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**LA THÈSE A ÉTÉ
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KIPARSKY'S LEVEL-ORDERED LEXICAL HYPOTHESIS
AND MORPHOLOGICAL DEVELOPMENT
IN CHILDREN FIVE TO THIRTEEN YEARS

BY

DARLENE LA CHARITE

A THESIS

SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES AND RESEARCH
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FOR THE DEGREE OF
MASTER OF ARTS

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TO VICTOR CHARLES McCARTHY

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ABSTRACT

This study examines the possible application of Kiparsky's Level-ordered lexical model to the acquisition of morphology. Viewed as a model of acquisition, the theory predicts that morphological processes will be acquired in a bottom-up fashion. That is to say, that of the lexical morphological processes, level three processes will be acquired before level two, and level two processes will, in turn, be acquired before those morphological processes occurring at level one. Acquisition literature supports the acquisition of the English regular inflections (level three processes) before several derivational processes which are at level two of Kiparsky's level-ordered model. To explore the applicability of the model to acquisition, sixty-four children, ranging in age from four to thirteen years, were tested on their ability to append four level two and four level one suffixes to English words matched for frequency, number of syllables, stress pattern, neutrality (i.e. they do not cause stem changes), and general phonological shape. Results clearly indicate that children perform better on the suffixation task when they are dealing with level-two suffixes than when they are dealing with level-one suffixes. It is further indicated that the level-two suffixes tested are acquired several months earlier than the level one

suffixes. The conclusion is that morphological acquisition is relatively independent of the behaviour of particular items within a level, and that level ordering not only models the structure of English morphology, but that it represents an innate framework within which morphological acquisition occurs.

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Chapter 1

After the failure to validate claims of psychological reality made by early transformational grammarians, a wide rift developed between theoretical linguists and psycholinguists. Researchers on both sides have been guilty of assuming that findings in the theoretical sphere need have little or nothing to do with facts of acquisition or processing. The distinction between content and process has been widely accepted as more than just an heuristic.

This exclusivity is, however, being questioned once again. Both theoretical linguists and psycholinguists have recently demonstrated renewed interest in coming to grips with the discrepancies between their diverse findings. One theoretical linguist whose work promises a significant contribution in this regard is Paul Kiparsky whose level-ordered lexical model introduces (among other things) an intermediate level of representation which mediates between the underlying representation, which was considered real by theoretical linguists, and the surface occurrence of the word which was often regarded by psycholinguists as the only reality. The degree of abstractness of underlying representations posited by Chomsky and Halle (1968) was considered problematic from the point of view of acquisition. Researchers such as Hooper (1976) argued that segments which

never occur on the surface pose a barrier to acquisition. The intermediate (lexical) level of abstractness introduced by level ordering settles the dispute by introducing a level of abstractness which works with underlying representations but which corresponds to the speaker's conscious perception of the word. It is in part due to the work of theorists like Kiparsky, that theoretical linguists now feel more comfortable with lower levels of abstractness than were previously admitted, and that psycholinguists are becoming more interested in models of acquisition and processing that are motivated by linguistic theory.--

It is not difficult to justify the line of research that is being proposed. First of all, level ordering seems intuitively suited for application to acquisition in ways that previous theories have not been. Level ordering provides a framework within which findings in diverse areas of psycholinguistics are united and put into perspective. Because it seems inconceivable that the structure of language and the way the speaker learns and uses that structure have no common basis, it is worth exploring theories which promise to provide such a basis. Both level ordering and acquisition research stand to gain considerably if it can be established that the two are in some way connected. Theoretical linguists and psycholinguists have often adopted different criteria for

psychological reality, but it is nonetheless the case that any theory which is demonstrated to be 'psychologically real', in a way that is subject to empirical verification, as well as theoretically sound, will enjoy a tremendous advantage among theoretical linguists as well as among psycholinguists. Linguistic theories are routinely judged on the basis of their power, adequacy and simplicity. That is to say, that theory is best which accurately accounts for the widest range of language facts in the simplest terms. A theory which can account not only for structural facts, but facts of its acquisition and use will be, by the theorist's own definition, better than theories that cannot.

A second benefit that will accrue to the theory of level ordering is a further means of deciding between alternative descriptions or explanations. If the connection between level ordering and acquisition is supported by empirical data, then information about acquisition and processing can be used in evaluating it against competing hypotheses. In other words, if acquisition facts can be shown to support existing tenets of the theory, they can be used, alongside structural facts, as criteria in future formulations and refinements of the theory.

Acquisition research, too, stands to gain considerably from an alliance with level ordering. Most importantly, it

4.

will gain a sense of direction. Despite the vast number of studies that have been done on various aspects of morphological acquisition and processing, relatively few English morphological processes (only the inflectional and a very few derivational processes) have been explored. What this means is that much remains to be done by way of charting the course of morphological development. The value of existing work is certainly not being discounted, but there remains a need for some principled way to extend and unite it. Level ordering can help to explain the links between the acquisition of inflectional and derivational morphology; it can contribute to the clarification of the relationship between the acquisition and processing of morphemes. Finally, by providing us with guidelines for charting the course of development, level ordering will put us in a better position to deduce the criteria which determine that course.

It is for these reasons that I have chosen to explore what Kiparsky's level-ordered lexical model and the facts of morphological acquisition might have in common. More specifically, I have undertaken to determine whether levels correlate with the ease and order with which morphemes are acquired.

This thesis is divided into five chapters. This first chapter serves as an introduction to the topic. Within the

Introduction is, first, an overview of Kiparsky's level-ordered lexical model, followed by a review of the relevant literature on morphological acquisition. The final section of the first chapter details the research hypotheses that form the basis of the experiment described in Chapter 2.

The second chapter of the thesis is taken up with a detailed description of the tests that were carried out on behalf of the hypotheses. Chapter 3 presents the statistical analyses and their results. Chapter 4 provides a discussion of the results and draws some conclusions about the implications of the results both for acquisition and the level-ordered model. Finally, chapter 5 considers possible courses of research in the areas of morphological acquisition and processing. First considered are lines of enquiry stemming directly from the present study; this is followed by suggestions for extending and elaborating current knowledge of morphological development and processing.

A BRIEF INTRODUCTION TO THE LEVEL-ORDERED LEXICAL MODEL

This summary of the level-ordered lexical hypothesis is based on the model proposed by Kiparsky (1982b) and further elaborated in Kiparsky (1982c).

One of the most notable features of Kiparsky's level-ordered lexical model is that phonological rules operate in

two distinct domains of the grammar. Some are post-lexical and operate on the output of the syntax which is fed by the lexical component of the grammar. Other phonological rules are lexical and inextricably linked to morphological processes of inflection, derivation and compounding. It is the lexical component of the grammar which has so far received most attention, and it is the lexical component which is the focus of this study. In that component, (at least some) phonological rules operate in tandem with word formation and inflectional processes. In fact, it is a significant feature of the model that morphology and phonology are mutually dependent. The relationship between the two can be most simply described in terms of morphological processes having or triggering phonological consequences. A morphological operation is submitted to the phonological component which contains a specific set of ordered rules which are restricted in their application to specific levels within the lexicon. If the morphological operation has created the appropriate environment for the application of a particular phonological rule or rules, the rule(s) may apply. The output is a form which exists as a lexical item. An example of this processing can be seen in the following derivation:

STEP 1 (morphological operation) - /davin/+/Iti/ → /davinIti/

STEP 2 (phonological operation) - /davinIti/ → /davinIti/

Within the lexicon, sets of morphological and phonological rules are organized into distinct layers or levels. The number of levels in the lexicon is a point of debate, but it must, to preserve the very concept of level-ordering, be more than one. The most general morphological-phonological processes occur at levels subsequent to the level at which exceptions are handled. For example, the plural of ox and the past tense of go, being irregular, would be formed at level I, while the plural of desk and the past tense of walk, being regular, would be formed at the last level. Within each level there may be several morphological and phonological rules. Kiparsky argues against the extrinsic ordering of morphological rules within levels, and the precise ordering of the phonological rules continues to be much studied and debated. Kiparsky (1983) and Halle and Mohanan (1985) have since established a fairly good ordering of phonological rules. Figure 1 depicts what is, basically, the 1982b model.

An essential characteristic of the level-ordered model is the distinctiveness of each level. There can be no backtracking to earlier levels; once an item has been processed at level n and passed to a subsequent level of operations, that item cannot return for processing to level n. It is thus immune to the effects of rules operating at

previous levels even though it may come to meet the conditions for their application. For example, heedlessness is exempt from Trisyllabic Laxing by virtue of the fact that #less and #ness suffixation, which create the appropriate environment for laxing, do not occur until after the level on which trisyllabic laxing operates.

It is also characteristic of the 1982 level-ordered model that lexical phonological rules operate only on derived items, i.e. those to which a phonological rule has applied or which have undergone some morphological operation such as affixation, inflection, or compounding. For this reason, a monomorphemic word like nightingale is insensitive to the demands of Trisyllabic Laxing, even though it potentially meets the structural description for application of the rule.

This description of the level-ordered lexical model is necessarily brief and perhaps simplistic. Moreover, the model that is presented here is at least four years old. Since its introduction some of its key features have been challenged and, in some cases, somewhat revised. At the heart of what are undoubtedly the most contentious and theoretically interesting debates are differences of opinion about the nature and domain of the phonological rules. There are several additional points of debate which have only been briefly touched on here, but the present application of

level ordering to morphological acquisition remains valid despite their ultimate resolution.

What remains unquestioned is that there are phonological operations that are closely linked to morphological operations. Further, these morphological-phonological interactions are of varying degrees of structural and semantic complexity; some morphological processes apply to a limited set of items and/or entail complex phonological consequences, while others are more general (productive) and both phonologically and semantically transparent. While there are obvious inadequacies in simplistically equating lexical and cyclic rules (as done by the 1982 model), it is generally accepted that level I is a cyclic level and the site of more complex morphophonemic operations than subsequent levels of the lexicon. Despite the fact that the level-ordered lexical model still requires refinement and elaboration (as Kiparsky is among the first to acknowledge) it has definite theoretical advantages over other models of the lexicon. Without pretending to provide an exhaustive list of such advantages, it is worthwhile to consider a few of them. To begin with, level ordering provides a principled distinction between + and #-boundary affixes, and accounts for their consistent order of attachment. Secondly, level-ordering unites both derivational and inflectional morphology under

the rubric of a unitary set of principles while still maintaining their distinctive characters. Thirdly, level ordering has done much to explain the interaction of at least two components of the grammar, morphology and phonology. One other advantage which must not be overlooked is that it appears to give insight into the structure of languages other than English, for which it was first developed. There is ample indication that the number of levels, and the functions of the processes occurring at each level may be language specific; nonetheless, level ordering appears applicable to a variety of diverse languages, many of which are unrelated historically or structurally to English. If it can be further demonstrated that level ordering reflects, in some way, the structure of acquisition and/or processing, its credibility will be further enhanced.

REVIEW OF THE LITERATURE ON MORPHOLOGICAL ACQUISITION

Acquisition studies have only recently begun to look at acquisition in relation to the level-ordered lexical hypothesis. For example, Peter Gordon (1985) demonstrated that some of the predictions of level ordering are borne out in acquisition. One prediction of the theory is that regular plurals cannot occur within compounds, and Gordon shows that children honour this constraint in their production of novel compounds.

However, despite the fact that most acquisition research does not address the question of level ordering directly, some of the data that has been gathered can be called upon to support the idea of using level ordering as a framework for the acquisition of morphology. Going back to the study done by Jean Berko (1957) which engendered such excitement among generative grammarians, there is evidence of the incremental approach to morphological acquisition. In the wake of behaviourist theory, focus was naturally on what Berko demonstrated that children can do rather than on the limits of that ability. What became of prime concern to linguists was that even small children can, and do, abstract and generalize in their production of language. However, Berko notes in the same paper that the children in the study, who ranged in age from four to seven years, 'operate with clearly delimited morphological rules' (p.164). Only

twenty-seven percent of the children (and all of these were among her older subjects) were able to coin a new word by any means. ⁸ Of that percentage, sixteen percent used a compounding strategy with appropriate stress (e.g. zibman) and eleven percent used an agentive -er suffix (e.g. zibber). There is, in other words, a distinction not only between being able or unable to coin new words, but between various processes for coining new words.

While Berko's experimental method has been criticized on several points (the small size of the sample, her failure to discriminate among subjects and to rule out alternate strategies such as rhyming, etc.) her tests are recognized for their ingenuity, and her study has remained a reference point for subsequent research in morphological development. A number of studies have been devoted to replicating her results over larger, better defined, groups of children and designing stimuli that narrow down the possible explanations for the results. The sum of this research is verification that children use rules, not merely analogy, in their formation of plurals and, significantly for us, that compounding and -er agentive (in this order) are among the earliest derivational processes acquired.

Subsequent research has taken a variety of directions. For example, Innes (1974) looked at the developmental

aspects of regular English plural formation and elucidated six stages of productive acquisition of the regular plural morpheme(s). According to her research, the rule for pluralization is formed on a class-by-class basis with /s/ and /z/ being distributed over an increasing range of appropriate environments, in stages I to VI. In fact, /z/ is introduced only at stage V. In sum, then, regular plural inflection is shown to emerge very early and order is demonstrated to hold not only across inflections, but within them as well.

Derwing has been concerned with a number of different issues in morphological acquisition. Some areas pertinent to the present discussion are summarized in a paper outlining recent research trends in the acquisition of both derivational and inflectional morphology (Prideaux, 1985). In a 1976 study, Derwing and Baker confirmed the order of acquisition of regular English inflections to be -ing (progressive), regular plural, regular past tense, the possessive, and then the third person singular verb inflection. This, of course, hearkens back to the ground-breaking work of Roger Brown (1973) who documented the order of acquisition of fourteen English morphemes for three children and concluded that, while there are variations in the age at which these morphemes are acquired, there is a

standard order in which they are acquired. Another of the areas Derwing (1976) explored was the acquisition of various derivational morphemes. In his investigations he established that -er agentive, adjective -y, and adverb -ly are mastered after regular inflection and that they emerge in the order given here. He notes also that performance on instrumental -er, though it is phonetically identical to -er agentive, 'lags consistently behind' -er agentive (Derwing and Baker, 1977: p.214).

Clark and Hecht (1982) traced the development of noun formation via compounding, -er agentive and -er instrumental affixation. Their tests revealed that children compound before they suffix in the formation of nouns. They first compound with man to form new nouns denoting persons, and they subsequently compound with thing to coin new instrumental nouns. Following this there may be a stage, prior to the replacement of compounding by derivational affixation, during which both compounding and affixation occur within a single lexical creation (eg. hearer-man).¹⁰ Children afterwards gain productive control over -er agentive and, later, -er instrumental.

