which used a larger

number of words. Once again, the object words were more accurate, and the error patterns in action words reflected the errors found in the children's earlier speech. The children attempted new consonants only in the object words. Camarata and Leonard conclude (*ibid.*, p. 62):

> The child utilizes additional processing capabilities when attempting either new forms or new functions; such advances cannot co-occur, because the increased processing demands associated with a new form or new function leave the child with limited processing ability.

Other semantic factors have been cited, such as lexical familiarity. It has been suggested, for example, that a child's ability to use a word in a new productive syntactic rule depends on the extent to which the child has previously encountered or used the word (Brown and Leonard, 1986; Bloom, Miller and Hood, 1975).

The point about familiarity is, of course, familiar. It has often been pointed out that children rely on ready-made, established units when producing more complex utterances for the first time (notably, as summarized in Slobin's [1973] formulation of cognitive strategies in terms of 'new functions—old forms' and 'new forms—old functions'). Clark (1974), arguing in support of the view that a mutual influence exists between linguistic competence and limitations of memory or processing capacity, concludes on the basis of an analysis of her son's speech in the third year that 'lack of familiarity is a more important factor in sentence complexity than length' (p. 8). She supports Bloom in separating the notion of limited memory capacity from that of sentence processing ability: children generally operating with sentences of a particular level of complexity can produce much longer utterances as long as the content is familiar (Bloom, 1970, p. 169). Muma (1978, p. 22) also draws a clear distinction between memory and processing capacity: 'young children do not have so much difficulty with memory span as with processing capacity'. Kamhi, Catts and Davis (1984) stress the importance of automaticity in processing (especially at 'lower' levels, but not excluding 'higher' levels): increasing familiarity at one level reduces the vulnerability of that level to demands made at another level.

Several other types of interaction have been indicated. The pragmatic demands made on a person can influence phonological performance. One group of language-delayed preschool children was asked to label pictures of objects whose name contained their error sounds (Weiner and Ostrowski, 1979). The clinician responded by asking 'Did you say *NAME*?', with *NAME* produced accurately or inaccurately. The children's errors decreased significantly when they thought they were not being understood (see also Gallagher, 1977; Longhurst and Siegel, 1973). The pragmatic distribution of information within the utterance is also relevant. Campbell and Shriberg (1982) found that a group of language-delayed children (mean age 5;10) used four natural phonological processes (Shriberg and Kwiatkowski, 1980) much less often during comments than topics.

Another kind of interaction emerged from the Campbell and Shriberg study: a relationship between the two domains of phonology (segmental and non-segmental). They found that the use of natural phonological processes was significantly reduced when words were produced with primary stress. The differential influence of stress on articulation is also recognized in the PROPH system of analysis, which profiles stressed and unstressed segments separately (Crystal, 1982a, pp. 66–67). A further interaction between levels has been noted with reference to morphology and syntax; extra morphological structure can result in a deterioration in syntax (for example

Bloom, Miller and Hood, 1975). And several authors posit a link between syntax and semantics (for example Leonard, 1976; Bloom *et al.*, 1980).

A number of authors reach a general conclusion. Clark (1974, p. 2), for example, believes that 'It would perhaps be fruitful to consider the child's verbal activity in terms of a number of tasks being performed concurrently (see Fitts and Posner, 1967). As the child acquires facility with one, he may be able to direct more of his attention to another. His output would then have to be considered, not as so many utterances requiring syntactic analysis, but as evidence of his growing capacity to manipulate a number of parameters concurrently in skilled performance'. Muma (1978) introduces the idea of 'oscillatory cycles', based on Menyuk (1964)—periods in which structures are produced with varying amounts of error, the errors alternately increasing and decreasing, but with the gross totals gradually diminishing over time. What is critical for clinicians, he argues, is to identify targets of intervention in terms of the number and nature of the linguistic systems which co-occur and co-vary. Schwarz *et al.* (1980) present what they call a 'synergistic' view, in which effects are explained through the recognition of independent systems working together. Panagos, Quine and Klich (1979) recognize an underlying organizational limitation: each level of language contains a hierarchy of elements, which children have a limited ability to manage while encoding. Some authors maintain a viewpoint about the direction of the processing constraints (usually 'higher' to 'lower'); others keep an open mind about the direction involved, in our present state of knowledge (for example Camarata and Schwartz, 1985). (For other conceptions involving interaction between levels, see Bowerman [1982] and, for a model of language production in terms of non-serial cognitive processing, Stemberger [1985].)

