Chapter 6: Conclusion

6.0 Outline

The structure of the conclusion is as follows. Firstly, the main points of the discussion so far are summarised (6.1). There are two main streams to this summary: those that concern the state of development of the PENMAN system; and those that concern the theoretical position taken in the thesis. Following this the discussion is split into two parts: section 6.2 is about the NIGEL system; presenting an agenda for further development. The last part (6.3) concerns the theoretical aspects of the work.

6.1 Summary

The introduction is mainly concerned with identifying the "problems" with NIGEL that become apparent when intonation and a general graphology are considered. These problems lie mainly in the system architecture. (i) NIGEL's output system - the punctuation system - is not sufficiently modular with respect to the resource - the grammar. (ii) Nor is the architecture of NIGEL sufficiently general to expand to implement systems for intonation.

i. Modularity makes computational linguistics more tractable. Three main principles - which guide the design of new parts of NIGEL - were identified. Firstly, the Stratificational Realisation Principle emphasises the importance of the systemic stratificational model - in which realisation is the main mechanism by which strata interact. The chooser and inquiry mechanism embodies this principle as well; the lexico-grammar realises choices made by the environment. Secondly, the Stratificational Opacity Principle is very important: each module 'knows' only that information that is relevant to its function - modules can not 'see into' each other. Thirdly, the Stratificational Unidirectionality Principle (SUP) recognises the relationship between the 'emic' - graphological / phonological - stratum and the 'etic' - graphetic / phonetic - stratum. In systemic linguistics the etic stratum is not seen as part of the language - so no meaning is made by the output system interacting with other strata. The SUP does not apply to other areas of the language; the chooser and inquiry system is not inherently one way.

   The modularity outlined in the introduction - and adhered to throughout the thesis - is based on the stratificational modularity of systemic theory.

ii. Generality is also very important. One of the main concerns of this thesis is in 'thinking ahead'; to avoid designing mechanisms that are particular to only one aspect of language.

Chapter two has two main parts. The first part develops an interface code for intonation specification based on Halliday's (1967, 1969, 1985.a,b) phonological system - and summarises the theoretical background of the speech synthesiser. The second part is concerned with how the systems for generating this code might be implemented in NIGEL: new parts of the lexico-grammar (Key and information systems), the semantic level (new choosers and inquiries), and the environment (discourse and interactant models) - all need to be developed. Similarly, the choice of the interface code must be compatible with the speech synthesis module - the speech synthesiser was developed with Halliday's system as its input.

Thus the specification of the interface code is the first step in a developmental path that extends both upwards and downwards. Looking upwards, it is possible to install some version of the Key network in NIGEL quite simply, by adopting Halliday's network which includes Key and

Mood (cf Halliday 1967). However, it is less easy to generate the Information Unit independently of the clause because the lexico-grammatical rank-scale is 'hard-wired' into the system; it was never designed to have two such rank-scales. Higher up the stratal model further development of discourse and interactant models will be essential to the information structuring and Key systems respectively. Looking downwards: the speech synthesiser is already developing along the right lines.

It is pointed out in chapter two that the phonological system - the system of Tones - is essentially redundant. If the Key system is distributed through the Mood network then the realisation of Key in Tone is simply automatically passed on to the output program. This redundancy is very helpful; it is not necessary actually to add such an extra stratum to NIGEL. However there is an alternative model in which the phonology would have take over the role of Key and and IU systems. When the text-to-speech method of speech synthesis is replaced with a more 'natural' phonological model then such an autonomous phonology may be introduced.

Chapter three takes a view different from that of chapter two. There was no model of graphology to simply adopt: so a graphological system is sketched. Instead of focussing on lexico-grammatical systems and higher level systems the focus is on the graphological system - analogous to the system of Tone, rather than Key. As well, the three ways that strata interact to make meaning are discussed.

i. The simple realisational relationship by which the stratal model operates is meta-redundancy. There is a meta-redundant relationship, for example, between a projected clause and its realisation with quotation marks.

ii. Meaning is also made through the choices made in 'navigating' the systemic resource. This is simply another aspect of meta-redundancy; one stratum realises choice made in another. It makes sense to think of choice in relation to large text pieces as well as at clause rank. For example, the way that the names of songs are italicised throughout the "Jungle Groove" text, for example.

iii. The two ways of meaning above are already implemented in NIGEL but there is another important one that is not: in the interests of generality it is desirable to be able to describe systems that are local in scope. While use of italics, for example, is not globally systematic it may be locally systematic. The important addition to a systemic model needed for this is a way of capturing the process by which local systems are negotiated. The mechanism by which this will work was introduced in chapter four, with the `REALISE` command in the GEKKO system.

Chapters two and three are complementary. Chapter two is rather tied to the NIGEL system and extensions that will be made to it; while chapter three is more ambitious in its scope - aiming to 'push back' the boundary between paralinguistic and linguistic systems. Intonation is not inherently discrete; implying that a grammatical treatment of intonation represents a compromise (cf Halliday 1967 section 1) between the discreteness demanded by formal linguistic models - like system networks - and actual intonation.