In an earlier study, Clark (1981) looked at lexical innovations by young children, focussing on denominal verbs which appear to emerge early and are apparently quite

productive. My own research confirms the early emergence and productivity of denominal verb formation by zero derivation, and suggests that it may be earlier and even more productive than compounding for young children. A particularly interesting point made in Clark's article is that, while denominal verbs are frequently coined by children, deverbal nouns rarely are. Clark maintains that children coin denominal verbs in order to fill gaps in their lexicons (which are generally short on verbs), but that does not fully explain the unidirectional application of the strategy. What makes the study of interest to us is that in the level-ordered lexical model, zero derivation of verbs from nouns occurs at level II along with other productive derivational processes, while zero derivation of nouns from verbs occurs at level I where exceptions and less productive processes occur. If we demonstrate that level-II derivational processes are acquired before level-I processes, the difference between the two types of zero derivation is explained.

The productivity of three agentive suffixes, -er, -ist, and -ian is compared in research carried out by Clark and Cohen (1983). Based on their relative productivity in the language, the researchers hypothesized that in acquisition...children should master -er first, and -ist and

-ian only later' (p. 613). Indeed, Clark and Cohen confirmed that productivity is an index of recall, insofar as children recall nonsense words as having an -er suffix significantly more often than they recall them with either of the other two agentive suffixes, regardless of how the item was suffixed on its initial presentation. When -er is omitted from the list of test items and only -ist and -ian are used, children prefer -ist to -ian. In short, the order of the three functionally equivalent suffixes, in terms of ease of recall for children, is -er, -ist, and -ian. The findings suggest that children are engaging in morphological analysis, and that some derivational suffixes, even within a single semantic field, are more accessible to them than others.

The formation of novel verbs with the prefix un- is considered by Melissa Bowerman in a 1982 study. While she did not make any explicit comparisons with the order of acquisition of other inflectional or derivational affixes, it is clear from her data that, though un- emerges early and precedes irregular inflection, it succeeds regular inflectional processes and adjective -y.

THE LEVEL ORDERING OF ACQUISITION

The order of acquisition that emerges from the preceding review of the acquisition literature is shown in Table 1. It is worth drawing attention at this point to the parallels between the order of morphemes presented by acquisition studies and the order reflected in Kiparsky's Level-ordered lexical model. At the bottom level of the model are the #-boundary inflections, -ing, and regular plural and past tense. At the second level of the model are zero derivation of denominal verbs, compounding, and #-boundary derivational affixes that include agentive and instrumental -er, -ist, -ly, un-, and -y. At the first level of the model are +-boundary affixes and irregular plural and past tense inflection. There is a striking correspondence between the order of morphological processes gleaned from acquisition studies and the order given in the level-ordered model, though it must be noted that the correspondence works from the bottom up and the ordering correspondence is general rather than precise. That is, the processes first learned correspond to processes not at the top level of the model but at the bottom; also, the correspondence between the order given in the model and the order of acquisition list is not exact in morpheme-for-morpheme terms. Table 2 shows both the order of processes in Kiparsky's model and the order of acquisition.

—TABLE 1: The Acquisition Order of Morphemes

Earlier ac- quisition	
	-ing (progressive)
	-regular plural
	-regular past tense
	-possessive
	-3rd person singular
	-N→V \emptyset -derivation (order with respect to possessive and 3rd singular is un- known)
	-compounding with nouns
	-er agentive
	-adjective -y
	-un- (order with respect to -er and -y is unknown)
	-adverb -ly
	-er instrumental
	-agentive -ist
	-agentive -ian
	-irregular plural (order of these last two with respect to -ist and -ian is unknown)
Later ac- quisition	-irregular past tense

TABLE 2: Theoretical and Acquisition Order of Morphemes

Order of Acquisition	Order in the Model
-ing (progressive)	
-regular plural	-irregular plural
-regular past tense	-irregular past tense
-possessive	+boundary affixation
-3rd person singular	
-denominal verb formation	-N→V \emptyset -derivation
-compounding with nouns	-compounding
-agentive -er	#boundary affixation
-adjective -y	
-instrumental -er	
-adverb -ly	
-un-	
-irregular plural	-regular plural
-irregular past tense	-regular past tense
-agentive -ist	
-agentive -ian	

Objections may be raised against the application of level ordering to acquisition on the strength of an apparently gross ordering coincidence. Moreover, because the extrinsic ordering of word-formation rules within levels must be rejected on theoretical grounds, the disparity is not easily dismissed. The dilemma that we now face is how we are to reconcile the theorist's rejection of extrinsic ordering with the psycholinguist's finding that order of acquisition holds in more than just a general way. More serious, the acquisition studies give no indication that the relationship between morphemes on different levels is any different than the relationship between morphemes of the same level. It appears, therefore, that if we press the matter we will once again find psycholinguists and theoretical linguists on opposite sides in a dispute, each claiming support from the facts. This is particularly troublesome in view of our need to justify the application of level ordering to acquisition. We have here an obvious problem with an application that so far appears to have in its favour only a general similarity in the ordering of morphemes.

However, the discrepancies appear, in this case, to be less significant than the similarities. The argument of theorists is that synchronic order need not reflect

acquisition or historical order, but this line of argument instantiates the different criteria for psychological reality set up by theorists and psycholinguists. Focussing on this problem is neither productive, nor, I believe, important. If we look beyond the item-for-item correspondence we are better able to appreciate the implications of the group-for-group correspondence that is supported by both the model and acquisition research. A preoccupation with the discrepancies is liable to accomplish little more than to detract from a more important issue, which is the need to elucidate a set of principles governing morphological acquisition. What we have so far is a list of morphemes and the order in which they are acquired; we have no way of generalizing this information, or making predictions about the acquisition of other morphemes. It is true that psycholinguists have made some effort to determine why one morpheme is acquired before another, but the reasons given have limited explanatory power. Some ordering is explained in terms of whether the process is inflectional or derivational, some in terms of relative semantic and phonetic opacity, and some in terms of degree of productivity. Yet none of the explanations in isolation has global application and none of them can handle exceptions. How, for example, can we explain better performance when children are suffixing -ment to an item such as embellish

than when they are suffixing -al to migration? Frequency counts indicate that both items occur extremely infrequently, though intuition indicates that of the two, children are more likely to have heard migration than they are to have heard embellish. Both are similarly stressed, have an equal number of syllables, and are phonologically transparent in these suffixations. As for semantic complexity, neither seems particularly easier nor more difficult than the other. What is needed is a framework for the information and the observations that we have. The problem is not that psycholinguists are wrong, but rather that what they are giving us are facts rather than principles and these take us forward only one tiny step at a time. In contrast, viewing acquisition order from the perspective of level ordering allows us to see a fundamental pattern that has gone unrecognized. All the first morphemes acquired make up the regular inflectional processes of English; those next mastered are #-boundary processes; those last acquired are +-boundary processes. The morphemes in the Order of Acquisition list fall into clearly defined sets that correspond to the levels of Kiparsky's 1982b level-ordered lexical model. The correspondence is not gross at all; the between-level distinctions are, in fact, upheld by acquisition order. There is no problem such that a morpheme is acquired in an order that causes a

violation of stratum boundaries. The model provides the framework that is needed to tie acquisition research together and put it into perspective. Viewing acquisition order in terms of level ordering gives to acquisition research a clear sense of direction. It affords us a better view of the gaps in our information and allows us to integrate the information we have about acquisition and processing. From this there emerges a sense of direction that is badly needed if we want to look beyond isolated bits of information to the principles underlying morphological acquisition.

In a recent unpublished paper, Tyler and Nagy (1986) investigate the role of overgeneralization in the acquisition of English derivational morphology. Their finding is that children at a certain stage tend to accept and overgeneralize novel neutral suffixes (they cite as examples -er agentive, and -ness) but not non-neutral suffixes such as -ity and -al. They conclude that children first learn neutral suffixes as productive processes and that they later learn non-neutral suffixes analogically. They posit, in other words, that the acquisition of neutral and non-neutral suffixes is distinct both in terms of when they are learned (neutral suffixes are acquired first) and in terms of how they are learned. Of greatest interest for our present purpose is the fact that neutral suffixes occur

at level II of Kiparsky's model and non-neutral suffixes occur at level I. Tyler and Nagy go on to describe a model of morphological acquisition that 'differentiates between Neutral and Non-neutral suffixes and the rules which govern them...' (p. 12). They further note that the model should place together 'both suffixes and the phonological rules that are triggered by suffixation...' (p. 13). There is no direct reference in this paper to Kiparsky's level-ordered hypothesis, but it is clear that the criteria they establish for a learning model are met by level ordering.

Janet Randall (1982), in her paper on the development of complex morphology, describes hypothesis generation within parameters that are predicted by the logic of the level-ordered model. She demonstrates that children are sensitive to form, meaning and subcategorization in their acquisition of complex morphology. A child will, first, assume that a complex form is maximally related to the base, and s/he will retreat from that assumption only on the basis of positive evidence to the contrary. In the face of evidence that both category and meaning differ from those of the base, the child will assume the unmarked portion of the base's subcategorization. Randall concludes that children are 'operating under a morphological "distance" principle of some sort...' (p. 211). This is consistent with the principles which distinguish levels. Level III inflections

are semantically, phonologically and subcategorically close to their bases. Most derivations have different subcategorizations than their bases, but level I derivations are generally semantically and phonologically more distant from their bases than level II derivations. Randall further assumes that "the definition of distance necessary for the learning model is the one specified by UG " (p. 223). This echoes Gordon's (1985) claim that level ordering represents innate parameters of acquisition imposed by Universal Grammar.

THE IMPLICATIONS OF LEVEL-ORDERING FOR ACQUISITION

There are a number of interesting predictions that follow from an acceptance of level ordering as a model of morphological acquisition. Recall that levels are not merely affix addresses, but that they represent fundamental distinctions between affix types. Level III processes, which include English inflectional processes, are obligatory morphological processes that are phonologically and semantically transparent and very productive. As Helen Goodluck (personal communication) has pointed out, one has only to be exposed to the difference between 'one A - two A/z/' to figure out the significance of the /z/ morpheme. From there one must, of course, work out the phonetic variants, [əz], [s], and [z], but these are without exceptions and apply to other processes, as well, such as third person singular verb agreement. Other level III inflectional processes are similarly highly contextualized and their variants strictly governed. These affixes attach at the word level and are neutral in that they do not phonologically alter the stem word to which they are affixed. Moreover, level III operations are extremely general processes in the language; they are obligatory, and there are very few exceptions to processes at this level.

Level II processes include compounding, denominal verb

formation and #-boundary derivations which are rule-governed, which are phonologically, and, to a lesser extent, semantically transparent, but which are optional. They are very productive, it is true, but not to the extent that level III processes are productive, and certainly, there are a far greater number of exceptions than for level III processes. Compare, for example, the number of exceptions to regular plural formation, and the number of exceptions to the verbs that can take agentive -er. Moreover, there are ways around most level II processes. If you can't form an appropriate word in one way, you can probably find an alternative. From the learner's point of view this means less consistency in the input, but also greater possibility of communicating effectively with limited command of the morphological possibilities of the language. Neither of these conditions favours learning in the way that consistency and obligatoriness do.

Level I processes are more complex yet; they are generally phonologically and semantically opaque, and what rules can be said to operate at that level operate within narrow bounds. Take as an example +ify suffixation. Not only does it apply to limited numbers (and classes) of words, but it can trigger one or a combination of phonological stem changes. Diverse, for example, undergoes only the suffixation process; glory undergoes a stem vowel deletion;

there is a stress shift in solid and part of the stem is lost (or never acquired) in horror. Other +-boundary suffixes trigger even more complex changes. Moreover, it is often difficult for the average native speaker, much less a learner, to see a semantic relationship between the underived and derived form. Consider, for example, the difference in relationship between dance - dancer and maxim - maximal.

Block and Kessel (1976), in their reanalysis of Roger Brown's (1973) study, conclude that commonality between semantic and grammatical complexity is the best predictor of acquisition order. Anshen and Aronoff (1981) propose that productivity of an affix is a determinant of performance on a lexical decision task. If performance on a lexical decision task is related to acquisition, as the work of Carroll and White (1973) suggests, then we can include affix productivity as a determinant of acquisition. Viewed in this way, it is reasonable to assume that level III inflections (being the most productive and the least semantically and grammatically complex) are the easiest and, therefore, the first to be learned. This should be followed by acquisition of level II affixes and processes which are somewhat more complex, and not what Henderson (1985) terms 'automatically productive'. Level I affixes and processes which are the most complex and the least productive should

be acquired last.

If this generalization is true, then it should be the case that children will master the morphology of their language in a 'bottom up' fashion in any language, and that order of acquisition will reflect level assignment of the process in the language. English-speaking children should gain productive control over regular inflection before they gain productive control over #-boundary derivations and other level II processes. They should acquire +-boundary affixation and other level I processes last. The prediction is that children will perform significantly better on a suffixation task involving level II suffixes than on the same kind of task involving level I suffixes. It is further predicted that the level II suffixes will be acquired earlier than the level I suffixes.

To test these hypotheses, I tested groups of children from junior kindergarten through grade six on their ability to extract suffixes from sets of ten orally-presented stem-derivation pairs and to append them to test items. All the children were tested with four level-I suffixes and four level-II suffixes for a total of forty items at each of the two levels. Performance on level-I and level-II suffixes was then compared, and an age-score correlation done for each set of scores. Results provide clear support for the hypotheses.

NOTES

1. Since that time there have been a number of changes to the theory. For example, the 1982 model presumes that all lexical phonological rules are cyclic and that non-cyclic rules are post-lexical. This was shown to be overly simplistic and that at least some lexical phonological rules are non-cyclic. (See, for example, Booij and Rubach, 1985). However, most of the changes in the model concern the phonological rather than the morphological component (a distinction which is debatable, but convenient for the present purpose). Those aspects of the theory upon which the present thesis depends remain essentially unchanged.

2. Booij and Rubach (1985) have proposed that only some lexical phonological rules are linked to the morphological operations, while others, though still lexical, are post-morphological. They therefore distinguish three types of phonological rules; cyclic lexical rules, post-cyclic lexical rules, and post-lexical rules. Of these, only the cyclic lexical rules are linked to morphological processes. Mohanan and Mohanan (1984) also posit a set of non-cyclic lexical rules, but like Booij and Rubach still admit of a set of cyclic lexical rules as well.

3. Mohanan and Mohanan (1984) argue for the stratum

independence of phonological rules, but they still support the interaction of the morphology and lexical phonology.

4. Kiparsky originally claimed that the output of each cycle of operations existed as a lexical item; it is now generally accepted that only the output of a level necessarily has lexical status.

5. Kiparsky (1982) proposes three levels for English, while Mohanan (1982) assumes four. Later (1983) Kiparsky revised his model in favour of two levels for English. However, my current application of the theory is unaffected by the outcome of this debate over the number of levels in the model, as long as the concept of levels remains intact.

