

The multi-route model of early lexical development

Martyn D. Barrett^(*)

University of London

Título: El modelo de ruta múltiple del desarrollo léxico temprano.

Resumen: Se revisan los principales postulados del modelo de ruta múltiple del desarrollo léxico temprano, que fue originalmente planteado por Barrett (1983a, 1986). Se muestra que este modelo predice una gran variedad de perfiles evolutivos diferentes que pueden mostrar las palabras aisladas en el curso de su adquisición temprana. Se revisan los datos empíricos que se han obtenido en diversos estudios sobre la existencia de esos perfiles evolutivos predichos. Se concluye que las pruebas proporcionan un fuerte apoyo empírico al modelo de ruta múltiple.

Palabras clave: Desarrollo léxico temprano; adquisición del lenguaje; modelo multi-ruta.

Abstract: The principal postulates of the multi-route model of early lexical development, which was originally put forward by Barrett (1983a, 1986), are reviewed. It is shown that this model predicts a large variety of different developmental profiles which may be exhibited by individual words during the course of their early acquisition. The empirical evidence which has been obtained in various studies concerning the existence of these predicted developmental profiles is reviewed. It is concluded that this evidence provides strong empirical support for the multi-route model.

Key words: Early lexical development; language acquisition; multi-route model.

Introduction

In the mid-1980s, I proposed a multi-route model of early lexical development in order to explain the various developmental phenomena which characterize young children's acquisition and use of words during the second year of life (Barrett 1983a, 1986). Since that time, several new studies have appeared in the literature in which data that are directly relevant to testing the predictions of the multi-route model have been reported. Consequently, in the present paper, I wish to take stock of the multi-route model, and to examine how well this model has fared in

^(*) **Dirección:** Dirección: Department of Psychology, Royal Holloway and Bedford New College, University of London (Egham), Surrey TW20 0EX, Great Britain. E-mail (on JANET): uhjt016@vax.rhbc.ac.uk

the light of the evidence which is currently available. In order to do so, however, it is first necessary to outline some of the principal postulates of the model itself.

The principal postulates of the multi-route model of early lexical development

The multi-route model was originally formulated in order to explain the development of the meanings of three different types of word which children typically begin to produce during the second year of life: context-bound words, nominals and non-nominals. Context-bound words are words which are produced by young children only in very limited and specific situations or contexts in which particular actions or events occur (for example, producing the word *bye* only while putting a telephone receiver down, or saying the word *chuff-chuff* only while pushing a toy train along the floor). Nominals and non-nominals, by contrast, are used in a contextually-flexible manner. Nominals are words which are used by the child in order to refer to one or more objects in a variety of different behavioural contexts (e.g. using the word *car* to refer to cars in various situations); non-nominals are words which are used in a variety of different behavioural contexts either to refer to the actions of people or objects (e.g. using *run* to refer to the action of running) or to express notions and relations such as disappearance, recurrence, opposition, rejection, etc. (e.g. using *gone* to comment upon the disappearance of an object).

According to the multi-route model, there are two principal routes in early lexical development, one which is followed by context-bound words, the other of which is followed by nominal and non-nominal words (see Figure 1). The model proposes that these two routes differ by virtue of the nature of the internal representations onto which the words are initially mapped. A context-bound word is initially mapped onto an event representation (Barrett 1983b, 1983c, 1986; Nelson 1982, 1983, 1985); the child then uses the word only in the context of that represented event. By contrast, a nominal or non-nominal word is initially mapped onto a prototype (Anglin 1977, 1979; Bowerman 1978, 1980; Barrett 1982, 1983b; Greenberg & Kuczaj 1982); the child then uses this type of word to *designate* objects, actions or relations which closely resemble the prototype. Thus, according to this model, children utilize two different kinds of internal representation when they first begin to acquire words: event representations and prototypes (Mandler 1983; Barrett 1987).

However, context-bound, nominal and non-nominal words are not always used by young children in the same unchanging manner after they have been acquired. Instead, these words can exhibit marked developmental changes during the second year of life. The multi-route model interprets these changes in word use as evidence of changes which are occurring to the underlying representations.

