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WRITTEN LANGUAGE SKILLS AND THE NOTION OF 'LEXICON'

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Abstract: Research on written language skills is continuously having to deal with assumptions about the relationship between spoken and written language. What seems clear is that no objective description of this relation can easily be given, a fact that is highlighted by the claims for both a “written language bias” and a “spoken language bias”. These claims point out how the study of written language is restricted by the study of spoken language and vice versa. These insights are important observations on the empirical basis of studies in speech and writing. In the present paper it is claimed that it is possible to investigate the relation of speech and writing on a stronger empirical basis, and that this can be done by first giving equal validity to spoken and written language, and second by giving preference to theory with a minimum of introspection. The paper addresses researchers working with written language skills.

First, some assumptions concerning the mental lexicon in mainstream theory of written language skills are questioned. These assumptions are here linked to cognitivism and linguistic formalism. Second, alternative assumptions are derived from a pairing of functional approaches to language and connectionism. These alternative assumptions may be seen as contributions to a revitalized understanding of the connection between phonology and lexicon when studying written language skills.

Keywords: Phonology, Connectionism, Dyslexia, Mental lexicon, Lexical access, Non-words.

1 INTRODUCTION

Over the past decades there has been a growing awareness about how insights from written language have influenced the study of spoken language, for instance Per Linell's book "The written language bias in linguistics" (1982). In the new interest in writing research, this awareness has also led to the claim of a "spoken language bias" (Wengelin, 2002). Both insights can be considered as observations that may help to keep the study of spoken and written language empirical. The present paper investigates aspects of the spoken language bias in the study of written language when it comes to the notions of 'phonology' and 'lexicon'. This attempt is made by first showing how mainstream theory is restricted in its scope concerning the connection of 'phonology' and 'lexicon'. Second, an alternative theory is suggested, claimed to meet empirical criteria in the scientific study of both spoken and written language. Third, the issue of dyslexia research and 'non-words' is brought into the picture in order to illustrate the consequences of the proposed theory shift. Dyslexia research is of specific interest here, because it is the domain where assumptions concerning the connection of 'phonology' and 'lexicon' become more explicit than in any other part of research into written language. The motivation for this investigation is a search for a stronger empirical base for the study of written language. We know that spoken language plays an important role for most human learning to read and write. However, we should be careful about making *a priori* assumptions about how phonology is connected to the mental lexicon in reading and writing. At least, the theory of this connection must be open – and even vulnerable – to empirical findings in reading and writing behaviour.

2 ABOUT PARADIGMS IN RESEARCH ON WRITTEN LANGUAGE SKILLS

Although one should be careful about announcing new paradigms, there are good reasons to investigate the criticism and reflections lying in such propositions. In the scientific study of dyslexia there are implications for a change from a cognitive to a connectionist paradigm (Tønnessen, 1999). The rise of the connectionist view of processing and development poses so many objections to traditional cognitive theory that one may claim, with Thomas Kuhn, that the phase of *normal science* has been passed, bringing a period of pronounced professional uncertainty (Kuhn, 1970). If this is so – and even if it is not – there is a positive challenge in objections, be they contributions to the existing puzzle or to a qualitatively new foundation.

When focusing on behavioural phenomena, different disciplines can easily be paired off to serve a specific focus. The rise of the cognitive sciences in the last part of 20th century can be seen as an interplay of linguistic formalism and cognitive psychology (Gumperz & Levinson, 1996). In pairings of this kind, one should carefully examine the assumptions being transferred from one discipline to another. In this particular case, structuralist principles from the work of the linguist Ferdinand de Saussure concerning arbitrariness and abstractness of language (Givón, 2001) are adopted into the scientific study of dyslexia. Along this line, the faculty of language is seen as highly innate, and qualitatively different from other human abilities. At the other extreme, the functional approach to language focuses on the importance of stimuli, and therefore on language *use*, as the origin of language change and evolution. In all such pairings, there are lurking dangers related to interdisciplinary work. One such danger is the loss of complexity when theory is transposed into a different arena.

The different nuances of the pairings above should be quite evident. It nevertheless remains a challenge to discern what assumptions should be rejected and which should be adopted in forming a new framework. One such issue is the nature of representations. The 'phonological deficit hypothesis of dyslexia' (Shankweiler & Liberman, 1989) is grounded on formalist and cognitivist assumptions of abstract and invariable representations, where phonology is the only way to the lexicon. On the contrary, connectionist theory claims distributed representations, without giving explicit priority to spoken phonology when it comes to the lexicon. The issue of representation is a matter of lexicon, and any phonological theory has to deal with the question of representation in order to be valid in explanations of human behaviour.