6. Sensitivity to derived environment is, in fact, assumed here to be a distinguishing feature of lexical phonological rules. Unfortunately, the distinction has proved to be overly simplistic, particularly when such matters as stress assignment are considered. Perhaps Booij and Rubach (1985) resolve the problem most neatly with their distinction between lexical phonological rules that refer to lexical information and lexical phonological rules that do not (ie are non-cyclic). In any case, a distinction is now made between structure-preserving and structure-changing lexical rules, and it is generally assumed that rules that simply

add structure have wider application than those that alter it (i.e. they can apply in non-derived environments).

7. In fact, consistency with respect to order of attachment is not always observed, something that has led to the positing of loops which supposedly allow an item to return for processing to previous levels. See Mohanan (1984). This, of course, seriously undermines the whole concept of level ordering, and it is not, I believe, theoretically necessary. Therefore, for reasons which are beyond the scope of this thesis, I have disregarded the idea of loops.

8. Two points need to be raised here: First is that Berko's claim appears, in the light of subsequent research, somewhat strong; it has been demonstrated since (e.g. Clark, 1982) that children as young as two freely coin denominal verbs, though the elicitation of those abilities is heavily task dependent. The second point I wish to raise concerns the percentages I have given here which differ from those provided by Derwing (1985). I do not know how Derwing arrived at a figure of 47%, but I suspect that he refers only to the younger group in Berko's study. My figure of 27% is based on the entire sample.

9. The stages of acquisition of the regular plural inflection are reported to be as follows:

- Stage I: No overt plural markers are used.
- Stages II-IV: [s] and [z] are used in appropriate environments. Other items remain unmarked.
- Stage V: [əz] is added to stems ending in sibilants. Items ending in [z] remain unmarked.
- Stage VI: All items are appropriately marked for plural.

10. Kiparsky maintains that the Avoid Synonymy Principle rules out the creation of derivations which may overlap in meaning with existing lexical items. However, he does state that this may be more of a learning principle than an absolute constraint, and Clark proposes that children may initially assume that each word formation process is functionally distinct. Upon learning that -er and compounding with man serve the same function, children will adopt the preferred form. Thus, the Avoid Synonymy Principle will be observed.

Method

Subjects were 34 children from junior kindergarten through grade six. The children were divided into 8 groups by grade. Within each group there were 4 boys and 4 girls. The subjects attend a middle class suburban primary school that was selected because the area is socio-economically homogeneous. All the children tested live in the neighbourhood served by the school. Within each grade the four boys and four girls were chosen randomly from an eligibility list drawn up by the teachers in accordance with the following criteria:

1. All children were to be of normal intelligence as determined by school performance. Teachers were instructed to leave off the list of eligible children any that had demonstrated exceptional learning abilities at either end of the scale.

2. Also excluded from the eligibility list were children with obvious handicaps that might affect the normal course of language development or which might result from language learning problems. These include hearing problems, reading and learning disabilities, and speech impediments.

3. All children were to be from English monolingual

backgrounds. There is 75 minutes of French instruction daily given to students in all grades, and the older children do, of course know more French than the younger ones, but no natively bilingual children were to be included.

4. All potential subjects were to be within the normal age range for the grade. Within the group that was selected, the overall mean age of the subjects is 101.25 months (8 years 5 1/4 months). The mean ages at each grade are as follows: Kindergarten I - 52 months; Kindergarten II - 73 months; Grade 1 - 85 months; Grade 2 - 96 months; Grade 3 - 108 months; Grade 4 - 118 months; Grade 5 - 133 months; Grade 6 - 145 months. Table 3 contains a complete list of the ages of the subjects in each grade.

5. Only right-handed children were to be considered for testing.

A letter was prepared and sent by the school principal to the parents of all the children in the school. It explained very briefly the purpose of the tests (data collection for a thesis in child language development), and the way it would be carried out (one-on-one taped interviews by a trained teacher, etc.). No mention was made of selection criteria. The parents were given the opportunity to request that their child(ren) be excluded a priori. No such requests were made.

TABLE 3: AGES OF SUBJECTS

The following table gives the ages of the subjects at each grade level in years and months. The mean age for each grade is also provided, both in years and months, followed in brackets by the mean age in months only.

GRADE	AGES	MEAN
KI	4.8; 4.10; 4.10; 5.0; 5.0; 5.2; 5.4; 5.6	5.0 (60.5)
KII	5.9; 5.9; 5.10; 5.11; 6.2; 6.5; 6.5; 6.5	6.1 (73)
Gr1	6.5; 6.6; 7.0; 7.0; 7.1; 7.3; 7.3; 7.11	7.1 (84.625)
Gr2	7.10; 7.10; 7.10; 8.0; 8.1; 8.1; 8.2; 8.3	8.0 (96.125)
Gr3	8.6; 8.8; 8.8; 9.0; 9.1; 9.2; 9.4; 9.4	9.0 (107.625)
Gr4	9.3; 9.5; 9.7; 9.10; 9.10; 10.0; 10.4; 10.6	9.10 (118.125)
Gr5	10.9; 10.11; 10.11; 11.1; 11.2; 11.2; 11.3; 11.3	11.1 (132.75)
Gr6	11.6; 11.7; 11.8; 11.10; 11.11; 12.5; 12.9; 13.0	12.1 (145)
OVERALL MEAN		8.6 (102.219)
RANGE		8.4 (100.00)

Materials and procedures. One tape recorder was used to play an introduction to the tests and a second was used to record each interview as a backup to manual scoring. The word lists used in the tests consisted of eight sets of twenty word pairs. Each set consisted of items amenable to suffixation with one of the following suffixes: #er (agentive); #less; #ness; #ment; +ize; +ate; +al; +ity.

The word lists were drawn up such that each pair within a set was matched for frequency, ¹ number of syllables, stress pattern, and general ease of articulation. ² Within each pair one item was randomly chosen to serve as the test item; the other member of each pair served as an example. Table 4 below contains one example-test item pair from each suffix set.

Table 4: Sample of examples and test items

EXAMPLE PAIR	TEST ITEM
peddle-peddler	meddle
pity-pitiless	mercy
wistful-wistfulness	bashful
punish-punishment	excite
final-finalize	terror
motive-motivate	active
arrive-arrival	survive
obese-obesity	deform

(See Appendix I for a complete list of examples and primes.)

Eight suffixes were chosen for testing, four from level II of Kiparsky's model and four from level I. With the exception of -er agentive which was chosen as a reference point (its acquisition is well documented in the literature), the other three level II suffixes were chosen randomly. The choice of the four level I suffixes, however, was severely constrained by the need to choose suffixes for which there were sufficient numbers of items which are not subject to the stem changes that normally accompany level I suffixation.

Across levels, items were also matched, though exact correspondences on all points was not always possible. At level I there are 6 one-syllable words, 24 two-syllable words, and 10 three-syllable words. At level II there are 5 one-syllable words, 21 two-syllable words, and 14 three-syllable words. All subjects from a particular classroom were taken to the testing area at one time. Two other researchers assisted with the tests and as soon as a group arrived, we introduced ourselves to the group and took down their first names and birthdays. Following this the children were given a group introduction to the tests. The introduction consisted of a tape recording of a mini test session involving level I and II suffixes which were not on the tests proper. The voices on the tape were those of myself and my ten-year-old son who received the same

instructions for the demonstration tape as did the children being tested. The transcript of the introduction can be found in Appendix II. The children were invited to join in answering my taped questions along with the child on the tape. Most children did so, but no particular note was made of those who chose not to participate in this way. The introduction to the tests was given in the school library and the tests were carried out with one child at a time in a small adjacent room where the children normally go for remedial reading and individual language instruction.

Testing began with the youngest children and proceeded up through the grades. The order in which the children of a particular group was tested was randomly determined, but it happened on occasion that a child was reluctant to go first. When this happened, the next child on the list was chosen and the reluctant child was given the option of succeeding his/her replacement or going last. Immediately after being tested, a child was sent back to the classroom. While one child was being tested the remainder of the younger groups was shown a nature filmstrip. The children from grades 3 and up brought schoolwork with them and were occupied with that while they waited.

The test. In the testing room we verified the child's identity and further explained the procedure as follows:

"I'm going to say two things that are sort of the same and sort of different. You can join in saying them after me if you like. After that I'm just going to say one thing and you will see if you can tell me what the other one should be."

One suffix set was presented at a time. The 10 example items and their suffixed counterparts were read out slowly, one pair at a time (e.g. observe-observer, help-helper, etc.). The children were invited to join in by repeating the example item and its suffixed counterpart (which most children did), but no formal note was taken of those who did or did not choose to. After all 10 example pairs were read out, the subject was told that one part would be given, and that s/he was to tell us what its partner should be. The test items were then read out slowly, one item at a time, allowing the child time to respond to each one in turn. Once all 10 test items of that suffix set had been provided, the entire procedure was repeated with another suffix set. The suffix sets and the items within each set were presented in the same order for all subjects. The level two suffixes were presented first, in the order #er, #less, #ness, and #ment, followed by the level one suffixes in the order +ize, +ate, +al, and +ity. I conducted all the tests, but the two people who assisted me took turns

taking phonemic transcription or monitoring the children who were waiting to be tested. Each interview took about ten minutes.

The interviews were both tape recorded and simultaneously hand recorded by one of the two people who assisted me. Both are senior linguistics students trained in phonemic transcription. An answer was either correct or it was not. We counted the following as incorrect:

1. failure to respond
2. repetition of the prime
3. substitution of the target suffix with another suffix
4. degradation of the suffix (e.g. /mɒf/ for /nəs/)
5. insertion of extra segments (e.g. /mɛnθəlɪnɛt/)
6. degradation of the stem (e.g. /skɔndəlɪnəs/)
7. non-suffixation answers (e.g. rhyming or making up words)

We did not count as errors articulation difficulties involving sounds that are normally difficult for young children (e.g. interdental) provided that such difficulties did not manifest themselves only on the suffixes. After an interval of several days, I replayed the tapes, noting the correct responses and recoding the wrong answers in phonemic transcription. These transcriptions were then checked against the manual score sheets which had been

prepared by the scorers during the course of the interviews. Any items over which there was a discrepancy were replayed for a fourth independent scorer who was asked, simply to record the response in phonemic script. On the basis of that transcription, one of the original scorers and myself decided whether the item was to be counted as correct or incorrect. (In fact, there was overwhelming consensus as to whether the items were right or wrong and it was only necessary to send a few items to arbitration.)

Each subject's scores on the four same-level suffixes were then averaged. It is on the basis of these means that performance on level I and II is calculated and compared.

NOTES

1. All frequency matches are based on counts given in Francis and Kucera (1982) and Carroll (1971). Admittedly, neither is ideal for child language, but there are no current vocabulary studies which look any more promising. Any frequency study, to be truly suitable, would be required to consider both active and passive knowledge of both the base words, and the suffixed forms. Moreover, there are the inherent problems with the suffixes and bases that make frequency control all but impossible anyway; level I suffixes are less common in the language, and they generally attach to less common words.

2. To say that I took into consideration 'general ease of articulation' means that I matched items containing sounds that are more difficult or later acquired. For example, a prime containing a stop-lateral cluster, or an interdental fricative was matched with an example word containing the same sound in a similar environment. Similarly, efforts were made to ensure that the level I items were no more difficult to pronounce (according to this criterion) than level II items.

3. To choose items which undergo various stem changes introduces another variable into the task; children are then being asked not just to suffix but to perform various

complex phonological operations as well. Another complicating factor was a limitation on the number of items that undergo a particular phonological change. A single non-neutral suffix can trigger³ one or more of several kinds of phonological change including stress and vowel changes, velar softening, the dropping of parts of the word stem, etc. Finding twenty items in four suffix groups which undergo an identical change is well-nigh impossible.

Chapter 3

Results

The level I and level II mean scores for each subject are displayed in Table 5. There were ³ eight scores of 0% on level I suffixes as opposed to three scores of 0% on level II suffixes. All of the zero scores belong to subjects in the first three grades (Kindergarten I - Grade 1) though one child at the grade 2 level scored only 2.5% on level I suffixes. At the other end of the scale there were six scores of 100% on level I suffixes and six scores of 100% on level II suffixes. All of the perfect scores were achieved by children in grades 4, 5, and 6. The mean level I score is 58.945 and the mean level II score is 66.758 across all subjects. Nearly half the level II scores (47%) are in the 100th percentile, compared to 34% of the level I scores. 9% of the level II scores fall in the 0 - 9% score range, while 17% of the level I scores are in that score range. The absolute frequencies, relative frequencies, cumulative frequencies, and percentiles for each level are given in Tables 6 and 7:

TABLE 5: AGE AND LEVEL I AND II SCORES FOR EACH SUBJECT

In the following table age is given in months and scores are given in percentages.

SUBJECT	AGE	LEVEL I SCORE	LEVEL II SCORE	I - II
1.	56	0	27.5	-27.5
2.	58	27.5	35.0	- 7.5
3.	58	0	15.0	-15
4.	60	12.5	0	12.5
5.	60	62.5	32.5	30
6.	62	0	5.0	- 5
7.	64	0	0	0
8.	66	22.5	17.5	5
9.	69	2.5	2.5	0
10.	69	0	2.5	- 2.5
11.	70	2.5	17.5	-15
12.	71	15.0	20.0	- 5
13.	74	0	0	0
14.	75	15.0	25.0	-10
15.	75	27.5	45.0	-17.5
16.	75	0	37.5	-37.5
17.	75	35.0	45.0	-10.0
18.	76	10.0	37.5	-27.5
19.	84	85.0	70.0	15.0
20.	84	72.5	32.5	40.0
21.	85	77.5	62.5	15.0
22.	87	12.5	67.5	-55.0
23.	87	0	22.5	-22.5
24.	95	62.5	25.0	37.5
25.	94	50.0	82.5	-32.5
26.	94	85.0	87.5	- 2.5
27.	94	2.5	20.0	-17.5
28.	96	62.5	97.5	-35.0
29.	97	67.5	87.5	-20.0
30.	97	67.5	90.0	-22.5
31.	98	75.0	80.0	- 5.0
32.	99	85.0	65.0	20.0

TABLE 5 continued.