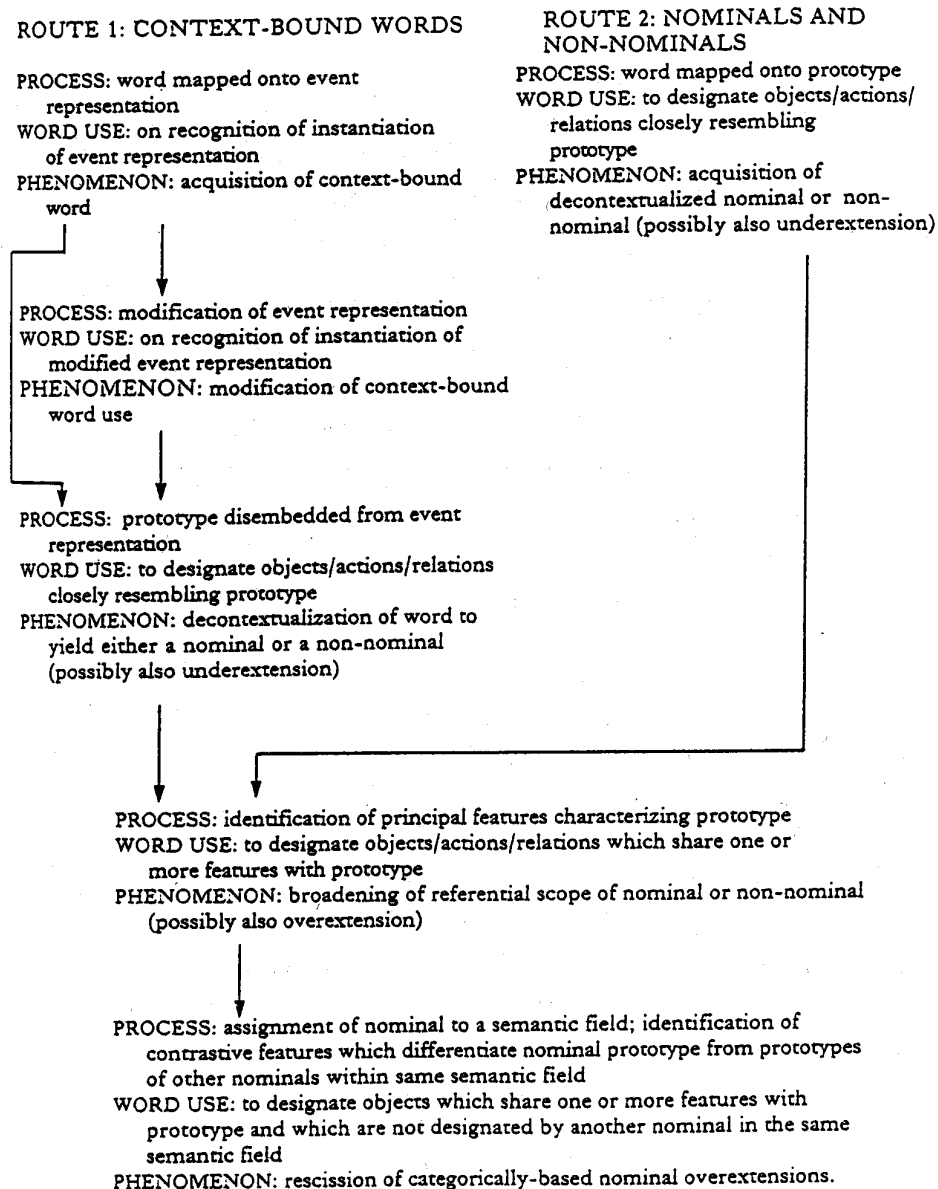


Figure 1: A diagrammatic summary of the multi-route model.

According to the model, context-bound words can undergo two different types of change after their initial acquisition. Some context-bound words can undergo a modification of the way in which they are used, even though they still remain context-bound. For example, a child may

begin by using the word *boo* only when hiding behind a curtain, but may later go on to use the word when hiding behind any one of a range of different objects (e.g. cushions, bed clothes, furniture, etc.). The word is thus still context-bound, but the range of objects which can appear in the eliciting context has been extended; this implies that, in the event representation which determines the child's use of the word, the specification of the objects which can be involved in the represented event has been modified.

