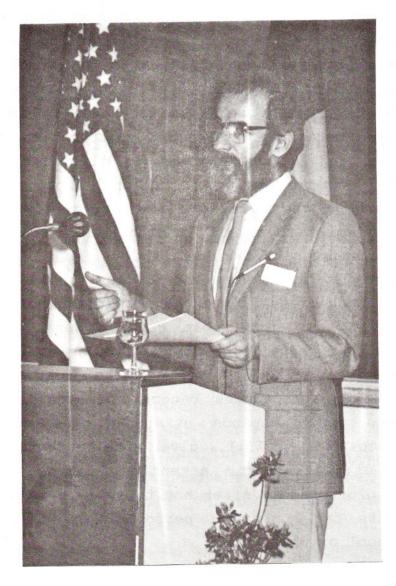---

PHONOLOGICAL ASSESSMENT AND LANGUAGE

PROCESSING

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It is a sad fact of clinical life that routine assessment procedures and techniques of remediation generally lag behind developments in research theory and practice, often by as much as a generation. This used to be due to the vast gap which existed between the academic and clinical worlds : few linguists were experienced in clinical practice, and few clinicians had been trained in linguistics. Today, the situation has fundamentally changed : a substantial number of linguists have now worked closely in collaboration with clinicians, as is evidenced by the papers in such publications as <u>Clinical Linguistics and Phonetics</u>; and in many countries it is usual for clinicians to receive basic courses in linguisics, in several cases taking this training to higher degree level. And yet, despite these advances, the progress in routine clinical and remedial work has not been as great as one might have predicted. In the majority of clinics and classrooms, the same kind of investigative procedures are in use now as were in use a generation ago. There seems to be an inherent conservatism in the teaching situation which it is difficult to counter - not because of the state of mind of the clinicians and teachers, I hasten to add, but because inadequate staffing, opportunities for in-service training, and resources makes it difficult for people to obtain up-to-date information about new procedures, to purchase the material, and (crucially) to find the time to implement them. It is much easier to stay with a well-tried system which has been in use in a clinic for several years, and were everyone knows its strengths and failings, than to launch oneself into the uncharted world of a new procedure, with its inevitable greater demands on intellect and time. For there is no doubt that, as we learn more about the complex nature of language handicap, our assessment and teaching procedures become correspondingly more complex, and make demands upon us which are increasingly difficult to fulfil, given the numbers of patients and pupils waiting for attention. These are factors which are unfortunately often not taken into account when people evaluate the number of personnel required to staff a clinic, school or unit.

Although these points are commonly voiced with reference to the large and open-ended domains of grammar, semantics, and pragmatics, the more well-defined and finite field of phonology is nonetheless affected. Phonology is one of the areas which has attracted a great deal of research in the last 20 years, both in theoretical linguistics and in language acquisition, but is by no means uncommon to observe procedures still in routine use which were devised in the 1960s or before, based on long outmoded conceptions of language analysis. Here are three examples of what I mean.

1. The majority of phonological assessment procedures still focus on consonants of the (total or virtual) exclusion vowels. One can understand the reasons for this state of affairs. Consonants are the more important information carrying units in the sound system, they manifest several clearly-identifiable and easily-describable disturbances, and they undoubtedly present us with remedial problems far more frequently than do vowels. Also, vowels are far more difficult to describe precisely in auditory terms, and display regional variations more often, which makes it difficult to standardize procedures. On the other hand, patients with problems in vowel production and perception are by no means uncommon, and we know from phonetics reasearch that there is a close bond between the properties of certain types of consonants and certain types of vowels. A notable case is the correlation between vowel length and the distinction between so-called "voiced" and "voiceless" consonants in syllable-final position. It is not possible to arrive at an adequate assessment of the phonological role of voicing in patients without considering the question of vowel length, which in turn raises questions of their efficiency in stressing syllables and their overall rhythmical ability. Any inadequacies of articulatory timing in consonant production will inevitable spill over into vowel articulation, and may have serious consequences in languages where vowel length is phonological, or where diphthongal qualities play an

important part. And there are immediate consequences for
therapeutic procedures, for example in auditory
discrimination activities or in oral training, as the
focus switches from the consonantal contrast alone to the
acoustic characteristics of the whole syllable.