SUBJECT	AGE	LEVEL I SCORE	LEVEL II SCORE	I - II
33.	102	65.0	82.5	-17.5
34.	104	80.0	97.5	-17.5
35.	104	92.5	90.0	2.5
36.	108	17.5	67.5	-50.0
37.	109	92.5	97.5	- 5.0
38.	110	97.5	97.5	0
39.	112	87.5	95.0	- 7.5
40.	112	27.5	87.5	-60.0
41.	111	92.5	95.0	- 2.5
42.	113	100.0	97.5	- 2.5
43.	115	95.0	92.5	2.5
44.	118	50.0	92.5	-42.5
45.	118	92.5	95.0	- 2.5
46.	120	95.0	92.5	2.5
47.	124	97.5	100.0	- 2.5
48.	126	72.5	92.5	-20.0
49.	129	87.5	92.5	- 5.0
50.	131	100.0	97.5	2.5
51.	131	97.5	100.0	- 2.5
52.	133	97.5	97.5	0
53.	134	75.0	97.5	-22.5
54.	134	95.0	100.0	- 5.0
55.	135	80.0	85.0	- 5.0
56.	135	100.0	97.5	2.5
57.	138	97.5	97.5	0
58.	139	100.0	100.0	0
59.	140	100.0	97.5	2.5
60.	142	92.5	100.0	- 7.5
61.	143	100.0	95.0	5.0
62.	149	95.0	100.0	- 5.0
63.	153	85.0	95.0	-10.0
64.	156	77.5	92.5	-15.0

Table 6: Frequencies and Percentiles of Level I Scores

SCORE	f	RELATIVE f	F	PERCENTILE
90 - 100	20	.313	64	100th
80 - 89	8	.125	44	68th
70 - 79	6	.094	36	56th
60 - 69	6	.094	30	46th
50 - 59	2	.031	24	37th
30 - 39	1	.016	22	34th
20 - 29	4	.063	21	32nd
10 - 19	6	.094	17	27th
0 - 9	11	.171	11	17th

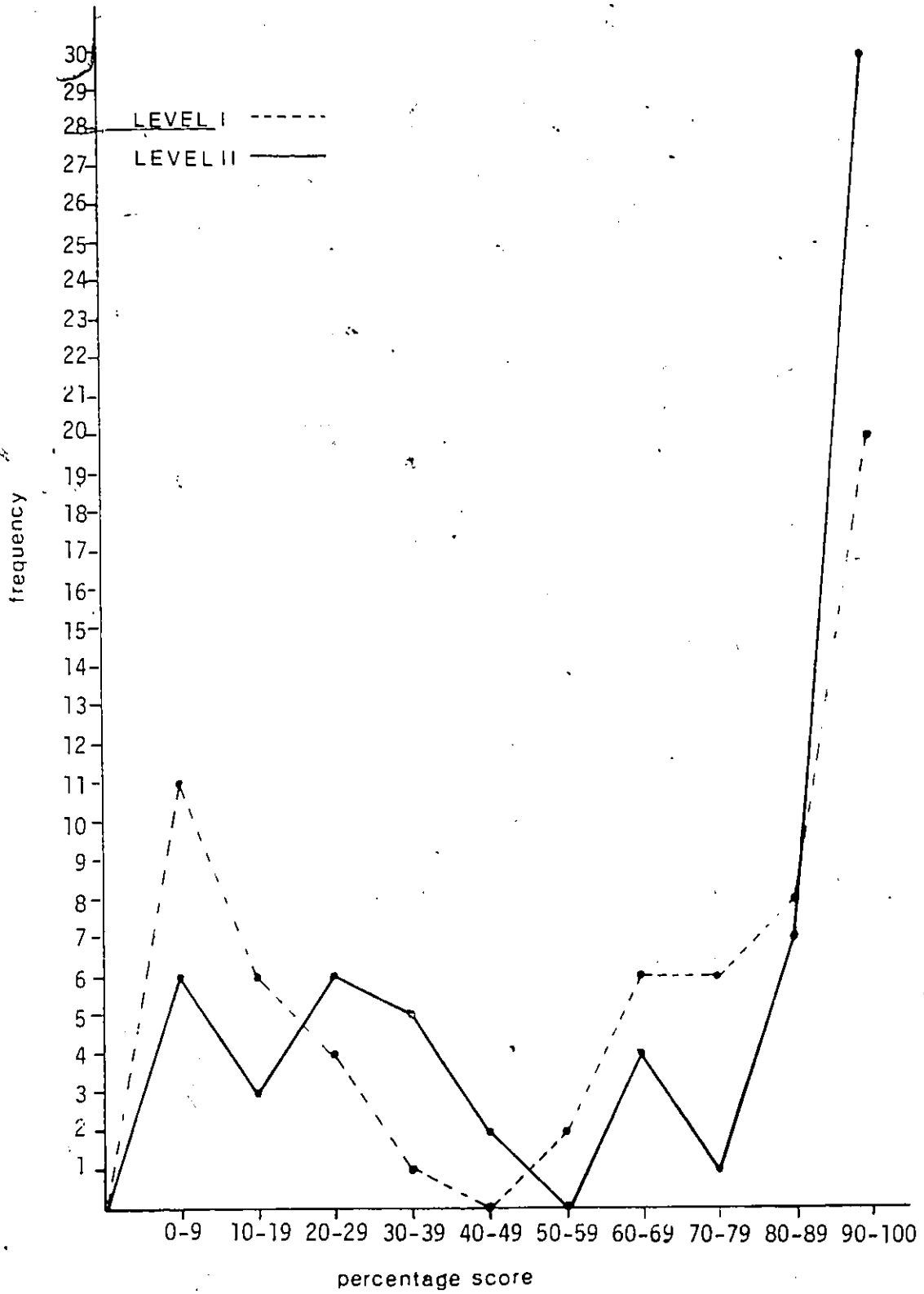
Table 7: Frequencies and Percentiles of Level II Scores

SCORE	f	RELATIVE f	F	PERCENTILE
90 - 100	30	.469	64	100th
80 - 89	7	.109	34	53rd
70 - 79	1	.016	27	42nd
60 - 69	4	.063	26	40th
40 - 49	2	.031	22	34th
30 - 39	5	.078	20	31st
20 - 29	6	.094	15	23rd
10 - 19	3	.047	9	14th
0 - 9	6	.094	6	9th

Note that for level I suffixes there were no scores in the 40-49% range, and there were no scores in the 50-59% range at level II.

The distribution of scores for level I and II suffixes is shown in Figure 2. As the graph indicates, there are a greater number of level I than level II scores at the low end of the scale and a lower number at the top end. That is to say, more children scored low on level I than on level II suffixes, and more children scored high on level II suffixes than scored high on level I suffixes. It is also clear from

Figure 2: The Frequency Distribution of Level I and II Scores



the graph in Figure 2 that neither set of scores is normally distributed.

Table 5 also reveals that the children at each grade level vary greatly in their ability to handle the suffixation task, though this variability narrows considerably in the upper grades. Table 8 below summarizes the range of scores for both level I and II suffixes at each grade.

Table 8: Range of Level I and II Scores at Each Grade

GRADE	LI RANGE	DIFFERENCE	LII RANGE	DIFFERENCE
KI	0-62.5	62.5	0-35	35
KII	0-27.5	27.5	0-45	45
G 1	0-77.5	77.5	22.5-70	47.5
G 2	2.5-85	82.5	20-97.5	77.5
G 3	17.5-97.5	80	67.5-97.5	30
G 4	50-100	50	92.5-100	7.5
G 5	75-100	25	85-100	15
G 6	85-100	15	92.5-100	7.5

The table shows that the lowest score for level I suffixes is consistently lower than the lowest level II score, beyond the kindergarten level. The difference between the lowest and highest score is also greater for level I than for level II suffixes, except at Kindergarten II. The magnitude of the

difference decreases sharply for level II suffixes at grade 4 and for level I suffixes at grade 5, though the two suffix levels demonstrate somewhat different patterns of decrease. Performance on level I suffixes (as indicated by mean grade score) is consistently below performance on level II suffixes. This is illustrated in Figure 3. The distinction between performance on the two levels is most marked at grades 2 and 3. Table 9 below contains the percentage difference between the mean level I score and the mean level II score for each grade.

Table 9: $\bar{X}_{LI} - \bar{X}_{LII}$ for Each Grade

Grade	K I	K II	G 1	G 2	G 3	G 4	G 5	G 6
$\bar{X}_I - \bar{X}_{II}$	-1	-10.9	-.9	-14.4	-18.1	-7.9	-4.4	-3.4

Two scores for each subject were computed from the data. One score is the mean of the subject's scores on the level I suffix items, and the other is the mean of the subject's scores on the level II suffix items. Because we do not have a normal distribution, the method of analysis used was the Wilcoxon signed-ranks test. This was performed on 57 pairs of scores which showed a difference between the two levels. The difference between the level I and II means was significant, $z = 3.639$. $p < .0002$ for a one-tailed test. The

Figure 3: Histograms Comparing Level I and II Mean Grade Scores

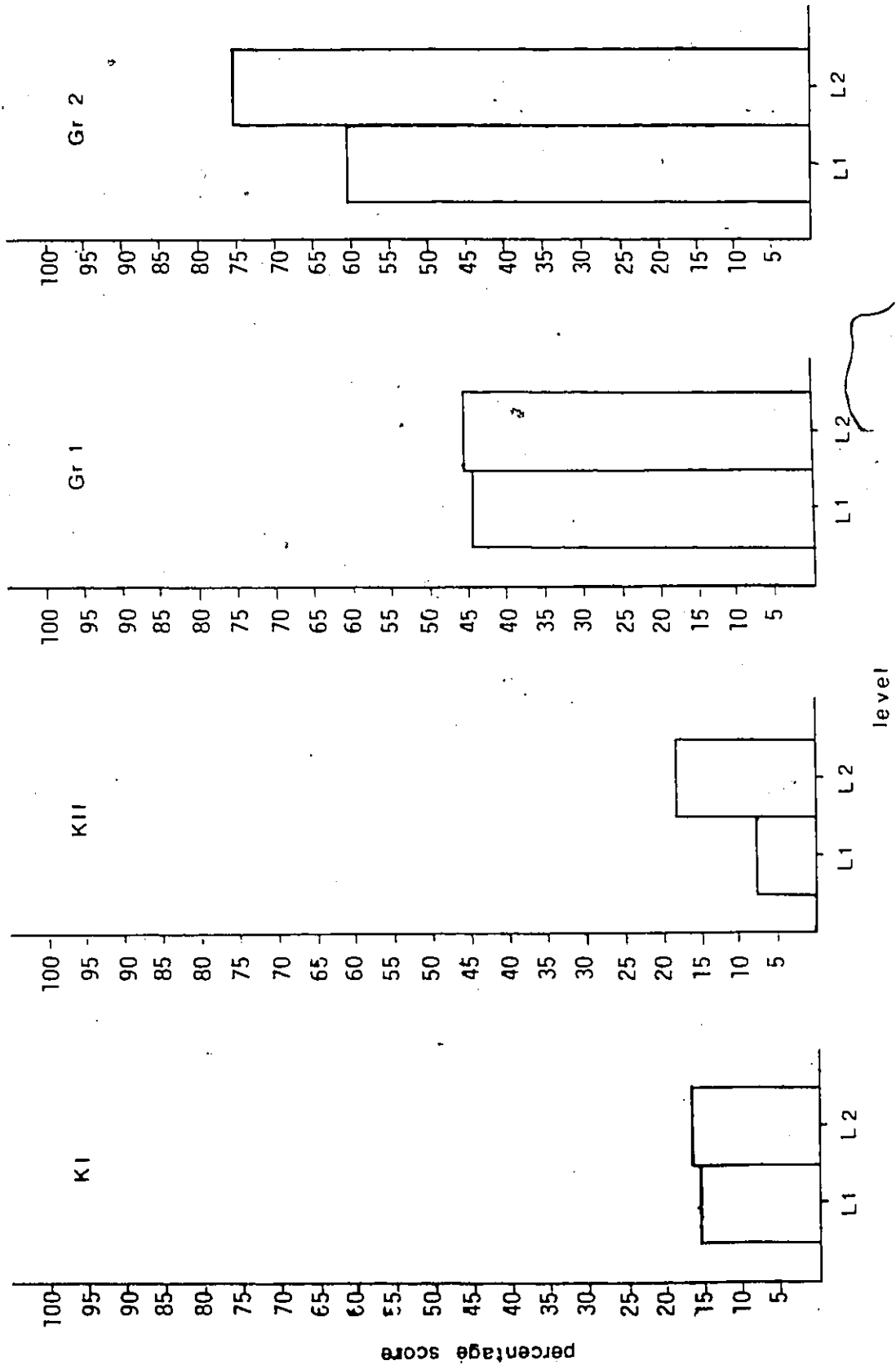
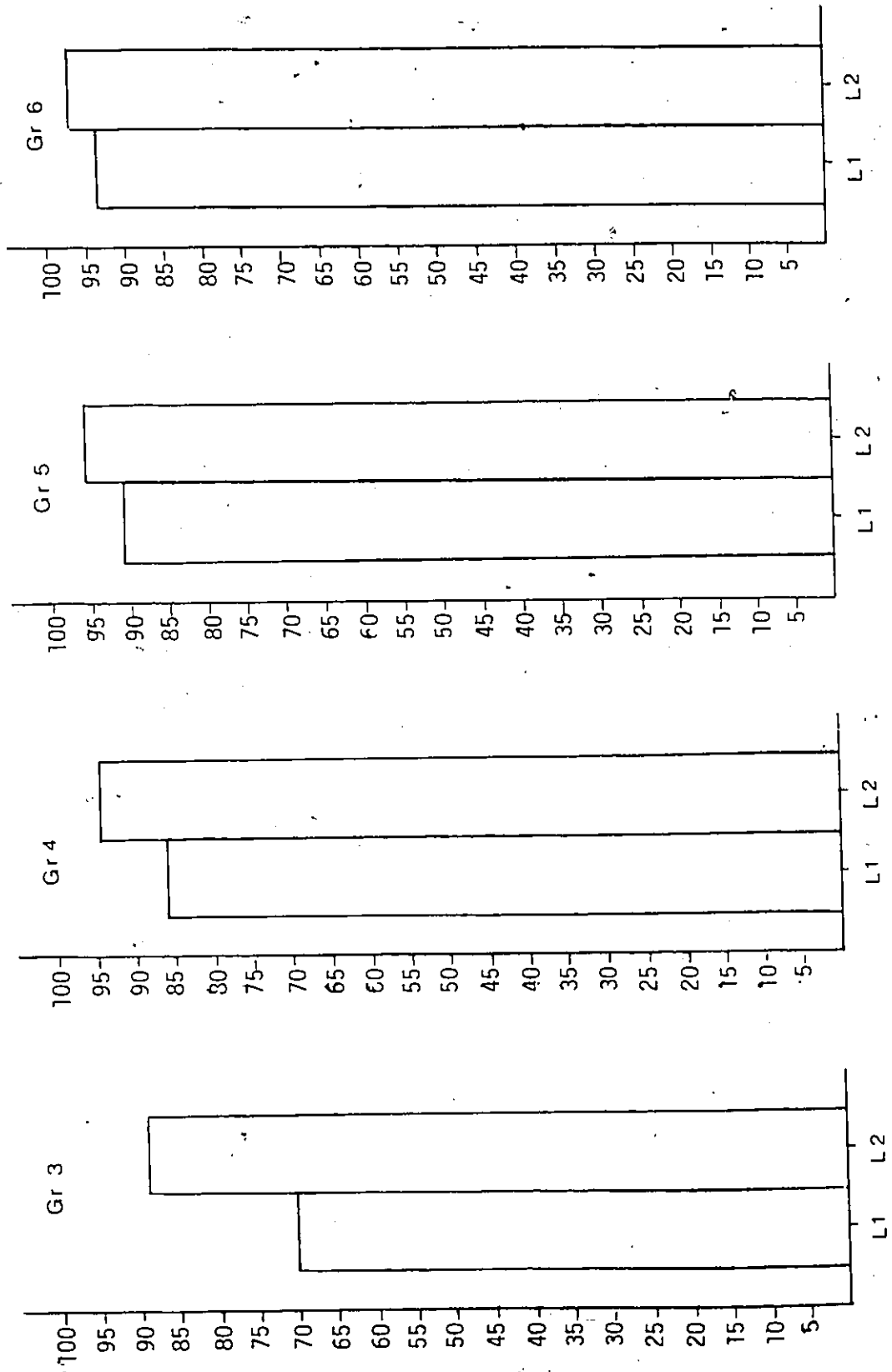


Figure 3 continued



direction of the difference between the levels is that level II suffix scores are greater than level I suffix scores:

Table 10: Level I - Level II Results

$\sum +$ scores (ie Level I > Level II) =	368.5
$\sum -$ scores (ie Level I < Level II) =	-1284.5
$W =$	368.5; N = 57; z = 3.639

Scores on both level I and level II suffixes increase with age and grade. Table 11 contains the mean ages and the mean level I and II scores for each grade. The increase in scores as subjects get older is shown graphically in Figure 4. There is a positive linear relationship between age and score for both level I and II suffixes, though the line begins to flatten at around 107 months for level II suffixes and at about 117 months for level I suffixes.