In addition, some context-bound words (whether their use has been modified or not) can undergo decontextualization to yield either a nominal or a non-nominal. For example, a word such as *chuff-chuff*, used initially only in a context-bound manner while the child is pushing a toy train along the floor, could later come to be used as a decontextualized nominal in order to refer to toy trains in any situation. The multi-route model postulates that this kind of decontextualization entails the partitioning of the underlying event representation, and the disembedding of one of its constituent components from the remainder of the representation; this disembedded component then begins to function as a prototypical referent for the word.

Nominals and non-nominals can also exhibit developmental changes (irrespective of whether these words have been derived from a previously context-bound word or not). As noted already, the multi-route model postulates that the child's initial use of such words is governed by the prototypes onto which these words have been mapped. Thus, the child may begin by using such a word only to refer to objects, actions or relations which closely resemble the prototype. For example, if the child initially acquires the word *dog* in relationship to a particular dog which happens to be small, the child may adopt a mental representation of this small dog as the prototypical referent for the word; the child may therefore come to use the word *dog* only to refer to small dogs (and not to refer to large dogs). Thus, nominals and non-nominals may be underextended at this point in their development.

However, nominals and non-nominals may subsequently come to be used more extensively by the child, to refer to a wider range of objects, actions or relations. Once again, the multi-route model postulates that this type of change in word use is the result of a change in the internal representation which underlies the use of the word. Specifically, it postulates that, at this point in development, the child analyzes the underlying prototype into its principal constituent features, and starts to use the word to refer to new objects, actions or relations which share one or more of these features with the prototype. At this stage, overextension of the word may also occur; for example, the child may begin to use the word *dog* not only for referring to dogs of all sizes, but also for referring to cats, horses, or cows (as they also have features in common with the prototype for *dog*).

It should be noted that if a word is overextended in this way, then the overextension is likely to be exhibited not only in the child's production of that word, but also in the child's comprehension of the word (as it derives from the underlying semantic representation, which is hypothesized to guide both the production and the comprehension of the word). Furthermore, such categorical overextensions are likely to be comparatively stable and are likely to persist until the child acquires further information concerning the correct meaning of the word. Thus, categorical overextensions need to be distinguished from other types of overextension which may occur; for example, from overextensions which are caused by the child making accidental lexical retrieval errors, by the child deliberately misapplying a word for playful purposes, or by the child deliberately stretching the use of an acquired word in order to fulfil a particular communicative purpose for which the child has not yet acquired the appropriate word. The distinction between categorical overextensions and these other types of overextension needs to be em-

phasized because, with these other types of overextension, there is no reason to expect either that the child will exhibit them in both production and comprehension, or that the child will continue to produce them over an extended period of time.

When a categorical overextension does occur, the multi-route model postulates that the overextension will eventually be rescinded when the child finally identifies the features which differentiate the prototype of the word from the prototypes of the other categories which fall within the same semantic domain. For example, the overextension of the word *dog* to other animals will be rescinded when the child identifies those features which differentiate the prototype of the word *dog* from cats, horses, cows, etc. Notice that there is no reason to suppose that the child will identify these contrasting features immediately; for example, it may take the child some time after acquiring both the word *dog* and the word *cat* (together with their respective prototypes) before the child finally identifies the contrasting features which differentiate dogs from cats. Thus, prior to the identification of these contrasting features, there may be a transitional period during which the child uses either of these two words (the application of each being governed by its own prototype) to refer to objects which have features in common with both prototypes; that is, the two words may exhibit overlapping extensions prior to the identification of the relevant contrasts. However, once the relevant contrasts have been identified, then the extensions of the two words should separate out and become mutually exclusive. Thus, according to the multi-route model, the meanings of such words eventually come to contain three different types of information: information about prototypical referents, information about the principal features of prototypical referents, and information about the contrasting features which differentiate prototypical referents from the prototypical referents of other categories which fall within the same semantic domain.