The aim of this paper is to highlight an alternative understanding of lexicon and concept, according to the indicated shift in theory. An initial step in this enterprise is to give written and spoken language equal validity as languages, as suggested by Wallace Chafe (Chafe, 1994). It is claimed that this is not a random choice of position, but it is the conception of the relationship between spoken and written language that best secures an empirical investigation of the same relationship while leaving out *a priori* assumptions. A second step is to investigate aspects of spoken language bias in the study of written language. The arguments follow in three main sections. First, the powerful pairing of cognitive psychology and generative grammar is described with an emphasis on the connection of phonology and lexicon. Second, an alternative pairing of psychology and linguistics is suggested: connectionism and linguistic functionalism. Third, the issue of 'non-words' in dyslexia

research is presented as a powerful illustration of the consequences of the paradigmatic theory shift.

2.1 Linguistic formalism and cognitivism

The linguistic formalism derived from Chomsky can be characterized by a focus on innate universal grammar (UG), and a disregard for the role of stimuli. According to this position, language use is only relevant in triggering the innate structures. With regard to the tradition, Chomsky's position can be characterized as a continuation of essential principles of structuralist theory from Saussure (Givón 2001). This is particularly the case for Saussure's principles of abstractness and arbitrariness. In Chomsky's formalism, though, the principles of abstractness of language structure and the arbitrariness between linguistic structure and meaning are preserved – and the degree of abstractness is increased.

It is probably not controversial to pair off linguistic formalism from Chomsky and cognitive psychology. With regard to the tradition, cognitive psychology cannot be characterized as continuous in the sense outlined for linguistic formalism. Rather, cognitive psychology emerged as an antithesis to behavioural psychology (Chomsky, 1959). These different conditions in history may shed light on the rather simplistic adoption of linguistic theory into the cognitive approach, and may probably also explain why the assumptions of linguistic theory are rarely questioned in cognitive approaches to dyslexia. The formalist propositions regarding innateness and stimuli do fit extensively with the cognitive opposition to behaviouristic psychology.

The focus on rationality and abstractness in the outlined pairing can be considered to support the wide interest in cognitive maps and models in the tradition. The claim of innate structures implies models of representation with some ontological validity. From an empirical point of view, this is dangerous enterprise, because the models are derived from assumptions that cannot be falsified. Every theory will have to make assumptions on this point. However, the important point is what status such models are given in explanations.

In his book “The Science of Words”, G.A. Miller puts forward the question of how to use lexical memory economically. In this discussion he ends up in an intermediate position between two extremes, on one hand a strict *inheritance system*, and on the other *complete redundancy*. The inheritance system is presented as being highly efficient, thanks to the assumption that a hyponym inherits the properties of its superordinates (Miller 1996). According to this system we get a hierarchy of related nouns where the semantic features of

words are not all stored with the individual word, but are assigned to the word by being part of the hierarchy. This is the case with words 'oak' and 'tree'. The word 'tree' is the more generic one, and the common semantic features are therefore stored with 'tree' while only the semantic features specific to 'oak' will be stored here. In this way we get hierarchies of nouns, where the generic semantic features are stored higher up in the hierarchy, while the distinguishing features are stored with each single word. This kind of sharing of semantic features with hyponyms is what is meant by 'inheritance'. There is thus no redundant information stored, the semantic features are never doubled. There are several experiments that point to inheritance systems as a plausible structure for storage, but also many findings that question the strict hierarchical structure of inheritance systems. One argument against this position is the impact of frequency or familiarity of categories, which overrules the assumed hierarchy: "Some psychologists believe that people's memory for words and their meanings cannot be organized in this efficient manner. There are simply too many facts that a simple inheritance theory cannot explain" (Miller, 1996, p. 180).

On the other theoretical extreme, we find what Miller calls *complete redundancy*, where semantic features are stored in memory with every word. By the term 'redundancy', we mean the non-sharing of semantic features for related nouns, every relevant semantic feature is related to the isolated word. In this view, all features can be retrieved directly without the reference to the hierarchy to which the noun belongs. As Miller points out, the position of complete redundancy is as implausible as the strict inheritance system. A totally redundant system neglects the role of hyponymy in language comprehension (Miller, 1996, p. 183). Further, the burden on memory capacity is posed as an objection to this extreme. In consequence, Miller presents the intermediate position:

Assume therefore, that lexical memory is a hybrid compromise between efficiency of storage and efficiency of retrieval. The basic design is that of an inheritance system, but frequently used paths develop shortcuts; information that is at first retrieved inferentially comes by frequent association to be stored redundantly. (Miller, 1996, p. 183)

In a compromise between the two extremes, so-called *basic concepts* are presented as a plausible solution. Basic concepts, or base-level terms, are understood and named earlier by children than concepts situated elsewhere in the hierarchy (Lakoff & Johnson, 1999) and this is the level at which most of our knowledge is organized. In a lexical hierarchy, basic concepts

are somewhere in the middle, with less specified levels above and more specific concepts below. In this way, the notion of strict inheritance system is adjusted so to have less specific features on the top. It is still an inheritance system, but the burden of adequate information is placed in the middle of the hierarchy. Strict inheritance is thus broken, and it is not a big step to include redundant storage. In an evolutionary perspective it is also possible to think of basic concepts related to frequency by the proximity to humans' everyday life.