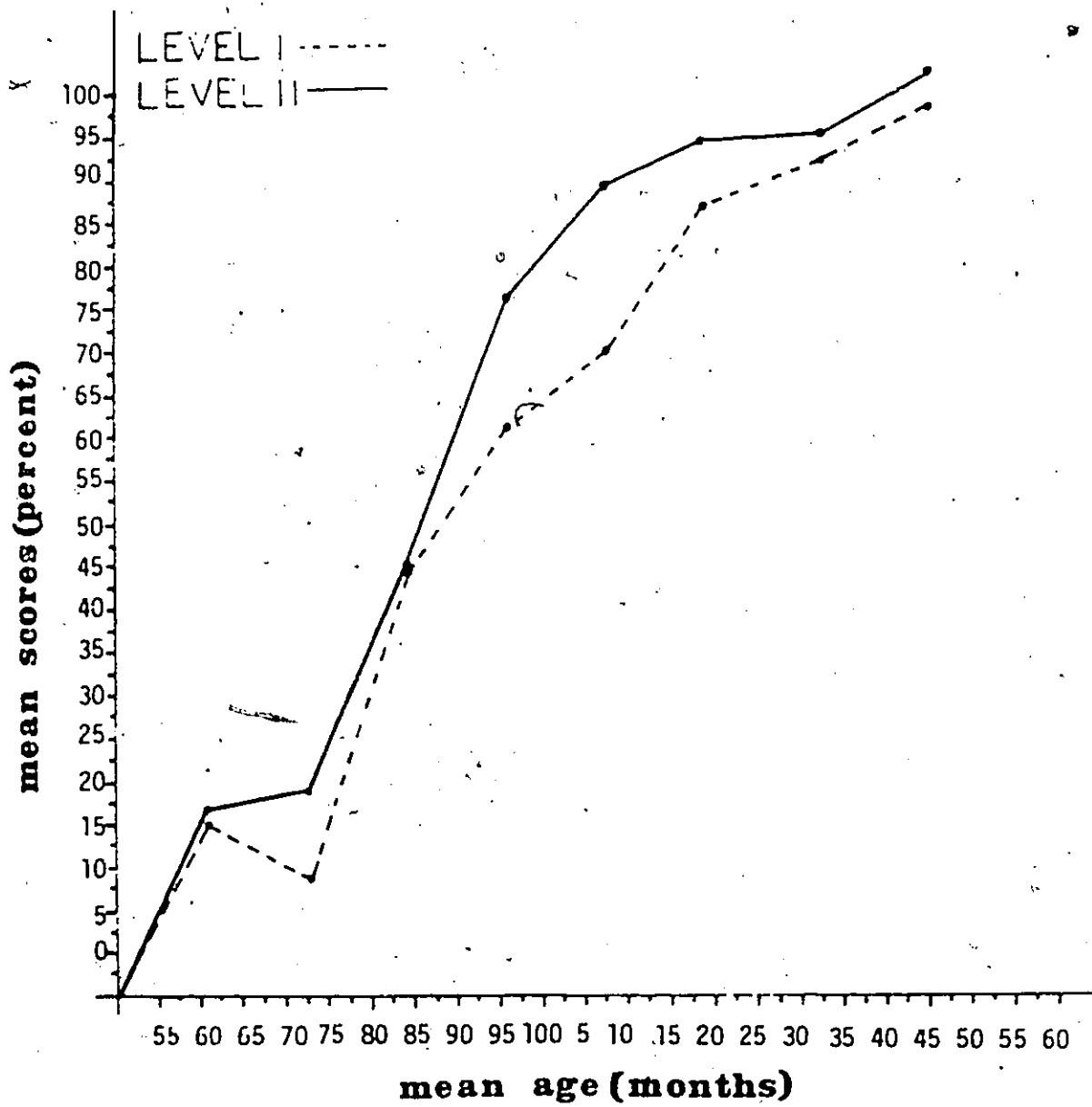
Both level I and level II suffixes correlate well with age. Using the Pearson product moment correlation, we get a level I correlation coefficient of .786; the level II correlation is somewhat stronger with a coefficient of .848. The common variance between score and age is .618 and .719 for level I and II respectively. Age is a better predictor of score on level II than on level I suffixes. This is depicted in Figure 5:

TABLE 11: LEVEL I AND II MEAN SCORES AT EACH GRADE

The following table gives the mean ages and the mean scores for level one and two suffixes at each grade.

GRADE	MEAN AGE	LEVEL I SCORE	LEVEL II SCORE
KI	60.5 mos.	15.625	16.5625
KII	<u>73</u> mos.	7.8125	18.75
Gr1	84.625	44.375	45.3125
Gr2	96.125	61.875	76.25
Gr3	107.625	70.0	89.375
Gr4	118.125	86.875	94.6875
Gr5	132.75	91.5625	95.9375
Gr6	145.0	93.4375	97.1875
MEANS	102.219	58.945	66.758
STANDARD DEVIATION		33.526	34.73

Figure 4: Graph Showing Mean Age and Mean Level I and II Scores



Results on Matched Items. Although the word lists were drawn up such that level I and II test items are matched for frequency, stress pattern, number of syllables, and general ease of articulation, it is not the case that the correspondence is exact in all respects. That is to say, it is not necessarily true that a particular level I word of X syllables, a Y frequency score, stress pattern a, and a particular level of articulation difficulty, is matched with a level II word of X syllables, Y frequency, stress pattern a, and the same level of articulation difficulty. As often as possible, this was done, but it was not possible to control all the parameters in the case of all the words used. Therefore, a second set of statistical tests was carried out on 17 test items that are matched in all respects. A complete list of the matched items can be found in Appendix III. All the suffixed forms are items with a frequency of less than 5 occurrences in 1,000,000 words.

Each subject's level I and II mean scores on the matched items are displayed in Table 12. There were twelve scores of 0 on the level I suffixes, and six scores of 0 on the level II suffixes. This contrasts with level I and II 0-scores of eight and three, when all items are considered. The level I zero scores belong to children in the first four grades, while the level II zero scores belong to children in Kindergarten I and II. There were fifteen perfect scores on

TABLE 12: AGE AND LEVEL I AND II SCORES FOR EACH SUBJECT
MATCHED ITEMS ONLY

In the following table age is given in months and scores on matched items are given in percentages.

SUBJECT	AGE	LEVEL I SCORE	LEVEL II SCORE	I - II
1.	56	0	35.294	-35.294
2.	58	11.765	47.059	-35.294
3.	58	0	11.764	-11.764
4.	60	0	0	0
5.	60	70.588	23.529	47.059
6.	62	0	0	0
7.	64	0	0	0
8.	66	17.647	17.647	0
9.	69	0	0	0
10.	69	0	17.647	-17.647
11.	70	17.647	11.764	5.882
12.	71	0	0	0
13.	74	5.882	17.647	-11.765
14.	75	17.647	47.059	-29.412
15.	75	0	0	0
16.	75	0	47.059	-47.059
17.	75	29.412	47.059	-17.647
18.	76	17.647	41.176	-23.529
19.	84	82.353	82.353	0
20.	84	70.588	52.941	17.647
21.	85	88.235	76.471	11.764
22.	87	11.765	82.353	-70.588
23.	87	0	17.647	-17.647
24.	95	52.941	17.647	35.294
25.	94	47.059	82.353	-35.294
26.	94	76.471	94.118	-17.647
27.	94	0	41.176	-41.176
28.	96	47.059	94.118	-47.059
29.	97	64.706	88.235	-23.529
30.	97	70.588	94.118	-23.529
31.	98	76.471	88.235	-11.764
32.	99	94.118	64.706	29.412

TABLE 12 continued.

SUBJECT	AGE	LEVEL I SCORE	LEVEL II SCORE	I - II
33.	102	52.941	82.353	-29.412
34.	104	76.471	94.118	-17.647
35.	104	94.118	94.118	0
36.	108	5.882	76.471	-70.588
37.	109	100.00	94.118	5.882
38.	110	100.00	94.118	5.882
39.	112	70.588	94.118	-23.529
40.	112	35.294	94.118	-58.824

41.	111	100.00	100.00	0
42.	113	100.0	94.118	5.882
43.	115	100.00	94.118	5.882
44.	118	35.294	100.00	-64.706
45.	118	88.235	94.118	- 5.882
46.	120	100.00	88.235	11.764
47.	124	100.00	100.0	0
48.	126	70.588	94.118	-23.529

49.	129	82.353	100.00	-17.647
50.	131	100.0	94.118	5.882
51.	131	100.00	100.0	0
52.	133	100.00	100.00	0
53.	134	94.118	100.00	- 5.882
54.	134	88.235	100.0	-11.764
55.	135	70.588	82.353	-11.764
56.	135	100.0	100.00	0

57.	138	100.00	100.00	0
58.	139	100.0	100.0	0
59.	140	100.0	100.00	0
60.	142	88.235	100.0	-11.764
61.	143	100.0	88.235	11.764
62.	149	88.235	100.0	-11.764
63.	153	70.588	94.118	-23.529
64.	156	82.353	100.00	-17.647

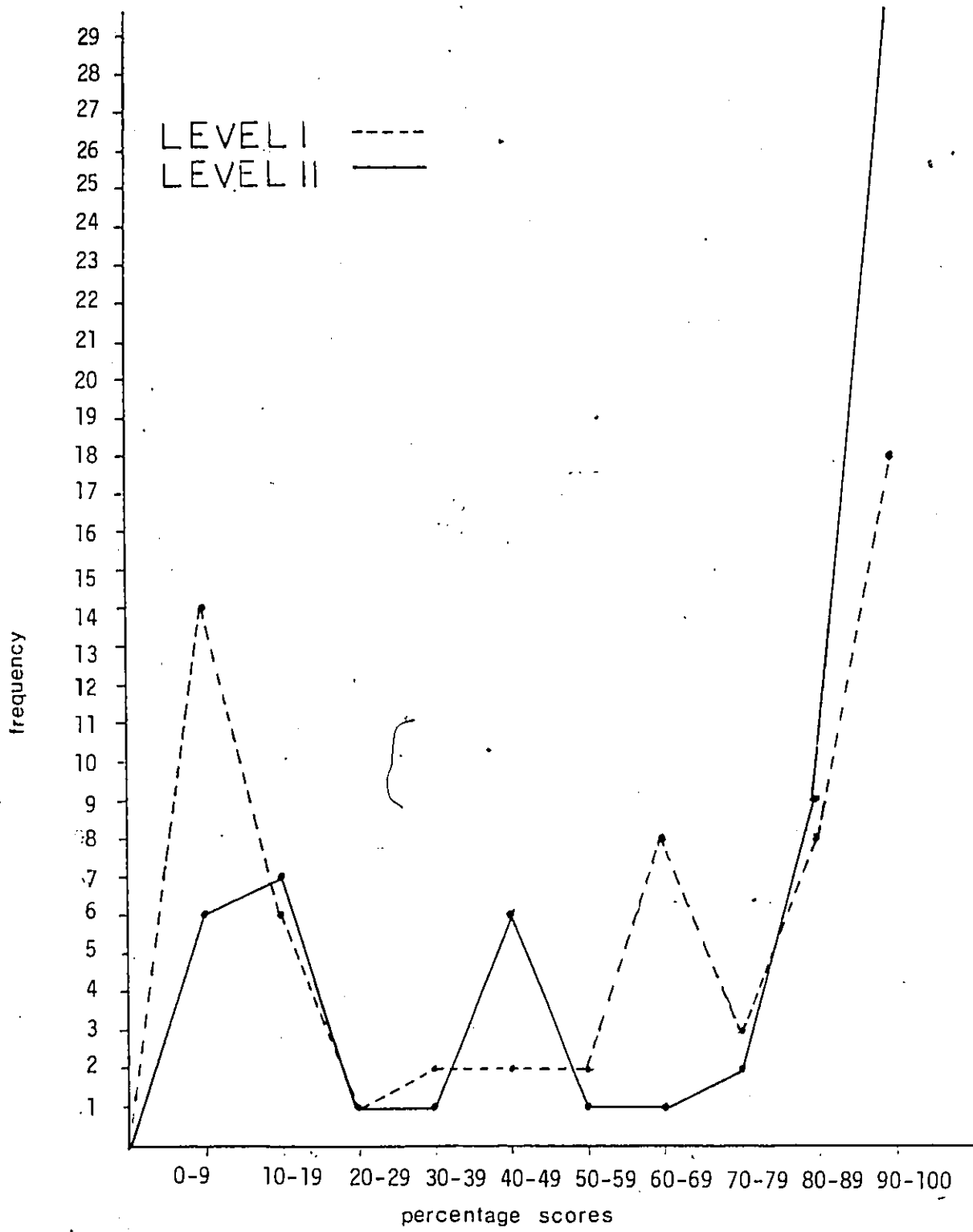
both level I and II items, but the perfect scores were distributed over grades 3 to 6 for level I and over grades 4 to 6 for level II. The mean scores for level I and II suffixes are 57.261 and 68.566 respectively.