In the original formulation of the multi-route model (Barrett 1983a, 1986), it was also noted that some words do not exhibit any developmental changes during the course of the second year of life. For example, some context-bound words may continue to be used in exactly the same unchanging manner throughout this period. For instance, a child might use the word *thanks* solely as an accompaniment to the action of receiving an object from another person, without ever altering this pattern of use. Thus, with some context-bound words, there may be no modification of, or alteration to, the event representation which underlies the use of the word.

Also, it was noted that some nominals which are acquired during the second year of life appear to be used by the child in an entirely appropriate manner right from the outset; these words seem to be mapped onto an accurate category structure right from the outset. However, we know that infants have usually acquired some prototypically-structured object categories before they are six months old, that is, well before the acquisition of the first word (see Roberts & Horowitz 1986; Colombo et al. 1987). Consequently, the acquisition of the accurate use of a nominal right from the outset is readily explicable by postulating that such words are mapped immediately onto a comparatively mature category structure which has already been acquired by the child before the acquisition of the word itself.

In addition, some words may be mapped onto underlying category structures which are still in the process of their formation by the child. For example, the child may have acquired a prototype for a particular category, and may have already identified the principal features of that prototype, but might not yet have identified the contrasting features which differentiate that prototype from the prototypes of other semantically related categories. If a word were to be mapped on to such a category which is still in the middle of its formation, then we might expect

such a word to be overextended on its initial acquisition; this overextension would then be rescinded later on, when the child finally identifies the relevant contrasting features.

Table 1: Some of the developmental profiles which may be exhibited by individual words, as predicted by the multi-route model.

1. Acquisition of context-bound word > modification of context-bound use of word > decontextualization into underextended nominal > overextension > rescission of overextension
2. Acquisition of context-bound word > decontextualization into regularly extended nominal > overextension > rescission of overextension
3. Acquisition of context-bound word > modification of context-bound use of word > decontextualization into underextended non-nominal > broadening of referential scope
4. Acquisition of context-bound word > decontextualization into underextended non-nominal > broadening of referential scope
5. Acquisition of context-bound word > modification of context-bound use of word
6. Acquisition of context-bound word
7. Acquisition of underextended non-nominal > broadening of referential scope
8. Acquisition of underextended nominal > overextension > rescission of overextension
9. Acquisition of overextended nominal > rescission of overextension (for words mapped onto concepts which are already partially formed)
10. Acquisition of regularly extended nominal/non-nominal (for words mapped onto comparatively mature concepts)

It can be seen from the preceding account that the multi-route model attempts to account for a wide range of different developmental phenomena. These include: context-bound word usage, decontextualization, underextension, overextension, and the rescission of overextensions. Several of these developmental phenomena may be displayed successively by an individual word during the course of its development. Furthermore, the model also postulates that some words may be mapped onto fully developed category structures, while others may be mapped onto category structures which are only partially developed, with the result that not all words need necessarily display the full sequence of developmental phenomena.

Consequently, this model predicts a large variety of different developmental profiles which may be exhibited by individual words during the course of their acquisition. Some of these different developmental profiles are summarized in Table 1. But although this model predicts that many different developmental profiles can occur, the model also predicts that there will be certain constraints on these profiles, not in terms of the individual phenomena which will be displayed in the development of any given word, but in terms of the *sequences* in which the phenomena should occur if these phenomena are displayed in the development of a particular word.

The evidence

The evidence which can be used to evaluate the adequacy of the multi-route model comes from a variety of different studies, including diary, observational and experimental studies. This evidence can be divided into two types: weak and strong evidence. Weak evidence concerns the existence of the individual developmental phenomena themselves (such as context-bound word usage, decontextualization, overextension, etc.). If these phenomena do not actually occur during the course of early lexical development, then the multi-route model is clearly inadequate as an attempt to account for the underlying developmental processes. Strong evidence, by contrast, concerns not merely the existence of the individual phenomena themselves, but also the order in which these phenomena occur when they are exhibited in the development of a particular word; as we saw above, the multi-route model makes some specific predictions about the order in which these phenomena should occur.