2.2 Linguistic functionalism, relativity and connectionism

The functionalist approach to language is characterized by the focus on language use as a basis for language change and evolution. In many important ways, functionalism rejects the basic assumptions of structuralism and formalism, even though structuralism is somewhat closer to functionalism at some points. Functionalism is therefore not a continuation of formalist theory, rather it objects to the central assumptions in formalist theory. These objections can be formulated as an antithesis to the Saussurian principles that Chomsky validated and extended. In this sense, the functionalist position is on the one hand characterized by iconicity and analogy rather than arbitrariness, and on the other hand a focus on language use and concreteness rather than abstractness.

Still, functional grammar is not (yet) mainstream theory in linguistic circles. Functional approaches to language have been continuously claimed as being parallel to mainstream theory, be that either Saussurian or Chomskyan theory. The functionalist M.A.K. Halliday has insisted that the adherents of generative theory for a long time behaved as a suppressed minority, whereas they were in fact a suppressing majority (Maagerø & Tønnessen 2001). In line with Halliday, there is a point to be made about the powerful and dominant joint venture of formalism and cognitive psychology. At the same time it should be underscored that the functional approach to language is not new. Most functionalists owe some debt to the linguistic relativity hypothesis of Sapir and Whorf. The hypothesis focuses on how language and thought are influenced and formed *by culture through language*.

Hence, we have no recourse but to accept language as a fully formed functional system within man's psychic or "spiritual" constitution. We cannot define it as an entity in psycho-physical terms alone, however much the psycho-physical basis is essential to its functioning in the individual. (Sapir, 1921, p. 9)

For the focus of this paper – the notion of lexicon and concept – it might be illustrative to hold onto the linguistic relativity hypothesis as a specific part of functionalism, as long as the original hypothesis was concerned about aspects of lexicon and concept. First, it may seem odd to pair off two positions as different as linguistic relativism and connectionism: the first with its roots in anthropological linguistics, and as a counterpart to linguistic universalism, the latter with its roots in neuropsychology, and as a counterpart to cognitive psychology. Despite their different origins and their different occurrences in history, they share some common and interesting insights. With regard to the different occurrence in history of linguistic relativity and connectionism, they can both be said to be opposed to a strand of common sense, with origins back to St. Augustine, claiming that language is nothing more than a nomenclature for already existing concepts (Gumperz & Levinson, 1996). Their opposition has different directions, though. The view of linguistic relativity has a focus on how culture forms our thoughts through language, whereas connectionism opposes the strict symbolic understanding of language, underscoring the connections of neurons in networks. It is important not to underestimate the difference of the positions, with the risk of forcing non-existing similarities, but I still claim that there is a point to be made by keeping them together in some approaches. And that is my intention in the case of lexical access and retrieval. With regard to semantics, I pair off linguistic relativism and connectionism in opposition to linguistic universalism and cognitive psychology, and thereby connect them with an alternative understanding of the relationship between word and object.

The linguistic relativity hypothesis was strongly opposed in the late Sixties, and has not had a strong impact since then. Connectionism represents a contemporary alternative to cognitive psychology, beginning in the early Eighties. Despite the different traditions and lack of continuity, these positions have both insights in common and specific insights to semantics that might revitalize the old questions of semantics: the relationship of word and object. An interesting idea is whether they would be better semantic theories seen in combination than as individual corrections to a mainstream theory.

Theories also extend knowledge by establishing linkages with other theories. As noted, most modern behavioral science theories are circumscribed in their scope: they focus on one aspect of human behavior. (Whitley, 2001, p. 17)

A further idea is whether connectionism and linguistic functionalism together can support an alternative understanding of *concept* and *lexicon*. In cognitive psychology there is a focus on

underlying and innate structures, and therefore universal concepts. The conception of a highly structured sample of lexical symbols can also be identified in the ‘inheritance system’ described in the preceding paragraph in the present paper. In many ways, the mental lexicon is understood in similar ways as the physical lexicon, in which the concepts function as the real entries. The inheritance system lays a greater burden on underlying hierarchical structures than the complete-redundancy view does, and this is probably the system that has been championed in most introductions to semantics. At the same time, it reduces the status of the word to simple symbols of the real concepts or ideas.