Based on this evidence, from studies of both normal and handicapped child language, there is I believe a strong case for the more systematic study of the interaction between linguistic levels in the field of language disability. There has been too ready a tendency to assume that, because a linguistic form is absent from a child's production, it is therefore not part of his competence. The direction of the above research suggests that absence or inaccuracy may also arise as a result of limited sentence processing capacity. (Cf. the analogous debate in relation to whether adult aphasia can be best described in terms of competence or performance, Weigl and Bierwisch, 1970; Whitaker, 1969; Crystal, 1982b.) But there are three major problems which have to be considered.

(1)   Only a few of the many kinds of interactions have been investigated (cf. figure 1), and some very selectively. Only a more systematic coverage of the types of interaction can determine the universality of any processing hypothesis. For example, Paul and Shriberg (1982) found that in the case of two of their four groups of children phonological simplifications could not be predicted on the basis of morphological/syntactic complexity. They conclude that the other children (approximately half the sample) did not have a limited encoding capacity. However, while in this case there seemed to be no trade-off between phonology and grammar, this does not exclude the possibility of a trade-off between phonology and semantics, pragmatics, non-segmental phonology, or other levels. Phonology and grammar may be intact, but limitations may be apparent at other levels. Any conclusion about processing is premature until these other interactions are also investigated. Similarly, Kamhi *et al.* [1984] found that some aspects of phonological accuracy increased and others decreased as language complexity (measured using LARSP [Crystal, Fletcher

and Garman, 1976]) increased, and there were several individual differences, both within and between stages. They present an explanation for the variability in terms of styles of language acquisition (children being more or less tolerant of variation, more or less willing to take risks, etc.). But once again, it would be as well to determine whether the involvement of other levels could explain any of the variability before proceeding to search in a quite different direction.

(2) The notions of complexity operating at each level need further refinement. There is still little empirical evidence for the existence of interactions between relatively *specific* features at each level. One example of such a study is Cohen (1978), who examined the percentage of correct /s/ production in relation to both nouns and verbs in normal and language-impaired children (finding the proportion to be higher in the former). There needs to be more analysis in which individual features at different levels (specific phonemes, word classes, semantic fields etc.) are placed in correspondence. At the same time, we need to be alert for the existence of possible confounding factors. For example, increasing the phonological complexity of a word (for example in terms of syllable length) affects syntactic ability (Panagos and Prelock, 1982). But as phonologically more complex words are likely to be less familiar to the child, one must ask whether the effect is due to phonology alone, or whether there is not a semantic factor which needs to be taken into account.

(3) Methodological questions need to be addressed. Most of the information so far collected has used an experimental design, often involving relatively uncommon sentence types (such as passives, embedded clauses) and abnormal tasks (such as imitation). A few studies have used samples of spontaneous speech (such as Paul and Shriberg, 1982), to avoid this problem; but it is unclear to what extent context, content, and other variables alter the processing demands made during spontaneous speech (Kamhi et al., 1984). In a clinical setting, spontaneous speech can sometimes be as unnatural as in any experimental setting. We therefore need studies in which a fairly clear-cut effect is monitored in a range of elicitation conditions.

Further interactions

The remainder of this paper provides some data relevant to the first of these questions. The subject is S.P., a language handicapped boy, of normal intelligence, aged 4;7 at the time of recording. S.P. had a history of upper respiratory tract infections, with some otitis media, but hearing was said to be within normal limits. Test results at age 3;10, using the Reynell (1977) Developmental Language Scales, were: comprehension 3;2; expression 2;6–3;0 (with several possibly stereotyped responses). The parents had sought help because they were concerned over S.P.'s non-fluency after a stay in hospital (acute torticollis and lymphadenopathy); his father had stammered as a child, and was still non-fluent on occasion.