As far as the weak evidence is concerned, a very wide range of evidence has now been accumulated from a host of different studies which indicates that the individual phenomena postulated by the multi-route model do indeed occur. For example, Bloom (1973), Bates et al. (1979), Lock (1980), Gopnik (1981, 1982), Dore (1985), Harris et al. (1988) and Smith & Sachs (1990) have all documented the occurrence of context-bound word usage by young children, while Dore et al. (1976), Bates et al. (1979), Lock (1980), Gopnik (1981, 1982), Dore (1985) and Smith & Sachs (1990) have all documented the occurrence of decontextualization. Also, a very large number of studies have now documented the occurrence of both underextension and overextension in early child language (see, for example, Clark 1973; Gruendel 1977; Barrett 1978, 1982; Bowerman 1978; Braunwald 1978; Rescorla 1980; and Anglin 1983), while the rescission of overextensions is well documented by Barrett (1978, 1982), Rescorla (1981) and Mervis (1984). Thus, there is abundant evidence from a variety of studies that the individual phenomena contributing towards the developmental profiles predicted by the multi-route model do indeed occur during the course of early lexical development.

However, it is the strong evidence which is of much greater importance for the purposes of testing the predictions made by the multi-route model. This strong evidence will therefore be discussed in more detail than the weak evidence.

The original strong evidence with respect to which the multi-route model was first formulated was reported in Barrett (1983a, 1986). This evidence came from a detailed longitudinal diary study which I conducted on the early lexical development of my own son, Adam. This study began when Adam was aged 11 months old, and it continued until he was 2 years 3 months old. In this study, I made a particular effort to track the ontogenesis of individual words in Adam's lexicon through this period of his development. The most salient aspect of these data was the sheer variety of the different developmental profiles which were exhibited by the individual words which Adam was acquiring, and it was the attempt to account for this variety which led to the original formulation of the multi-word model. Some of the developmental profiles which Adam's words exhibited are shown in Table 2; it can be seen that all of these profiles are consistent with the sequences of phenomena postulated by the multi-route model (see Figure 1 and Table 1).

Table 2: Some of the developmental profiles exhibited by Adam's words (from Barrett 1986).

1. Acquisition of context-bound word
2. Acquisition of context-bound word > modification of context-bound use of word
3. Acquisition of context-bound word > modification of context-bound use of word > decontextualization into non-nominal
4. Acquisition of context-bound word > modification of context-bound use of word > decontextualization into nominal
5. Acquisition of context-bound word > decontextualization into underextended nominal > overextension > rescission of overextension
6. Acquisition of context-bound word > decontextualization into non-nominal
7. Acquisition of context-bound word > decontextualization into nominal
8. Acquisition of underextended non-nominal
9. Acquisition of regularly extended nominal
10. Acquisition of overextended nominal > rescission of overextension

The formulation of the model was also influenced by some of the findings from a previous study which I had conducted to investigate the early language development of two other children, Tina and Emily (Barrett 1979, 1981, 1983c). In this observational study, I video-recorded each child once every two weeks through their second year of life. From the transcripts of these video-recordings, I identified a number of context-bound and non-nominal words in the speech of these two girls. The patterns of development which were exhibited by these particular words (reported fully in Barrett 1983c) are summarized here in Table 3. It can be seen that these developmental profiles are also consistent with the sequences of phenomena postulated by the multi-route model (see Figure 1 and Table 1).

Table 3: The developmental profiles exhibited by Tina's and Emily's context-bound and non-nominal words (from Barrett 1983c).