2. The mention of stress and rhythm leads to my second
illustration, which is the rigid distinction often
presented between the "segmental" and the "non-segmental"
(or "supra-segmental") dimensions of phonological
enquiry. Intonation, rhythm, tone of voice, and other
prosodic and paralinguistic phenomena have of course long
been the area of greatest weakness in the entire domain
of language assessment, and even today I suspect that the
majority of clincians leave training school lacking in
confidence to make a sophisticated prosodic transcription
of speech. I have elsewhere discussed the importance of
this point, in relation to both children and adults (e.g.
Crystal 1984), and find it surprising that even today
there is still only one assessment procedure specifically
devoted to prosody, in a phonological sense (the "PROP"
profile, Crystal 1982). However, in relation to my
present argument, I find it equally surprising that the
relevant points of contact between segmental and non-
segmental phonology are not regularly recognized in the
assessment of a consonant / vowel system. In this
respect, there are several levels of interaction which
might be considered, depending on the kind of
phonological theory one wishes to make use of : in a
"metrical" theory (cf. Hogg & Mc Cully 1987) the point is
more systematically adressed than in most other
approaches, but as it is now 20 years, almost to the day,
since the systematic relationships between vowel values,
stress patterning, and other factors were first presented
in real detail (Chomsky & Halle, 1968), there is no doubt
that some kind on integrated approach is a requirement of
any modern phonological assessment. At the very least, I
would have thought, an inventory of consonants and vowels
would need to take into account their distribution in

relation to stressed and unstressed syllables, and to sequences of such syllables. In the PROPH procedure (Crystal 1982), for example, this distinction is fundamental to the whole assessment, with all syllable-initial en -final consonant segments, and all vowels, being immediately classified into stressed and unstressed contexts, and this factor is borne in mind in relation to other areas of enquiry (such as consonant clusters). The importance of this point, in everyday clinical terms, is I think recognized. We know that problems with rhythmical skills (such as copying elementary sequences of strong and weak beats) are rife in language-handicapped children, and that the behaviour of adult aphasics is much affected by such factors as intonation and stress. But there are few phonological charts where this kind of information can be systematically located and thus made available for interpretation.

3. My third example is the reluctance to move away from oversimplified models of phonological acquisition in carrying out an assessment. It is perfectly clear what everyone wants - a statement of the laws governing the order of emergence of phonological units and combinations. Once we know which consonants and vowels are followed by which, in the learning process, we will have clear guidelines both for assessment and for intervention. The early literature was full of emergence inventories, usually based on a gross frequency count of segments tabulated in speech samples, and we now know that there are several things wrong with these early inventories. The rate of acquisition alters, often quite dramatically, between intial, medial, and final positions in words. The order of acquisition is not the same between perception and production. The focus on individual segments had limited explanatory power, and more fruitful generalizations seem to be obtainable by thinking in terms of higher-order processes (e.g. consonant harmony). But above all, the detailed case studies made since the 1970s (Omsted 1971, Ferguson &

Farwell 1975) have shown the remarkable number of individual differences which affect children, at all stages of phonological development. No doubt as the number of case studies increase, these differences will be put more into perspective, and reliable statistical and other generalizations will emerge; but at present we are very much in a situation where we cannot see the wood for the trees, with few normal children having had their sound system investigated in a thorough longitudinal manner. As a consequence, it is in my view premature to operate with a simple measure of phoneme emergence, as one so often encounters in assessment procedures. Much as we would like to have incorporated one into our own work in this area (order of acquisition being an essential dimension of any "ideal" linguistic profile), Fletcher and I felt it to be less misleading, in our present state of knowledge to organize the phonological profile chart in terms of standard general phonetic articulatory categories (see further, Chapter 1 and 3 of Crystal 1982).

It will take some time before the very large range of relevant variables can be systematically taken into account, in arriving at an ideal phonological assessment procedure. This is not the place to review the whole range of factors which are likely to influence acquisition order, and thus matters of assessment and therapy, but restricting attention to just the following four types of point should show the problems which must be anticipated.

1. How should one take account of <u>frequency of use</u> of the phonological unit in the adult language - or at least in the sub-set of sentences used by parents and next-of-kin ? This is certainly a major consideration, given the (admittedly, not to be over-emphasized) importance of imitation in language learning. It is especially critical when there is a difference between the sound-system of the child/parents/peers and that of the therapist - a point whose significance has not been

sufficiently evaluated in the UK, where there are many value-laden differences of regional accent (especially in the Celtic-background areas). But there is not straightforward correlation between frequency of use and language acquisition. Statistical tables for English RP, for example, start off promisingly enough with /n/, /t/ and /d/ the most commonly occurring consonants, but these are then followed by /s/, /l/, / / and /r/, which are hardly candidates for early acquisition. On the other hand, the statical counts themselves are in need of refinement : the only reason why / /, for example, is so frequent is because of the use of this sound in the determiner system (the, this, etc.); or again, schwa is by far the commonest vowel in RP, but of course only in unstressed syllables.