Table 2 gives all of S.P.'s sentences in 10 minutes of spontaneous speech, taken from a sample in which he is playing with a toy farm with a speech therapist (whose input was not consciously structured in any way). The 126 sentences produce a profile which is entirely typical of S.P.'s language. The transcription does not, of course, convey the general impression of this child, who played with enthusiasm and intelligence, frequently initiated conversation, and was very willing to co-operate with the therapist.

The data show four kinds of interaction between levels, none of which seems to have been systematically investigated in previous research.

Table 2.   *Sentences used in a 10 min. sample of S.P.'s spontaneous speech.*

Section A
   Unintelligible (*1 syll*) 2   (*2 sylls*) 4   (*3 sylls*) a (*1 syll*)/   (*1 syll*) a pig/   that got (*1 syll*)
      on him/   so [e] him/
   Incomplete that's   and that
   Stereotyped one two three four/   five six seven/   six/   I don't know/ 2

Stage I
   Minor no/ 10   yes/ 6   yeah/ 13   oh/ 4   ah/ 4   sorry/
   Major drop/   way/   cow/   turkey/   chicken/ 2   horses/   stick/   lots/   Worzel
      Gummidge/   two/   there/   where/

Stage II
   Phrase a stick/ a gun/ a dog/ a donkey/ a sheep/ a cow/ nother one/ that one/ two mans/
   Clause he is/ it is/ it does/ it do/ got them/ some more have/ that a cow/ [t] a pig/
      a cow there/ look at that one/ 2   that one(s) flying away/

Stage III
Phrase	two brown . horses/	just big pigs/
Clause	(they) can kill somebody/	that goes in the water/
	that . that can go there/	there it is/ 2
	carry . thing . along/	where's that other pig gone/
	put that one with him/	knocked it over/
	that is too big/	that (isn't) the (wrong) one/
	there's a mans/	that one's got a saddle . on/
	falls – falls [frə də] . and back/	
	e . verything's . getting fall down/	

Stage IV
Phrase	horsie . with saddle/	
Clause	(I) want put that there/	(I) want to go this . as well/
	(he) don't live in a house or a field/	
	that goes in there/ don't they/	I got be careful/ don't I/
	[ne] . (*2 sylls*) do that (for)/ . don't they/	
	that is – making my (*1 syll*)/ don't (it)/	
	and that one(s) got a walking stick/	and the bath . go there/
	but nobody else have/	so someone sit on it/
	. and when he's turning (*1 syll*)	
	but they're aw – but they're aw – but they're awfully strong/	

Stage V
   er . some of them in it/ . and . some furniture in it/
   I don't want – m . me don't want what that is/
   it's me (that is) – watch Worzel Gummidge/
   you know that man with a gu . gun/ that Worzel Gummidge man/ and that . are the
      (*2 sylls*) on them – – on them . thick thick things/ and he fall(s) backwards and .
      frontwards/
   (we've) got (one of) these . got put it up a tractor . that (*1 syll*) . and put it in there/
      don't they/
   m . m . m my dad went in the woods/ a . and me/ – dad/ – me/ went in the woods/
      and we did saw a (lot of) fox/ – but my . dad . but my dad . but . my dad killed it/

( ) enclose unintelligible or unclear speech; *sylls* syllables; / tone unit boundary; . brief
pause; – pause equivalent to a unit of speaker's rhythm
Numerals refer to the number of times the sentence is used in the sample

(1)   The most noticeable interaction is between syntax and non-segmental pho-
nology—specifically, features of rhythm, intonation, and pause. The effect can be
summarized by saying that, as S.P. attempts more advanced structures (as defined
using LARSP), his fluency deteriorates. The critical level seems to be Stage V on

LARSP, the stage of complex sentence formation ('complex' here referring to the use of more than one clause within a sentence. S.P. was never heard to produce a complex sentence without a severe breakdown in its rhythmical and intonational structure. (Tag questions are not analysed as complex, in this approach; but even if they were, their comparative fluency can be explained by their stereotypical character in S.P.'s speech, with *don't* being the only type used.) The most dramatic examples are when he tries to use *but* as a clause connective (or even as an initiating conjunction in an opening sentence), when there was usually a phrasal stammer. By contrast, there was little sign of any major non-fluency in sentences assignable to early stages. His Stage I–III sentences were on the whole produced with fluency and confidence, the few exceptions being due to the occasional lexeme-finding problem (for example *carry . thing . along*) or the anticipation of a difficult word (for example *falls–falls* [frədə] (i.e. forwards) *and back/*). The quite noticeable non-fluency of *e . verything's . getting fall down* may not be an exception at all, given the complex verb phrase being attempted.