1. Acquisition of context-bound word > modification of context-bound use of word > decontextualization into underextended non-nominal > broadening of referential scope
2. Acquisition of context-bound word > decontextualization into underextended non-nominal > broadening of referential scope
3. Acquisition of context-bound word > modification of context-bound use of word > decontextualization into correctly extended non-nominal
4. Acquisition of context-bound word

Subsequent to the formulation of the multi-route model, I have conducted a third study, which has been reported in Barrett et al. (1991). In this most recent study, data on the early lexical development of four further children were collected using both fortnightly video-recordings and maternal diaries. Once again, these data related to the lexical development of these children during their second year of life. For reasons connected with the other goals of the study (which concerned the mother's speech input to the children), we focussed in particular upon the first 10 words which were produced by each of the four children. The maternal diaries and the video-recordings were used to identify the contexts in which the children initially produced these 40 words. The same data sources were then also searched to identify the first qualitative change which occurred in the children's uses of these words (only the first change in the use of each word was analyzed, due to the other goals of the study). This procedure led to the identification of the 8 developmental profiles listed in Table 4. Once again, it can be seen that all of these profiles are consistent with the predictions of the multi-route model (see Figure 1 and Table 1).

Table 4: The developmental profiles exhibited by the words produced by the four children studied by Barrett et al. (1991).

1. Acquisition of context-bound word
2. Acquisition of context-bound word > modification of context-bound use of word
3. Acquisition of context-bound word > decontextualization into nominal
4. Acquisition of context-bound word > decontextualization into non-nominal
5. Acquisition of nominal
6. Acquisition of underextended nominal > broadening of referential scope
7. Acquisition of non-nominal
8. Acquisition of underextended non-nominal > broadening of referential scope

Amongst the studies which have been conducted by other researchers, that by Dromi (1987) is probably the most useful for the purposes of testing the predictions made by the multi-route model. Dromi's study consisted of a detailed longitudinal diary study of the early language development of her daughter, Keren, between the ages of 10 and 18 months. Dromi's analysis of her data includes a description of the developmental profiles which were exhibited by *all* of the 276 words on which she managed to collect longitudinal data. The most frequently occurring developmental profiles (that is, those which were exhibited by 5 or more different words in Keren's vocabulary) are summarized here in Table 5.

It should be noted that the last 4 profiles shown in Table 5 include the category "unclassified use"; Dromi used this category whenever a word exhibited a use which was uninterpretable (either because the word was used ambiguously by the child, or because there was insufficient

information available to permit the more definite categorization of the word). Consequently, focussing upon the remaining profiles which do not include this "unclassified use" category, it can be seen that all 6 of these unambiguous profiles are consistent with the predictions of the multi-route model (see Figure 1 and Table 1). Furthermore, although only the more frequent profiles are shown in Table 5, examination of the full data set (reported in Dromi 1987) reveals that the developmental profiles that were exhibited by 182 words (out of a total number of 194 words which exhibited unambiguous profiles) are consistent with the postulates of the multi-route model. This congruence between Dromi's data and the predictions of the multi-route model is especially interesting and noteworthy, as Dromi's study was conceived and executed independently of this model (Dromi, personal communication).

Table 5: The most frequent developmental profiles exhibited by Keren's words (from Dromi 1987); numbers in parentheses indicate the number of words which exhibited each profile. (N.B. Dromi classifies context-bound words variably, either as underextended or as unclassified.)

1. Acquisition of underextended word (13)
2. Acquisition of underextended word > broadening of referential scope (35)
3. Acquisition of regularly extended word (98)
4. Acquisition of regularly extended word > overextension > rescission of overextension (7)
5. Acquisition of overextended word (8)
6. Acquisition of overextended word > rescission of overextension (7)
7. Acquisition of underextended word > unclassified use > broadening of referential scope (5)
8. Unclassified use (17)
9. Unclassified use > use of word with regular extension (10)
10. Unclassified use > overextension > unclassified use (7)

Another study which can be used to test some of the postulates of the multi-route model is that by Mervis (1984). This study provides a useful source of data concerning one particular sequence of phenomena predicted by the model upon which little systematic evidence has otherwise been reported to date: this is the sequence which relates to the rescission of overextensions.

Mervis' study focussed upon the early lexical development of 6 normally developing children (studied between approximately 9 and 24 months of age) and 6 Down's Syndrome children (studied between approximately 18 and 40 months of age). The study involved not only the observation of these children's language production but also the controlled testing of their lexical comprehension. Three different words were selected by Mervis for comprehension testing (*car*, *ball*, and *kitty*), and it is from these comprehension tests that the data which are relevant to the postulates of the multi-route model come.