2. The _functional load_ of a phonological unit is likely to be an important factor - that is, an estimate of the number of words which are actually distinguished using that unit. This is a salient clinical point, both for assessment and therapy. In relation to the former, many patients are characterized by the problem of having certain phonemes carry a disproportionate communicative load. And in relation to the latter, we know that it is easier to find certain minimal pairs (either for auditory or articulatory work) than others. Doubtless children learn the most widely used contrasts earlier on, but a precise quantification of this appealing notion is not at all easy. What kind of language sample should be used ? Should it include all words (such as proper names) ? It is possible to work out charts containing all possible minimal pairs in a language, as in Rockey (1973), but these charts include very rare words, dialect words, and the like, which would somehow need to be excluded in any assessment procedure. One would hardly wish to penalise a child for not using a distinction which was only common in distinguishing words they would never wish to use even as adults !

3. <u>Articulatory and auditory complexity</u> are two obviously relevant variables, and ones which are universally referred to, in some shape or form; but they are of course extremely difficult to define in any theoretically adequate sense, and to apply systematically to phonological units other than at a very gross and superficial level (e.g. the fine motor control required for certain fricatives, or the greater sonority of vowels over consonants). Problems of poor muscular coordination and poor auditory discrimination are easy to demonstrate in the clinical situation, but this is a far cry from defining the relevant parameters and quantifying differences between units, and (more to the point, when talking about assessment) degrees of approximation to accuracy in producing or perceiving these differences. Recent work in phonetics, moreover, has made it clear that any dynamic model of articulatory complexity is going to have to operate with larger units than the individual segment, in any case, in order to explain the frequency and range of effects of assimilation and elision which form so many clinical symptoms.

4. <u>Phonological factors</u>, as such are undoubtedly relevant - for example, the number of allophones a phoneme has within an individual accent, or its range of regional or social variability. In RP, /f/ has no important allophonic variation, whereas /t/ is affected in several ways, as any introduction to English phonology points out. The mastery of a phonological unit is probably influenced by factors of this kind, and presumably error analyses would be able to show some system in the order of emergence of variant forms; but very little work of this type has been done.

There are many other factors which any theory of phonological handicap would need to consider, such as the rate of neurophysiological maturation, the kind of phonological task presented to the patient, and the nature of the social interaction between patient ant therapist.

But I would like to focus now on a neglected principle which, if followed up, might lead to several fruitful lines of enquiry, both in assessment and treatment. The question is, quite simply, can phonological handicaps be explained solely in terms of phonological analysis ?

In a recent paper (Crystal 1987), I raised the question whether too much attention had been paid to linguistic levels, seen in isolation, and not enough to the nature of the interaction which takes place between them. I argued that the traditional preoccupation with levels had 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, in linguistic terms (diagnoses of "grammatical disorder", "semantic delay", etc.), there is a natural tendency to think of interactions as somehow "marginal" factors - as "additional complications". On the whole, it is argued, the patient demonstrates a given level of (in)competence, and we note that this level is occasionally disturbed when other, more complicating factors intervene (such as his attempting a more difficult word than normal). But it is possible to reverse this viewpoint, and see the interactions as central. Types of disability would then be defined in terms of interaction - where a diagnosis is not simply made in terms of, for example, "phonology" and "grammar", but in terms of the interaction between phonology and grammar, as the patient tries to increase the complexity of utterances.

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. Examples of some of these factors are too commonplace to warrant illustration - such as the effect of tiredness of a patient, when an increasing number of errors emerges towards the end of a session. Less obvious are such cases as a phonological contrast (e.g. /t/ vs /k/) becoming established in isolated word-pairs, but being lost in longer phrases :

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T what's that (pointing to a tap)
P /tap/
T and what's that boy got on his head
P /kap/
T so you tell me /
  the boy's --
P / got   tap on   hed/ (i.g. 'got a cap on ? a head')
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Another example would be a case where the contrast was established in words used towards the end of a sentence (such as in object or final adverbial role) but lost in words being used as subjects; or a case where the contrast was found in nouns, but not in verbs. In each case, there would be independent grounds for arguing that the loss could be related to factors of increasing grammatical difficulty - such as the prior emergence of syntactic "weight" towards the end of a sentence in English, or of nouns over verbs (see further below).