The distribution of scores on the level I and II matched items is shown in Figure 6. The distributions exhibit the same properties as the score distributions over all items: there are more low scores for level I suffix items and fewer high scores, and neither distribution is normal. It is also the case, as shown in Table 12, that there is a great deal of variation in ability within grades. Again, this variation decreases with age. The range of scores at each grade is summarized in Table 13.

Table 13: Range of Level I & II Scores at Each Grade

GRADE	LI RANGE	DIFFERENCE	LII RANGE	DIFFERENCE
KI	0 - 70.588	70.588	0 - 47.059	47.059
KII	0 - 17.647	17.647	0 - 47.059	47.059
G 1	0 - 88.235	88.235	17.647- 82.353	64.706
G 2	0 - 94.118	94.118	41.176- 94.118	52.942
G 3	5.882-100.000	94.118	76.471- 94.118	17.647
G 4	35.295-100.000	64.706	88.235-100.000	11.765
G 5	70.588-100.000	29.412	82.353-100.000	17.647
G 6	70.588-100.000	29.412	88.235-100.000	11.765

Figure 6: Frequency distribution of scores on matched items



On the whole, the same comments that were made of the entire body of test items can be applied to the test items: After kindergarten, the lowest level I scores are consistently lower than the lowest level II scores; the difference between the lowest and highest scores is greater for level I than for level II suffix items, with the exception of Kindergarten II. The variability decreases very sharply for level II suffixes at grade 3, and less sharply at grade 5 for level I suffix items. This compares to grades 4 and 5 which are the points of marked decrease in variation when all items are considered.

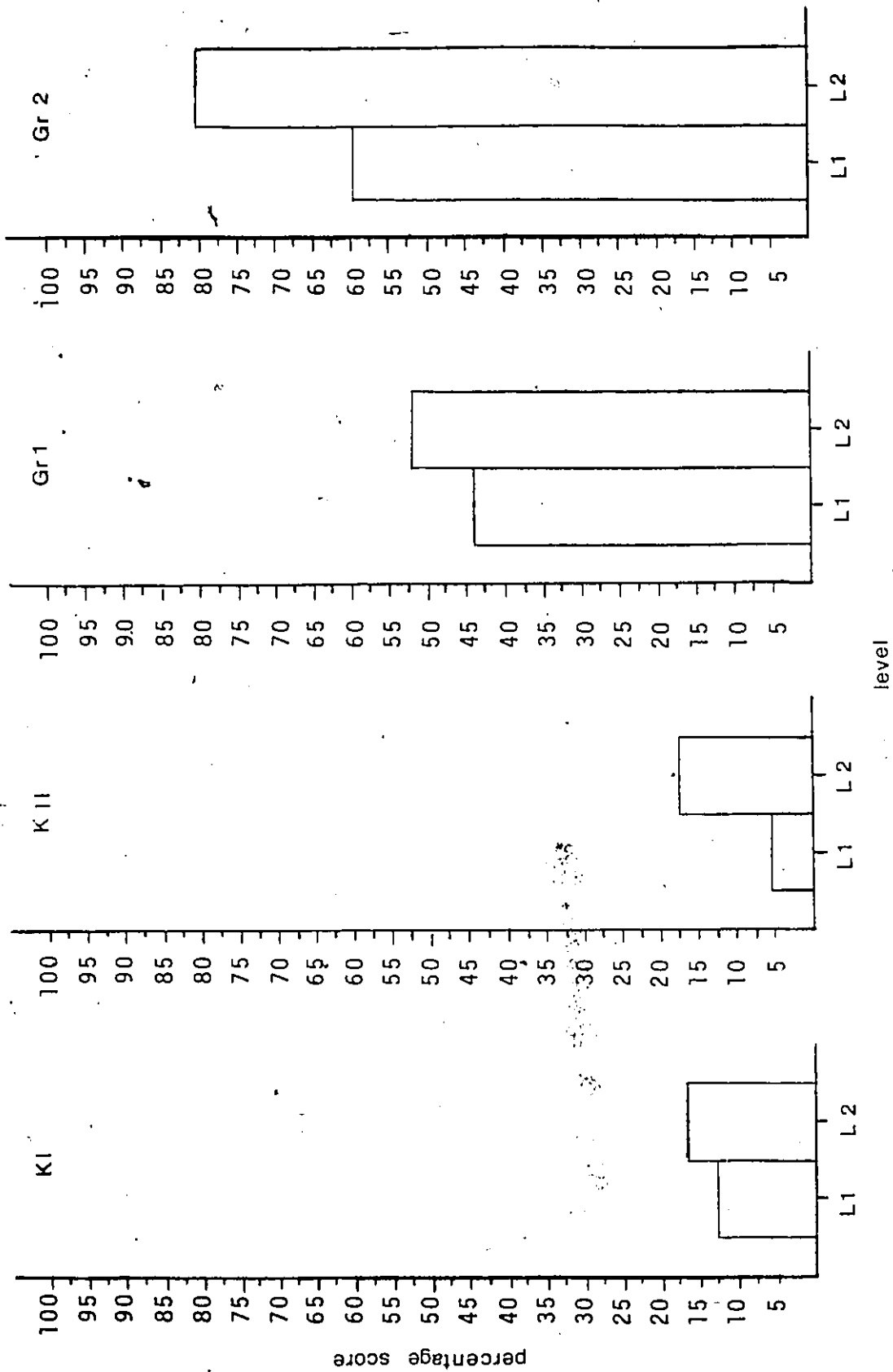
Difference in each grade's performance on level I and II suffixes (as indicated by mean grade score) is even more marked for matched items than it is for all items. See Figure 7. The difference in grade means for each level is summarized in Table 14:

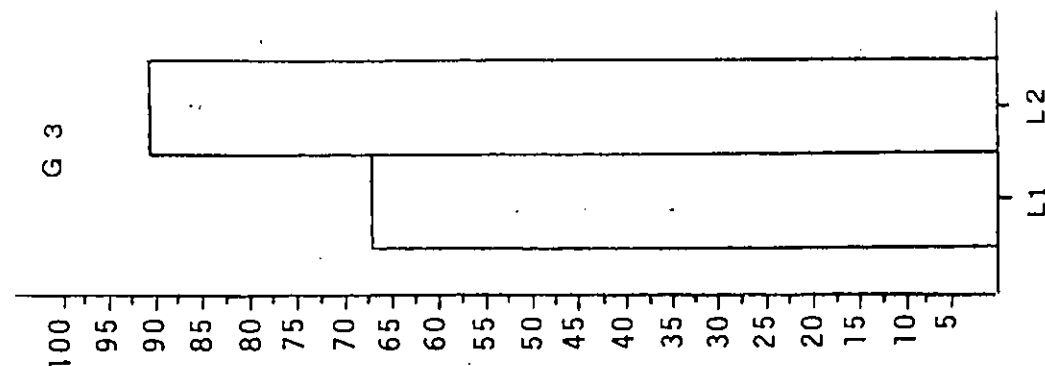
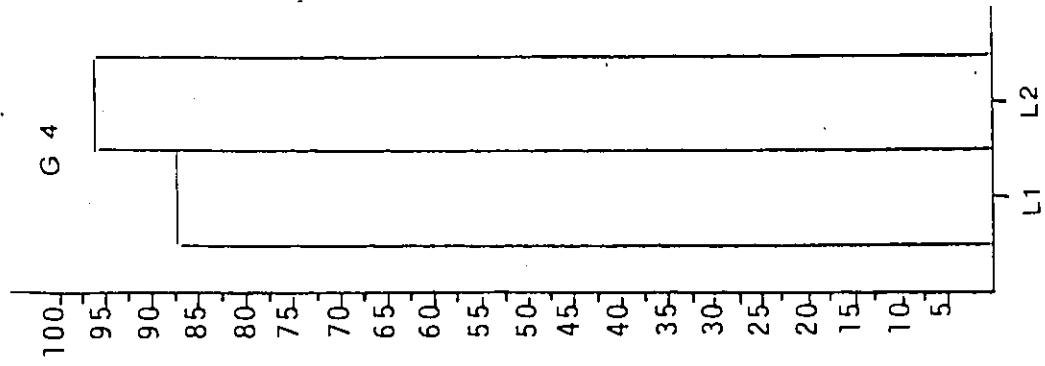
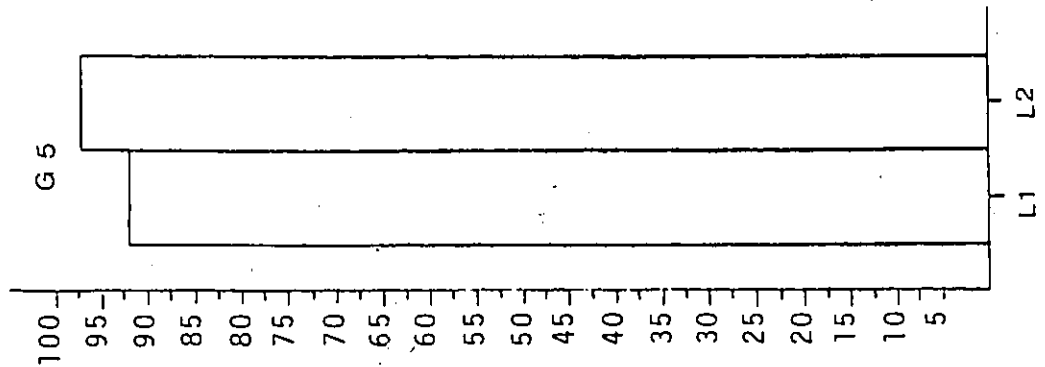
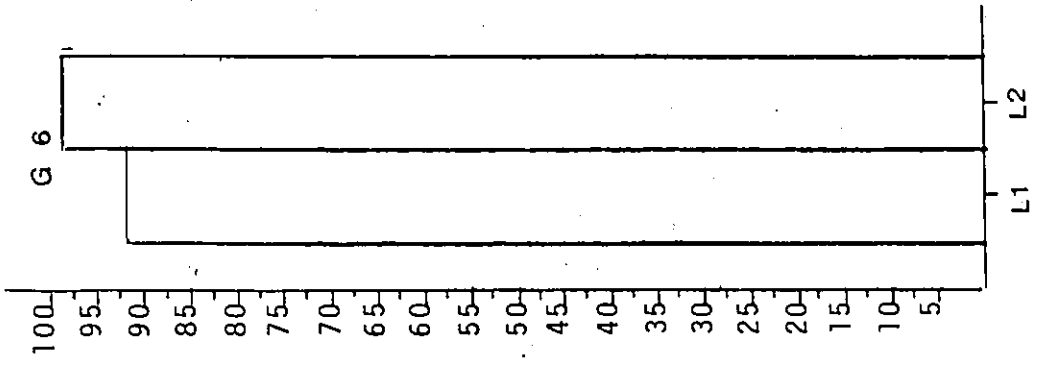
Table 14: $\bar{X}_I - \bar{X}_{II}$ for Each Grade (Matched Items Only)

Grade	KI	KII	Gr 1	Gr 2	Gr 3	Gr 4	Gr 5	Gr 6
$\bar{X}_I - \bar{X}_{II}$	-4.4	-12.5	-8.1	-21.3	-23.5	-8.8	-5.2	-6.6

Again, for further analysis, two scores for each subject were computed from the data. One score is the subject's mean score on level I suffix items, and the other score is the subject's mean score on level II suffix items. The Wilcoxon signed-ranks test was again applied to 47 score

Figure 7: Histogram comparing performance on L I and II





pairs in which there is a difference. The results are significant at the .0001 level for a one-tailed test. The direction of the difference between the levels is again that level II suffix scores are greater than level I suffix scores.

Table 15: Level I - Level II Results over Matched Items

$$\sum + \text{ scores (ie Level I } > \text{ Level II) } = 203.5$$

$$\sum - \text{ scores (ie Level I } < \text{ Level II) } = -924.5$$

$$W = 203.5; N = 47; z = 3.81$$

For the matched items, too, there is a correlation between grade and score. The mean age at each grade, and the level I and II mean grade scores are given in Table 16. Figure 8 presents the same information in graph form. For purposes of comparison, the age/score means calculated over all the items are also on the graph. The correlation coefficient of age and score on level I suffixes (using the Pearson product moment correlation) is .759; for level II suffixes, the age/score correlation coefficient is .824. The shared variances between age and score are .576 for level I and .686 for Level II. This is shown in Figure 9:

Figure 8: Mean age versus mean score on matched items

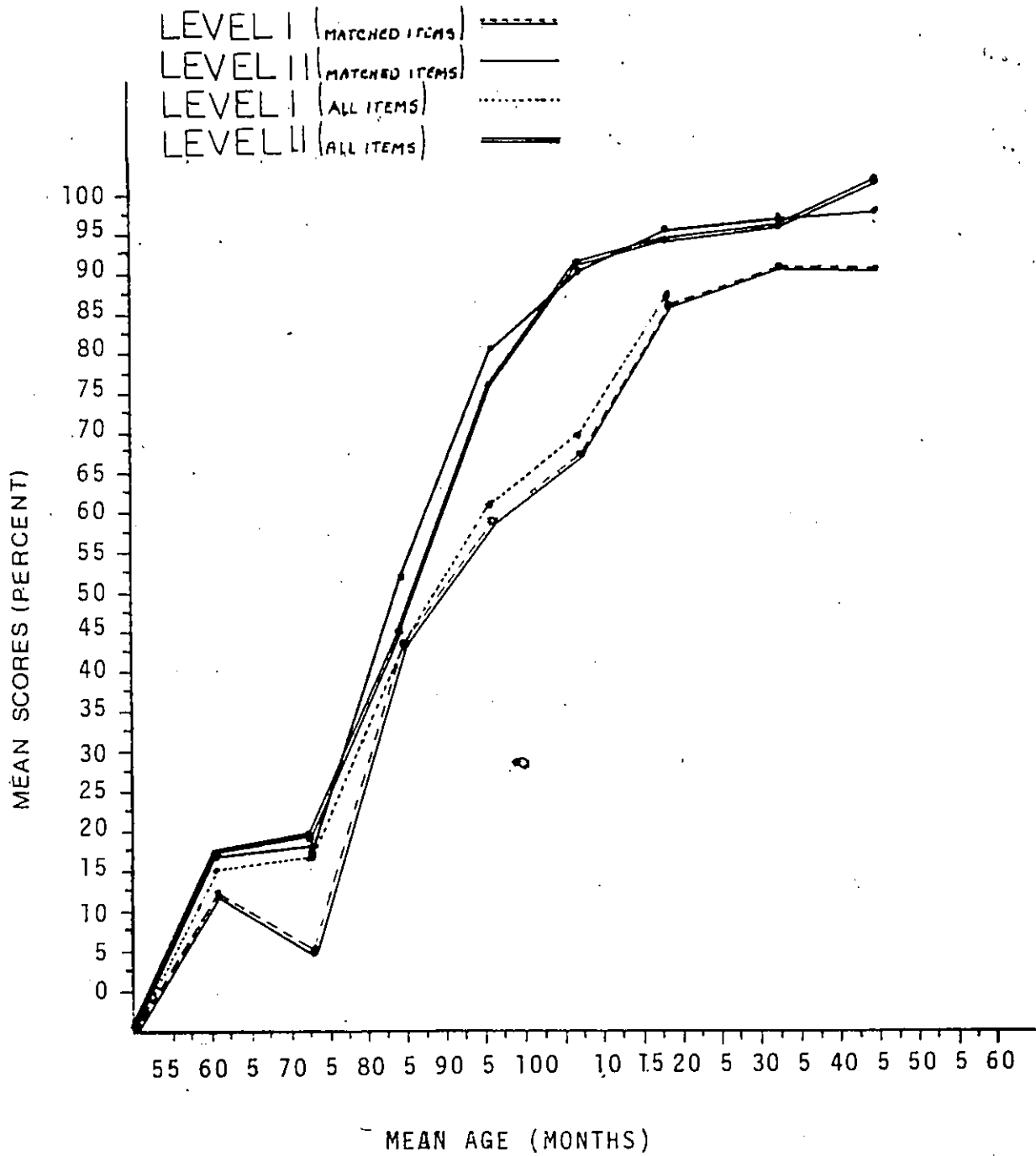
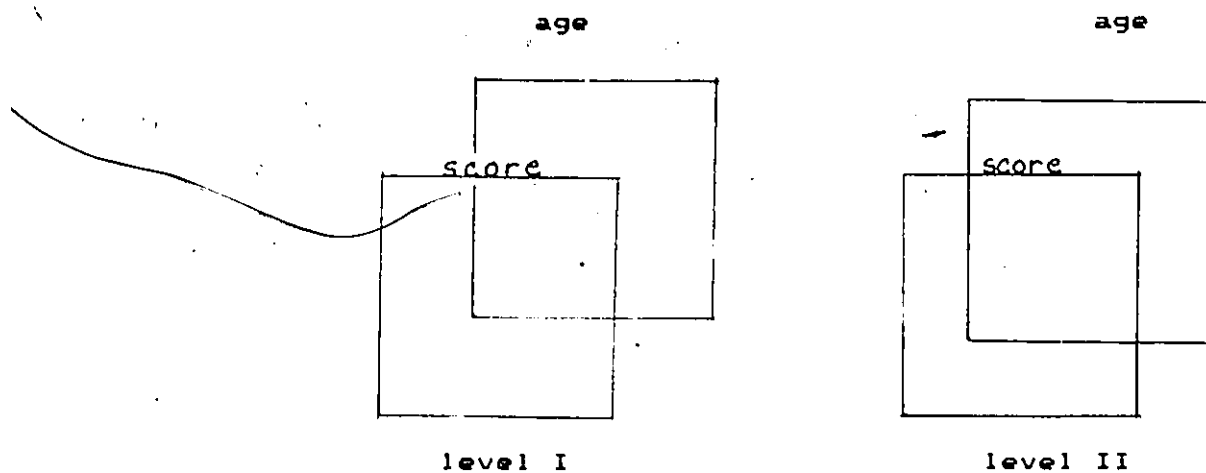


Figure 9: Common Variance of Age and Score for Matched Items



Complete competence, as indicated by a score of 100%, is achieved at 147.733 months for level I suffixes, and at 135.882 months for level II suffixes. This compares with 145.778 months and 137.775 months over all test items. When only matched items are considered, the level II suffixes are mastered 11.851 months earlier than the level I suffixes.

Results of tests on matched items reaffirm results of tests on all the items. First, the children tested performed significantly better on level II than on level I suffixes. Second, level II suffixes are mastered several months earlier than level I suffixes.

TABLE 16: LEVEL I AND II MEAN SCORES AT EACH GRADE

The following table gives the mean ages (in months) and the percentage mean scores for level one and two suffixes at each grade.

GRADE	MEAN AGE	LEVEL I SCORE	LEVEL II SCORE
KI	60.5	12.5	16.91
KII	73	5.147	17.647
Gr1	84.625	44.118	52.206
Gr2	96.125	59.559	80.882
Gr3	107.625	66.912	90.442
Gr4	118.125	86.765	95.588
Gr5	132.75	91.912	97.059
Gr6	145.0	91.176	97.796
MEANS	102.219	57.261	68.566
STANDARD DEVIATION		34.251	34.96

Chapter 4

Discussion and conclusions. The tests provide strong support for the hypotheses that level II suffixes are easier than level I suffixes, and that they are acquired earlier. The strength of the results is clear, in spite of the bias against performance on level II suffixes that is attributable to learning effect and item selection. Recall that all the level II suffixes were presented together before the level I suffixes. Therefore, it is likely to be the case that subjects were more comfortable with the demands of the task itself by the time that the level I suffixes were introduced. No measure of the learning effect of the tests has been obtained, but the phenomenon is well known and it is sufficient, for present purposes, to point out that presentation of the suffixes did not favour performance on level II suffixes.

It might be objected that fatigue biased against performance on level I, particularly in the case of the younger subjects. However, an analysis of the data obtained from 20 subjects outside this experiment, in which presentation order of the suffix sets was randomized, yielded results similar to those obtained from the subjects in this study.

The second way the tests biased against performance on

level II suffixes resides with selection of base items. Of this we have some quantitative measure, at least in terms of frequency. A comparison of the overall results, and the results on the 17 frequency-matched items also supports the claim that bias favours performance, not on level II, but on level I suffixes. The level of significance achieved when all items are considered is .0002, while the level of significance that emerges from considering only the frequency-matched items is .0001. The low probability that the results are due to chance, in spite of the two types of bias against the results, permits a high degree of confidence in the validity of the tests. It is fairly safe to assume that level I suffixes are, indeed, more difficult to acquire, and that they are, probably as a consequence of that, later acquired than are level II suffixes.

It may be argued that controlling for frequency of the stem, the target derivative, or even both, is inadequate, since it has been demonstrated (Bradley 1978) that it is the combined frequency of the word, in all its derivative forms that is a relevant variable. The combinative powers of an item are very close to the concept of productivity, which Anshen and Aronoff (1986) define as 'the likelihood that new forms will enter the language' (page 5). Therefore, productivity is inevitably a determinant of frequency, and it cannot be denied that level

II suffixes are generally more productive than level I suffixes. In sum, our results may be partly due to differences in the productivity of the two types of affix. Since difference in productivity is partly what characterizes the two levels, this is not thought to be a problem.

The same argument can be made for grammatical complexity. It could be objected that three of the four level II suffixes (#er, #ness, and #ment) form nouns, while only two of the level I suffixes (+al and +ity) are noun forming (and these are inconsistent noun formers at that). First, it must be noted that there is no reason to think that children find the derivation of nouns any less difficult than the formation of other parts of speech. For example, children begin very early to form verbs from nouns by zero derivation, but they rarely form nouns from verbs by zero derivation. Second, grammatical complexity is a very unwieldy variable. One should undoubtedly consider not just the part of speech formed, but the entire subcategorization of the suffix. This leads to issues such as abstractness which are, themselves, very complex. Finally, and most important, is the fact that grammatical complexity, like productivity, is partly what distinguishes level I and level II suffixes. There is no doubt that these different kinds of complexity are significantly linked to the differences in

the acquisition of the two levels of suffix. Our claim is simply that there are differences. Exploring the relative contributions of these factors to the acquisition of the morphology appears to constitute a logical extension of the present study, rather than an objection to its rigour.

In addition to confirming the hypotheses, the results point out several other interesting features of morphological development. The results reaffirm and elaborate two well-known and interrelated facts of linguistic development, namely that, while performance improves with age, there is tremendous individual variation among children of the same age. In other words, age is only a gross indicator of linguistic ability.²

It is hardly surprising that the younger subjects find the suffixation task considerably harder than the older ones, and that there is, in fact, a positive linear relationship between age and score. The finding that there is great variation among children of a given age is equally redundant. Nonetheless, these findings underscore the validity of the tests. Because results reiterate previously known facts of language development, we can be more confident that our results are generalizable beyond the sample population, and that other facts of language development in general are true of morphological development in particular. With this in mind, we can proceed with a

discussion of more novel and interesting aspects of the study.

One such aspect concerns the length of time over which morphological development takes place. It is surprising to find out just how late morphological maturity is reached, since it is widely assumed that children are simply lacking in vocabulary. That kindergarten children would find the tests difficult came as no surprise; that children of twelve would not demonstrate complete mastery came as something of a shock. Only three out of eight children at the grade six level achieved a perfect score even on the easier level II suffixes. At the grade one level, where the mean age is almost exactly seven years, children scored less than 50% on either level I or II suffixes. It appears that morphological development continues until about the age of puberty. Certainly children well past the age of seven are doing more than just adding words to their vocabularies; they are working out, and learning to exploit, the very structure of the morphology.

The fact that morphological development occurs over such a time period inevitably raises the question of its relationship to cognitive development. To begin with, the reader's attention is drawn to an interesting feature of the age-score correlation, namely that there are points at which it jumps. The relationship between age and score is

positively linear, but it is not perfectly so. For level II suffixes there is a rather sharp increase in mean score between kindergarten and grade one, and another between grades one and two. From that point there is a steady increase which tapers off at about grade four. A similar, though not identical, pattern holds for level I suffixes. It is as though something happens at certain points which gives additional impetus to morphological development, and which enhances children's ability to handle the suffixation task. The nature of the task, and the timing of the increases in performance, suggest that the impetus stems specifically from changes in cognitive functioning which are associated with what Piagetians refer to as the 'five-to-seven shift'. During the course of this shift from preoperations to concrete operations, children begin to focus on the linguistic form as an object in its own right, apart from its context or meaning. Children, generally between the ages of five and seven years, are beginning to be capable of metalinguistic, as well as linguistic, thought. The age for which competence is projected coincides with puberty, which is assumed to mark the onset of the period known as 'formal operations'. Note, too, that the extreme score variation within grades rules out education as the crucial factor. It seems reasonable, therefore, to propose that qualitative changes in cognitive functioning are related to

the score jumps on the suffixation task.

Because of the above-mentioned correspondence between Piagetian stages and levels of the lexicon, it is tempting to conclude that the structures are attributable to cognitive changes that occur during the period from 5 to 13 years. More careful consideration of the data indicates that such a conclusion is not only unwarranted, but incorrect.

Recall that suffixation is not an all-or-nothing task. Children may be able to suffix at level II but not at level I, and it is extremely difficult to explain this in terms of cognitive limitations. It should not be harder to form a generalization between, for example, the structures pulse and pulsate than between the structures point and pointless. Yet evidence from this study indicates that children do differentiate between +-boundary and #-boundary suffixes even without evidence that there is a basis for differentiation. One might argue that while the particular items, in the context of their presentation, are equal in complexity and consistency, the former pair is exemplary of a set of structures that is more complex than the child is able to handle at that point, so s/he postpones dealing with members of that set. There are two problems with this view, both stemming from the implicit assumption that differentiation rests on an awareness of the difference between level-I and level-II suffixes.

If previous knowledge of language learning is to be trusted, children should begin by assuming there is no difference between various suffixes, and one need only 'tack them on' to the stem. Upon learning that, in fact, some suffixes can be counted on to be consistent while others cannot, there should follow a differentiation or reorganization of the lexicon. The results of the study do not support either of these assumptions. Had the children in the study been operating on this basis there is no reason for there to be a difference in performance on level-I and level-II suffixes; there should be evidence of the all-or-nothing approach to suffixation, subject only to the kind of phonological limits outlined by Innes (1974).⁴ Moreover, on learning that the initial hypothesis is inadequate, children would be required to distinguish between those suffixes for which 'tacking on' is adequate and those for which it may not be. They would, in other words, set up level I and level II in their lexicons. Neither my findings, nor Gordon's (1985) square with a reorganizational account. Both sets of findings support the view that morphological development operates within the parameters defined, not by cognitive structures, but by the morphology. A more serious problem with any account that assumes a distinction between what the child is able to deal with at a given time and what s/he is not is

that it implies a sorting or filtering procedure that depends on perception and logic of which the child is supposedly incapable. On logical grounds, alone, we are led to conclude that learning the morphology consists of elaborating existing structures, and that while cognition may power the elaboration of the structures, it cannot define them.

The present study supports the view that young children first work with very productive and transparent processes, because they are incapable of the kinds or levels of cognitive processing required at higher lexical levels. Metalinguistic awareness, and skills of logic, analysis and synthesis are, undoubtedly, beneficial (perhaps even crucial) for the generalization that underlies the analysis or generative production of level-I and level-II derivations. As children develop cognitively, they become better equipped to deal with less consistency and greater complexity in the input. However, the view that the structure of morphology is a consequence of increasing cognitive capacity must be rejected. The fact that different levels are elaborated at different points in development provides the key to the specification of the 'set of learning procedures that determine how a child decides at which level a particular rule should be assigned' (Gordon 1985: 88). Gordon is correct when he assumes that the child

probably uses properties of levels in determining level assignment, but he is wrong in his assumption that all the levels are filled out simultaneously. Limits on cognition determine the levels of complexity with which the child can work; those levels of the morphology which demand more cognitive skills than the child has at a particular stage cannot be elaborated until such time as the child's cognitive capacities are equal to the task.

Conclusions

It is clear that Kiparsky's level-ordered lexical model is applicable to acquisition. The level of abstractness introduced by the model is psychologically real in ways that are amenable to empirical investigation and verification. A level is definable in both linguistic and psychological terms. Linguistically, it is an address for certain affixes and processes which conform to particular patterns of linguistic behavior. At the same time, a level is elaborated before or after another level, and is accessed with lesser or greater speed and ease than other levels. Further, the place of the level in the system imposes constraints on the hypotheses that will be generated in the course of acquisition.

NOTES

1. We mean by this that neither +al nor +ity always forms nouns from verbs. +al sometimes forms adjectives from nouns (eg. personal) and +ity sometimes forms its nouns from adjectives and sometimes from verbs (eg. obscurity and deformity).

2. Derwing (1985) makes the point that stage of language development is a better basis for grouping children than either age or grade. His point is well taken, but the fact remains that we have yet to define the stages. The results of this study may contribute to that endeavour, insofar as they demonstrate that stages in morphological development may be defined, at least partly, in terms of mastery of levels. We can, for example, distinguish a stage of level-II affix mastery that precedes a stage of level-I affix mastery, though it is important to conceive of these stages as being on a continuum, rather than existing as discrete periods in development.