In contrast to intonation, computational typographic systems are discrete. Thus, given a discourse model with the relevant systems, NIGEL could be made to output graphological paragraphs in the interface code specified here. Trying, however, to work out what the phonological version of the graphological paragraph is much harder. The prosodic paragraph discussed by Silverman (1987 ch.6) is not well defined or obviously delineated - intonation is much more complex than the typographic use of space.

The complementarity of chapters two and three lies in this difference in discreteness. While the phonological model is better developed for short-range supra-segmental phenomena - Tone contours - the graphological model makes description of larger units possible.

Chapters four and five simply describe the output systems. They both represent exercises in programming and engineering - converting the interface codes into sound or graphics. By virtue of the three principles for a clean one-way interface the output programs can be developed independently of the PENMAN system.

Chapter four, in discussing the GEKKO program, also defines the graphological interface code. Since it is designed to be as general as possible the numbered bracketting system is used. Typically, the bracketting indices are not needed to describe typographic texts. However, it is not known to what extent they would be necessary in describing spoken texts.

The indexed brackets make it unnecessary to have a multi-tiered model of graphology or phonology - as many structural devices as necessary can be described. This generality is desirable - not undesirable - because it means that computational designs using this set of formalisms will not require rebuilding in order to implement new things. In any case, having a multi-tiered model requires some prediction of how many tiers there are; such work for graphology has not yet been done. The tactics of English graphology (including punctuation and macro-punctuation) have not been described sufficiently formally to decide just how many tiers would be needed (cf Waller 1980).

Chapter five gives an overview of the way that the speech synthesiser works, in producing melodic speech. The question of long text pieces has not yet been attacked by King and Vonwiller, work has so far concentrated on the same domain as the grammatical system of Key described in chapter two: single tonics (and pre- and post-tonics.).

6.2 Agenda for further development

The following section identifies the short-term direction that the work described here will take. The immediate agenda essentially concentrates on clause-based grammar: the first effort will be towards making the existing NIGEL grammar output melodic speech, using Vonwiller and King's speech synthesis package; and towards 'rehabilitating' NIGEL's punctuation system.

i. Above the interface

1. Implement the Key systems in the mood-grammar. This will include compound Tones and more delicate specification of pitch range.
2. Convert NIGEL's rule-based punctuation to work cleanly via realisation statements. The three stratificational modularity principles will be adhered to.
3. The two steps above will require semantic systems (choosers) to make them work. The environment will have to be developed to support those choosers; it must be able to answer their inquiries. These developments will be in the discourse model and the interactant model. In particular, attention will be paid to dialogic discourse; this will increase the effectiveness of the PENMAN system as a human-machine interface.

ii. Below the interface

1. Continue liaison with engineers working on speech synthesis. The main areas are: the specification of pre- and post-tonics; implementation of longer units - 'prosodic paragraphs'; and more delicate specification of Tones - controlling range of pitch movement.

2. Implement the GEKKO system in PENMAN, concentrating first of all on punctuation rather than macro-punctuation.

In the longer term, those aspects of phonology and graphology which are not clause-based will be pursued. This will include re-design of some parts of the system to cope with IUs that are not necessarily congruent with the clause structure generated by the lexico-grammar. As well, the meaningful specification of typography as macro-punctuation will be attempted.

6.3 Theoretical conclusions

This thesis has used a very general descriptive paradigm, consistent with the systemic theory that informed the design of NIGEL. For example, it would have been a simple matter to start implementing systems for Key in NIGEL without worrying about the broader picture. However, by 'stepping back' and considering graphology as well as phonology, looking at the overall organisation of NIGEL, an agenda presents itself in which work on implementing Key systems is only one part.

The discreteness of typography means that it is possible to see clearly how the generation process in general might be modelled - the section in chapter three about 'ways of making meaning' is an example. It is much more difficult to think about phonological spans of text greater than one cause, because it is not immediately obvious just what such units there are.

For some linguistic endeavours 'constraint' in representation is valued over generality but the opposite applies in this work. One aspect of a very general descriptive paradigm is the way that it often generates more than one way of describing something . For many formal theorists this is anathema. However, for a practical project like the PENMAN system it is very valuable indeed to be able to make alternative analyses and to choose the one that works best - instead of being forced by theoretical pre-conceptions into an inappropriate model. Further, different analyses can be used for different purposes. An example of this is the graphological network presented in chapter three - it shows the tactical organisation of graphology. One alternative network would show meta-functional diversity. Another alternative would be a distributed system, like the 'Key in Mood' system (figure 2.6).

In the chapter on graphology (3) the discussion was based on literature and advertising; it is unlikely that the NIGEL grammar will be called upon to generate such texts. However, there is much to be learnt by looking at language that pushes at the boundaries of sytematicity - like the Bukoswki story with its odd punctuation, and the "Jungle Groove" text with its staccato punctuation of four sentences for one clause-complex - and at texts which define their own systems - like this thesis itself, referring to computer programs in all-caps. By taking such a view the danger of building limitations into systemic theory and into NIGEL is reduced.

Building limitations into a system is a way of creating problems which then need to be solved. An example of this is the inadequacies with NIGEL's architecture cited in the introduction: the punctuation system. Of course, the designers knew the limitations of the system and it was never meant to be extended to produce intonation but given the opportunity and the resources it is better to build extensible systems in the first place.