(2)   There is also an interaction between segmental phonology and other levels, but this does not manifest itself in the usual types of vowel or consonant substitution. Several of the more advanced utterances contain words or phrases which are largely or completely unintelligible, and where the speech is often not even transcribable (shown by the use of brackets). This is especially noticeable at the beginning of an utterance, where the subject of the clause is frequently lost or obscure: one hears some kind of noise, at low volume, and sometimes its segmental character is sufficient to permit a guess at the word(s) used. Sometimes also, especially in Stage V sentences, syllables run together *within* an utterance, resulting in unclear items. In all of these cases, it is by no means easy to disentangle the contributing effects of the other levels: presumably syntax (the type and level of construction), semantics (the familiarity and specificity of vocabulary) and non-segmental phonology (the variation in rhythm and tempo) are all involved. In S.P., the effect is only noticeable from Stage IV (there are a few cases of single item unintelligibility, but these were all 'straightforward' problems, such as the child speaking quietly, or the noise of a toy hiding the word on the tape).

(3)   There is a very important interaction between syntax and semantics, though it is unclear whether the effect is best explained by reference to lexical or grammatical aspects of semantic structure (Crystal, 1982a). As sentences advance syntactically, the semantic specificity of the clause elements reduces, with a corresponding increase in the use of deictic items. This is in evidence right from Stage II (*that a cow, a cow there* etc.). It is very rare, in fact, for S.P. to use a clause containing a subject which is other than a pronominal form. This is probably not simply a lexical problem, but a general matter of how much semantic content S.P. is capable of handling in a clause. He has a marked tendency to put only one semantically specific clause element into a clause: *I want PUT that there, so someone SIT on it, that one's got A SADDLE on, I got be CAREFUL don't I* etc. Nearly 70% of S.P.'s verbs are items which are relatively 'empty' of meaning such as *go, do, put, got, is* etc. Single clause elements, used as separate sentences, or asyndetically introduced into a longer sequence, permit much more specificity (*two brown horses, just big pigs, two mans, that Worzel Gummidge man* etc.). The one exception, in this sample, is *he don't live in a house or a field*, but this is an immediate reply to the therapist's stimulus, 'Does he live in a house or a field?', and must therefore be classed as imitation. Likewise, it is possible to discount

some of the apparently more advanced elements as being stereotyped units (the 'backwards and forwards' item, for example). The only clear sign of two element clauses (semantically speaking) is in the final sentence—*my dad went in the woods, my dad killed it*—and it might be argued here that the greater semantic load is at the expense of an almost total breakdown in narrative syntactic structure.

(4)   This last point raises a fourth possible interaction—the effects of a discourse level of organization on all the other levels. It is a fairly common observation that language handicapped children get into difficulties when they launch themselves into a narrative, even though their ability to use single sentences might be quite strong. S.P. certainly fell into this category, as his 'stories' about Worzel Gummidge and his dad illustrate. He operates in two quite different linguistic worlds: the non-narrative world is relatively clear and controlled; the narrative world is a total failure, with listeners often having to break in to stop him floundering and becoming increasingly frustrated and non-verbal. (What is not obvious from the transcription is his reliance on gesture to make good the deficiencies of the syntax and semantics, in these narrative sequences.) In Fig. 1, I have not distinguished a separate discourse level, grouping all effects of this kind under the heading of pragmatics.

   It is not possible to identify S.P.'s linguistic handicap without reference to some notion of a linguistic processing limitation in the amount of information that can be handled simultaneously at different levels. Several of his sentences have nothing at all wrong with them. Others are totally dislocated. He presents with a superficially erratic behaviour, which is often glossed by clinicians using the terminology of 'tendencies' ('dyspraxic tendencies' etc.). If we restrict our attention solely to the structure of a single level, there is no explanation to be found. A sense of system comes only when we broaden our perspective, and take the influence of different levels into account.