The children's comprehension of these 3 words was tested over the duration of the study with reference to a range of potential referents. Mervis found that the three words were invariably overextended shortly after their initial acquisition; that is, these words were frequently used to refer to objects which fell outside the normal adult extensions for these words; furthermore, this always occurred when the children had not yet acquired the more appropriate names for these objects. However, when the more appropriate name for an object was subsequently acquired, the old overextended name and the new name were typically both applied to that object interchangeably for a period of time; that is, there was typically a transitional period of overlap between the extensions of the two words. Finally, the extensions of the two words became mutually exclusive, with the new word capturing the domain of overlap from the old word. This sequence of phenomena (overextension > overlapping extensions > rescission of overextension) is precisely that which is predicted by the multi-route model (see above).

Finally, although it does not report data concerning sequences of phenomena in the ontogenesis of individual words, the study by Lucariello (1987) is useful in the present context because it reports some interesting new data on lexical development which are highly pertinent to some of the other aspects of the multi-route model. In this study, Lucariello examined two groups containing 10 children each: a Beginner speaker group (aged 15 to 19 months) in which the children had vocabularies ranging from 10 to 40 words, and an Advanced speaker group (aged 17 to 23 months) in which all the children had productive vocabularies of 50 words or more. These 20 children were taught the meanings of 5 unfamiliar object names in four learning sessions, and the children's comprehension of these words was subsequently tested in a range of different contexts using a variety of different procedures.

Lucariello found that children in both groups learnt the object names and were able to extend them to appropriate novel objects. The fact that the children in the Beginner speaker group did so implies that even comparatively young children are able to utilize the nominal route (see Figure 1) in their lexical development (as postulated by the multi-route model), and that these young children are not restricted simply to the context-bound route (as some alternative models of early lexical development have postulated: see, for example, McShane 1979 and Nelson 1985). It may be noted here that this finding that nominals (and not just context-bound words) can be acquired at an early point in lexical development has also been obtained by Harris et al. (1988) using a very different methodology, indicating that this finding is robust.

In addition, Lucariello found that the Advanced speakers were more likely to overextend the taught object names than the Beginner speakers. As the multi-route model postulates that overextension is a comparatively late phenomenon in the development of the meaning of individual words (see Figure 1), and that more advanced children are more likely to have begun the formation of mature category structures onto which new words can be mapped than less advanced children, the higher incidence of overextension in the Advanced group can be readily explained by this model.

Lucariello also reports that the two speaker groups did not differ from one another in terms of how they established relationships between words and underlying concepts, and that lexical learning seemed to proceed on the same word-by-word basis in both groups. Once again, this finding is consistent with the postulates of the multi-route model, which proposes that lexical development does indeed proceed gradually on a local, word-by-word basis, rather than proceeding via global systematic changes to large numbers of words in the child's lexicon (cf. McShane 1979 and Nelson 1985, who have both postulated that decontextualization, for example, is a global and systematic phenomenon).

Conclusions

From the preceding account of the evidence which is currently available, it is clear that the postulates of the multi-route model are well supported by this evidence. That is to say, there is not only extensive weak evidence for the existence of the individual developmental phenomena which are postulated by this model; there is also substantial strong evidence for the existence of the precise sequences of these phenomena in the ontogenesis of individual words which are predicted by the multi-route model.

It should be noted that the multi-route model is not the only model of early lexical development which is currently available. Alternative models are offered by Script Theory (Nelson 1985), Lexical Contrast Theory (Clark 1983, 1987) and Insight Theory (McShane 1979, Dore 1985). A critical difference between these other models and the multi-route model, however, is that all of these other models postulate just a single developmental route in early lexical development, and they all therefore fail to account for the basic fact that different words can exhibit very different developmental profiles. By contrast, the principal strength of the multi-route model is that it offers an explicit account of the variety of different developmental profiles that clearly do occur in early lexical development. On this score alone, the multi-route model offers a much more realistic approach to the early acquisition of word meaning by young children than any of these alternative competing models.

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