Examples of these kinds can be readily adduced from one's clinical experience, but what support does an interactionist position have in the research literature ? Evidence is slowly accumulating, especially in the area of phonology, in relation to both normal language acquisition and on language disability. Most of the studies that I am aware of refer to the interaction between phonology and syntax, and the transition between 1- and 2-word utterances has attracted particular attention. For example, Scollon (1976) noted that when words occurred in one (normal) child's "vertical constructions", their phonology tended to regress to that of an earlier stage. De Villiers and De Villiers (1978) noted

reduced phonetic accuracy when the child tried 2-word utterances. Waterson (1978) commented on the "trade-off" in complexity between syntax and phonology at this stage. In fact, she makes a general comment which bears directly on my argument (p. 415) : "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 operating across morpheme boundaries, which delayed the onset of 2-word utterances and caused a regression in the phonetic accuracy of word production.

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 vs object complexity based on Gentner (1982). Action words are thought to have a 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. : 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).

Several other types of interaction with phonology 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. Also, the pragmatic distribution of information within an 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 much less often during comments than during topics.

In my own experience, the most noticeable interaction has been between syntax and non-segmental phonology - specifically, features of rhythm, intonation, and pause. In the patient studied in Crystal (1987), it was hypothesized that the more advanced structures used (as defined using LARSP), the more his fluency would deteriorate. The critical level seemed 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). That patient was never heard to produce a complex sentence without a severe breakdown in its rhythmical and intonational structure. The most dramatic examples were when he tried 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. I have seen about a dozen language delayed children manifesting this

kind of problem, and the point has also been noted in relation to the emergence of "normal non-fluency" at around age 3, when the attempts to produce complex sentence structure lead to such effects as "him gone in the garden cos- cos- cos- k - cos him h h him looking for daddy" (Dalton & Hardcastle, 1977).

One should also note that several of the most important interaction effects do not manifest themselves in the usual types of vowel or consonant substitution. In the above patient, most of his more advanced utterances contained words or phrases which were largely or completely unintelligible, and where the speech was often not even transcribable. This was especially noticeable at the beginning of an utterance, where the subject of the clause was frequently lost or obscure : one heard some kind of noise, at low volume, and sometimes its segmental character was sufficient to permit a guess at the word(s) used. Sometimes also, especially in complex (Stage V, LARSP) sentences, syllables ran together within an utterance, resulting in unclear items. In all of these cases, it was 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) were all involved. There may also have been an effect at the discourse level of organisation. It is after all a fairly common observation that language handicapped children or adults get into difficulties when they launch themselves into a narrative, even though their ability to use single sentences might be quite strong. The above patient certainly fell into this category. He seemed to operate in two quite different linguistic worlds : the non-narrative world was relatively clear and controlled; the narrative world was a total failure, with listeners often having to break in to stop him floundering and becoming increasingly frustrated and non-verbal.

It is not possible to identify the linguistic handicap of such patients 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 these patients' sentences have nothing at all wrong with them. Others are totally dislocated. They present with a superficially erratic behaviour, which is often glossed by clinicians using the terminology of "tendencies". In phonological handicap, the most widely used of these "non-diagnoses" is the notion of "dyspraxic tendencies". To explain these notions, we must not restrict our attention solely to the structure of a single level. A sense of system comes only when we broaden our perspective, and take the influence of different levels into account.

Specific hypotheses about the influence of other levels on phonology can be easily tested in a clinical session. For example, the hypothesis about the correlation between Stage V sentence structure and fluency can be tested by making a patient give instructions using one clause (e.g. clap you hands) and two clauses (e.g. clap your hands and rub you 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 with the above patient, it proved possible to "induce" a stammer, by simply getting him to "overload" his linguistic processing capacity (by eleciting 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 reasearch.

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 before any assessment can be

complete 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 absolutely meticulous transcriptions, in which such variables as prolongations, pause, pitch range and direction are identified. 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. And even in routine case notes, some recognition of the importance of this dimension of transcription should become routine.

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. At present, all that can be confidently asserted is that mutual influence between phonology and other levels exists, and that this factor should play a more dominant role in our search for a general explanation of phonological handicap. If we can build this perspective into our work on assessment, we shall have taken a major step forward in eliminating some of the more worrying deficiencies of traditional models.

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