   Specific hypotheses about this influence can then be tested in further clinical sessions. For example, in S.P.'s case, the hypothesis about the correlation between Stage V sentence structure and fluency was tested in a subsequent session by making him give instructions using one clause (for example *clap your hands*) and two clauses (for example *clap your hands and rub your nose*), and observing the relative fluency of the two types of sentence. Indeed, for a short period of time, while therapy on this point was continuing, it proved possible to 'induce' a stammer, by simply getting him to 'overload' his linguistic processing capacity (by eliciting from him clauses with specific noun phrases as subject, or clause sequences using *but*). Being able to control the factors in the environment of the language handicapped child, and thus to *predict* the child's behaviour, is an important aim of clinical linguistic research.

Conclusions

I draw two main conclusions, when analyses such as the above are compared with the kind of discussion which has taken place in the research literature on this topic. First, there has been an inadequate specification of the error-patterns encountered in the data, whether spontaneous or experimental. It is clear that we need much more information about the prosodic variables in the speech of the language handicapped, these being defined both phonologically and phonetically (the latter including absolute information about such factors as speech rate). The prosodic data require

meticulous transcriptions, in which such variables as prolongations, pause, pitch range and direction are identified. (In the above examples, I have restricted the transcription to pause and tone unit boundary features only.) For research in this area, it is probably going to be necessary to use a much more sophisticated prosodic transcription than that routinely used in, for example, the grammatical analysis of handicap, or even in prosodic profiling (Crystal, 1982a). Certainly, the almost complete absence of prosodic transcription in the research literature on this topic to date is to be roundly criticised.

Secondly, it would seem premature to assert priorities within these influencing levels, and to introduce a notion of 'hierarchy'. There are too many possible interactions which have not yet been investigated. There are too many effects where it is not possible to be sure which of several factors is the primary one, or whether all must be specified in some mutually-defining or -reinforcing way (as in the case of word-finding difficulties affecting rhythmical structure, or the mutual dependency between phonological length and lexical familiarity). The error-patterns are complex, and require careful analysis, and we need to consider larger samples of data. We must also be extremely careful about uncritically assigning psychological reality to the 'levels' of descriptive linguistic theories, and to the (often arbitrary) boundaries between levels which are imposed, especially in approaches where the number of levels seems to multiply well beyond necessity. At present, all that can be confidently asserted is that mutual influence between some levels exists, and that this factor should play a more dominant role in our search for a general explanation of language handicap.

In a desperate search for an analogy to capture this conception, it seems to me that we can go no further than to liken language processing capacity to a bucket, into which a certain amount of linguistic water has been poured. The bucket gets larger, as the child develops; but in the case of the language handicapped child, there is a series of holes at a certain level. As the child's language level rises, and reaches the holes, there is a stage when *any* extra water poured into the bucket will cause some of the water already present to overflow via the holes (cf. the metaphor of 'cascade' used by McClelland in his processing theory [1979]). An extra 'drop' of phonology (syntax, semantics etc.) may cause the overflow of a 'drop' of syntax (semantics, phonology etc.). It may not be possible always to predict what the correspondences will be: there may be specific structural correlations, or perhaps the correlations relate to recency of learning (the more well-established structures remaining intact), or perhaps the influence is random.

All analogies, of course, leak, and this one, very likely, more than most. A 'bucket' theory of language handicap is too simple to last for long. But if processing theories of handicap are to be satisfactorily developed, then we currently do need a reasonably simple model of enquiry, which is in principle comprehensive, avoids the uncritical use of simple unidimensional notions such as 'span' (as in 'memory span'), and makes the fewest possible assumptions about linguistic hierarchy. A bucket model allows all this: it forces us to examine all possible levels, it is multidimensional, and it makes no assumptions about hierarchy. It can be used for the discussion of problems both of production and reception. Above all, it underscores the importance of the detailed description of patient behaviour, in order to establish the relevant parameters of evidence for testing clinical hypotheses about processing capacity. In this domain, linguistic and phonetic techniques can once again provide, as in so many other areas of language study, an indispensable foundation.

Acknowledgement

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