3. Of course, the marked increases in score on the suffixation task also coincide with the period during which most normal children learn to read, and that, too, may play a role in performance on the suffixation task. The task requires that the child be able to analyse a base and suffixed-form pair to extract the suffix, remember that

suffix as an entity in itself, and append it to new vocabulary items that are decontextualized and whose meanings are very likely unknown. Some aspects of these abilities are both prerequisite to, and a consequence of learning to read. See, for example, Downing and Valtin (1984) and Tunmer, Pratt and Herriman (1984) for a good discussion of the ways in which language development underlies reading ability, and how reading, in turn, fosters language development.

4. No formal error analysis of the data has been undertaken, but an informal perusal of the mistakes indicates that this is true. For example, there were more mistakes on -er agentive if the stem ended in /ɔ/, on -ness if the item ended in /əs/, etc.

5. This is essentially the position taken, for logical reasons, by Fodor (1980).

6. This is probably true of processing as well. See Stanners et al (1979), MacKay (1978), Petry, Carroll and White (1973), and Bradley (1980), to name only a few of the researchers who have done studies bearing on morphological processing and the organization of the mental lexicon.

Chapter 5

Future Directions for Research

There are several avenues for research opened up by the application of level ordering to acquisition. Those that will be considered involve three main lines of enquiry. The first will be that which stems directly from the current study. More than anything else, the suggestions constitute verification of the application of level-ordering to acquisition. The second line of enquiry stems from the application of level ordering to acquisition. In this section, the implications of the application, both for acquisition research and for the elaboration of the theory, will be considered. Finally, some consideration will be given to the possible application of level ordering to morphological processing generally.

VERIFYING THE EXPERIMENT AND RESULTS

Without question, any set of findings, regardless of its apparent conclusiveness, requires replication and verification. This imperative, in itself, raises a multitude of questions and defines a direction for future research in the area. First, one needs to know whether, or to what extent, the results are generalizable to other aspects of acquisition (such as comprehension); or even to other types

of production tasks. More important, can the results be replicated for other level I and II affixes, including prefixes? Can the results be duplicated for other languages? Research which addresses questions such as these will constitute tests of the test. They will help to verify the application of level ordering to morphological acquisition. Such research assumes priority in order that other lines of enquiry can be confidently based on firmly grounded assumptions.

Parallel to this line of research is one which explores the data gathered for this study in greater detail. The mandate of the experiment has been to test the hypothesis that level ordering models, not only the structure of the lexicon, but the structure of the acquisition of the knowledge of that structure. In the course of fulfilling this mandate, it has been necessary to ignore the fuller possibilities of the data. It would be useful to exploit the within-level and within-suffix distinctions that are available in the data. It would be possible to replicate Innes' (1974) exploration of the acquisition of the English regular plural. By careful examination of the items in each suffix set on which mistakes were made, we may be able to draw some reasonably firm conclusions about the role of phonology in the acquisition of the morphology.

Further to this, we can look at the kinds of mistakes that were made. A cursory examination of the data indicates that the types of mistakes that children make are highly predictable, and it is strongly suspected that particular types of error are indicative of stage of linguistic development. Just as charting the phonological terrain allows the identification of performance groups, so too will grouping by error type. This is of interest, of course, because it will help us to further elucidate the strategies and principles that underly the acquisition of morphology.

A more complex undertaking would be to unravel the relative contributions of phonological and semantic transparency, grammatical complexity, and productivity to morphological acquisition. The finding of Block and Kessel (1979) is that overlap between semantic and grammatical complexity is a predictor of order of acquisition. This leads to speculation that the later acquisition of level I suffixes involves overlap of the four characteristics identified above (i.e. phonological and semantic transparency, grammatical complexity, and productivity). However, it is clear from the experiment that eliminating phonological opacity is not sufficient to offset the distinction made between level I and II suffixes. In short, subjects responded in a way that indicates that they 'knew' the suffixes were of two different levels, even though all

the derivations used in the test were phonologically transparent. On what grounds was the distinction made? Further, to what extent could their judgement be altered by controlling for each of the other variables? The current data may be of help in answering these questions. For example, not all the suffixes at a particular level are equally productive; it may even be the case that not all level I suffixes are less productive than all the level II suffixes.² By reviewing the data in the light of differences in productivity, it would be possible to obtain a measure of productivity's contribution to acquisition order. If level I and II items are matched for productivity, as well as for phonological transparency, it will be possible to obtain a measure of the combined contribution of semantic and grammatical complexity. In short, the data are well suited to the kind of factor analysis carried out by Block and Kessel; the fact that they provide information about several more derivational affixes than those considered by Block and Kessel will surely make the analysis that much more revealing of the determinants of morphological acquisition.

RESEARCH INDIRECTLY INDICATED

The research directions outlined above arise in response to the question 'Is it really the case that level ordering

models acquisition in several respects?' This second line of enquiry seeks to consider the implications of the application. As such, it follows the logic of 'If level ordering models acquisition, then...' Such research will explore the nature and limits of the correspondence between level ordering and acquisition. Gordon's (1985) study belongs in this category. It is an unstated assumption of the experiment that level ordering is applicable to acquisition. By demonstrating that children are constrained in their production of novel compounds by the consequences of level ordering, his results validate that basic assumption. The more important purpose served by his study is to show one of the ways in which level ordering applies to acquisition. Specifically, he demonstrates that some consequences of level ordering are realized in acquisition. As soon as a relationship between theoretical consequences and acquisition is established, a wealth of research hypotheses emerge. For example, children should resist any regular inflection inside compounds. They should also demonstrate a preference for affix attachment that is in accord with level ordering (ie. [stem] +-boundary suffix] # boundary suffix]).

Perhaps an even more interesting tack is one implied by Gordon himself, namely the extension of his investigation to

other languages. There have been level ordered analyses done on a number of diverse languages, and it appears to be the case that level assignment of a particular process is language specific. For example, compounding occurs on level II in English, but my own work on Setswana indicates that, in that language, compounding occurs on the first of four levels. Diminutive formation, which is very productive in Setswana, occurs on level III. The prediction made by this analysis is that diminutives should not occur inside compounds. Motswana children should, therefore, resist forming novel compounds containing diminutive first members. In fact, since regular plural marking occurs on level four, after compounding, Motswana children, like English children, should also resist forming compounds containing plural first members. It is not suggested that designing good experiments which provide insight into the acquisition process is a trivial matter. Still, it is clear that, to identify particular research projects, one need only consider the structural consequences of level ordering morphological operations in a language, and then design studies which address the question of whether these consequences constrain the language learner.

So far, we have considered the application of level ordering to acquisition from the point of view of what it

offers to acquisition. It was stated at the beginning of the thesis that acquisition studies may, in turn, have something to say about level ordering. Mohanan (1982) does something of the kind when he uses pause insertion and word games to argue the distinction between lexical and post-lexical rules.

Some examples of the kinds of issue to which acquisition data could be applied include explication of what Kaisse and Shaw (1985) refer to as the 'vertical modularization between the morphological and phonological sides of the lexicon...' (p.13). There are indications that different levels of the lexicon are acquired and processed differently; this may be an indication of different principles and structural properties of the levels. Acquisition (and processing) data might be used to determine whether or not there may be a difference between compounding and derivation. This information is potentially useful because compounds are implicated in both the loop issue and the number of levels. For example, Kiparsky (1982) posits three levels in the morphology; this is achieved by separating derivation and inflection, and further distinguishing $+$ -boundary and $\#$ -boundary derivation. Halle and Mohanan (1985) derive a four-level model by further distinguishing between compounding and derivation. Kaisse

and Shaw state that their motivation for the four levels seems weak; since the difference between this and the three-level model lies in their treatment of compounds and derivations as different kinds of word-formation processes, the comparative acquisition and processing of compounds and #-boundary derivations may be of interest.

Acquisition and processing information may also be addressed to boundary and lexicalization issues. If, for example, a word is lexicalized (i.e. reanalyzed as underived, even though it may contain internal evidence of former lexical morphological operations) it is, as an underived item, subject to different rules, or it yields different results than is the case if the item is derived at an earlier level. It may thus give the impression of recursion to an earlier level when, in fact, there is none.

LEVEL ORDERING AND OTHER KINDS OF LANGUAGE PROCESSING

To say that a theory is psychologically real is generally interpreted to mean that it reflects what goes on in either learning or processing. Given the intricate connection between these two, it is not surprising that application of the theory to language learning raises questions of its application to processing. Processing, in turn, involves memory storage and retrieval, among other

things. While I know of no studies which bear directly on the application of levelordering to the storage and retrieval of lexical items, there are several pieces of research that indicate that the connection would be fruitful.

4

Researchers such as MacKay have done work on the organization of the internal lexicon which suggests one possible avenue for research. In his paper "Derivational rules and the internal lexicon" (1978) he contrasts two views of lexical storage and retrieval, and he comes up with evidence in favour of a Derivational Hypothesis which states that items are, in fact, put together rather than stored whole in the memory. Interestingly, he found that reaction times are related to derivational complexity. Examination of his material reveals that he compared what are, in terms of level ordering, level-I and II suffixes, and found that it takes longer for subjects to form derivations involving level-I than level-II suffixes.

An interesting sidenote to this discussion of MacKay's work is that level ordering offers a reconciliation of the different findings of other researchers, such as Steinberg (1973) whose evidence appears to support the Independent Unit Hypothesis. This hypothesis states that derivations are stored whole in the memory along with their bases.

Examination of the data indicates that Steinberg tested with level-I suffixes. Viewed from the perspective of level ordering, they could both be right. This suggests that a useful and interesting endeavour would be to review various conflicting experimental findings with a view to reconciling them within the context of the level-ordered model.

Stanners et al. (1979b) report that some prefixed words are stored whole in the memory, while others appear to be partitioned (and, presumably, subject to recreation). Their (1979a) study also reports that inflected forms fully activate their bases while derived forms do not. We can interpret their findings as demonstrating a three-way distinction in processing that coincides with the distinction between levels. In other words, there is evidence that each of the three levels in the level-ordered model represents a different type of storage and retrieval. This is consistent with the results of Bybee and Slobin (1982) who distinguish between the use of rules in the construction of regular past tenses and the use of what they term 'schemas' which are involved in the production of irregular past tense forms.

Of course, all these experiments were carried out before the advent of the level-ordered lexical hypothesis. Indeed, some of the research was carried out with little or no reference to any linguistic theory. Choice of affixes and

derivational processes to be studied appears to have been idiosyncratic, and this has led to unnecessary contradictions. Further, it has left researchers with no clear sense of direction. Reviewing studies on lexical storage and retrieval in the light of level ordering promises a means of unifying current knowledge and guiding its future development in a way that will satisfy both linguists and psychologists.

NOTES

1. The present study focusses only on the measure of correct responses. We did, however, record each mistake in phonemic script, so that it is possible to describe, in detail, the kinds of mistakes that were made and where they occurred.

2. Bradley (1980), as reported by Anshen and Aronoff (1986), notes that the suffix -ment (level II) is less productive than -ion which is a level-I suffix.

3. I would like to state, at the outset, that great care must be taken when evaluating theory in the light of psychological reality. In the past, the tendency has been to overzealously denounce the theory if it can not be shown to be psychologically real. There are several problems with such denunciation, not the least of which may be the interpretation given to psychological reality. For example, failure to confirm the derivational theory of complexity led some linguists to abandon the idea of transformations. Granted, transformational theory has undergone substantial revision since that time, but there has been other evidence that transformations are psychologically real.

4. Researchers at the Neurological Institute in Montreal are currently looking at certain kinds of aphasia in terms of level ordering, and they are encouraged by preliminary studies.

APPENDIX I

List of example and test items

EXAMPLE ITEMS	TEST ITEMS
[+ize] final urban pressure legal magnet regular trivial mineral visual suburban	terror polar special equal moral character natural popular rational computer
[+ate] motive urine captive granule lubric gyr rote phone valid crenel	active pollen person menthol medic air trunk pulse fabric module
[+all] arrive season music betray recite sensation rotation suicide emotion anecdote	survive person magic deny rehearse proportion migration homicide relation antinode
[+ity] obese perverse secure immune intense infirm complex odd lax rare	deform diverse obscure mature adverse rotund conform dense false scarce

APPENDIX I (continued)

List of example and test items

EXAMPLE ITEMS	TEST ITEMS
[Her] intrude peddle labour survey crusade organize guzzle infiltrate instigate moderate	invest meddle cater convey invade supervise embezzle legislate navigate motivate
[#less]worry odour pity window power word sense hope mind home	penny colour mercy sugar motion tire taste time point job
[ness]empty witty wistful lovely playful defensive attractive responsive assured obvious	happy bitter bashful guilty hopeful aggressive expensive submissive contrary scandalous
[#ment]punish involve achieve announce entertain refine accomplish astonish embezzle reinforce	excite invest adjust manage establish refresh bewilder advertise embellish require

APPENDIX II: SCRIPT FOR THE INTRODUCTION TO THE TESTS

INTERVIEWER: I'm going to say two things that are sort of the same and sort of different --- like this:

sun - sunny

I'll do that again with two different ones:

mood - moody

And again:

might - mighty

As soon as you figure out what I'm doing, I want you to join in. Michael is going to show you what I mean:

- kind - kinder
- quick - quicker
- happy - happier (Michael joins in here)
- fast - faster
- pretty - prettier
- smooth - smoother
- wide - wider
- tall - taller
- big - bigger

Let's try that again with some harder ones:

- king - kingdom
- serf - serfdom
- chief - chiefdom
- martyr - martyrdom

Now I'm only going to give Michael one of the things and he's going to try to tell me what the other one should be:

- friend -----
- kind-----
- quick-----

wide-----
 fresh----- (Michael provides suffixed
 close----- form of each word as soon
 neat----- as it is said)
 solid-----
 vague-----
 more-----

And that's what you will do. I will say two
 things that are sort of the same and sort of
 different. You try to figure out what makes
 them different. Then I'm only going to say one
 thing and you will try to tell me what the
 other one should be.

100
 101

APPENDIX III

List of Matched Level I and II Test Items

The following frequency counts refer to the suffixed target word. They are taken from Francis and Kucera and are based on number of occurrences in one million words of text.

FREQUENCY	LEVEL I		LEVEL II	
	STEM WORD	TARGET WORD	STEM WORD	TARGET WORD
0	moral	moralize	meddle	meddler
	popular	popularize	motivate	motivator
	pollen	pollinate	sugar	sugarless
	menthol	mentholate	hopeful	hopefulness
	computer	computerize	contrary	contrariness
	migration	migrational	embellish	embellishment
1 - 4	adverse	adversity	convey	conveyor
	natural	naturalize	navigate	navigator
	fabric	fabricate	penny	penniless
	terror	terrorize	colour	colourless
	module	modulate	mercy	merciless
	trunk	truncate	tire	tireless
	false	falsity	taste	tasteless
	scarce	scarcity	time	timeless
	pulse	pulsate	point	pointless
	deform	deformity	refresh	refreshment
	relation	relational	bewilder	bewilderment

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