It is a fallacy to assume that ‘if there is a word for [a concept] in the dictionary, a corresponding item of physical or psychological reality must exist, and the major task of science is to discover the a priori meanings of these linguistic givens. On the current psychological scene, this foolish assumption gives rise to ill-conceived attempts to decide what motives, intelligence, personality and cognition really are. (Kimble, 1989, p. 495)’ (Whitley, 2001, p. 11)

On the other hand, the proposal for complete redundancy reduces the power of a superordinate concept in favour of a focus on meaning connected to word form. A moderate version of this position can be said to fit a more moderate focus on the concept of linguistic relativity, and also connectionism. With a new status for word forms, the concept gets a secondary status as a dynamic effect of word forms.

(...) to speak in terms of not having, and then subsequently having, a concept is not the correct way to think about development which seems to be the result of progressive interactions at multiple levels of the network. (Elman et al., 1996, p. 152)

As a consequence, the discussion of how to use memory efficiently rapidly turns into a discussion of the relation between form and meaning/function. Linguistic relativity inherently puts a burden on the close connection between form and function. If culture has a dominant influence on our thoughts through language, word forms must be considered as one essential source of this guiding power. In connectionist theory there is no clear boundary between form and function, as long as the network is assumed to consist of both what we traditionally call form-weights and meaning-weights. This is a crucial point in connectionism, while it is not an issue in linguistic relativity theory, due to a different focus. But still, the two positions are

compatible due to the inseparability of form and meaning/function. Concerning reading, Marcus Taft hints at the alternative understanding of mental lexicon that can be derived from the union of form and function.

One interesting aspect of the model is that there is no level of orthographic representation or phonological representation for the whole word. Instead, information about the whole word is represented at a level of "concept" nodes which mediates between lexical memory and semantic memory. (Taft, 1991, p. 80)

Thus, the notion of lexicon and semantics becomes highly interwoven. Further, for the relativist, concepts cannot be universal and innate, instead they are calibrated by the limitations of the specific language, where meanings occur as parts of a system. The connectionist notion of distributed representation may seem to be in opposition to both the total redundancy view and the inheritance view. If representations are distributed, they cannot be said to be redundantly stored in the way outlined, because they exist as connections rather than being stored with each single word. At the same time there is no evident difference, except from the burden on memory. If the connectionist view is right, redundancy is probably not the right word for this phenomenon. It is tempting to consider the idea of complete redundancy as an attempt of adjusting the conception of lexicon to the framework of cognitive psychology, as it fits to the conception of human lexicon in terms of a dictionary. One could say that using the notion of 'redundancy' is to halt the explanation one step before the notion of distributed representations. This difference is no mere detail, because the notion of distributed representations lays a stronger burden on explanation of development than does the redundancy view, which primarily aims at a description of the state of the art. Although the structure of the inheritance system may appear somewhat rigid, we cannot exclude the possibility that some weights in the network are calibrated according to what is described as an inheritance system.

With Miller's intermediate position in mind, we may ask why we should look differently at those connections that are described as hierarchical than those that are familiar. May be they should be considered as stronger, rather than qualitatively different. With this step, we point out the relational 'nature' of words and concepts, rather than describing two systems where one is subordinate, which in my view is too hasty a conclusion.

3 WHAT ARE THE CONSEQUENCES OF A THEORY SHIFT?

The present reflections on the role of lexicon are claimed as of particular relevance to research on reading and writing disorders, with dyslexia research as a particular branch. The reason for this is the focus in dyslexia research on word-level reading, vocabulary, segmental phonology, reading comprehension and causal relations. Dyslexia research therefore has to deal with very precise and concrete interpretations of phonology, lexicon and concept. In this way dyslexia research represents a close-up view of assumptions in mainstream theory. The research field of dyslexia is therefore the place where the basic assumptions become most explicit, and where shifts in theory may have direct consequences for assessment and treatment. In the following we will look into assumptions related to the use of so-called ‘non-words’ which are extensively used for the assessment of reading skills (Rack, Snowling & Olson, 1992). The term ‘non-word’ is a point where several assumptions related to concept and lexicon can be unveiled. The assumed existence and use of ‘non-words’ is an area of controversy, mainly between linguists and psychologists. Here, I will claim that the different estimations of so-called ‘non-words’ can be related to the pairings of psychology and linguistics outlined, rather than to strict disciplinary boundaries. The following section is an attempt to make explicit the assumptions of mainstream and alternative theory using ‘non-words’ as an example. For the pairing of generative grammar and cognitive psychology, the assumptions are derived both from the logical consequence of the theory and from its application in research. For the pairing of functional linguistics and connectionism, an attempt is made to derive logical consequences of this joint venture. This is a more demanding task than for the pairing of generative grammar and cognitive psychology, due to two circumstances. First, the pairing of connectionism and linguistics has not been highlighted on the scientific scene. Second, the research conducted on this pairing as a main theoretical platform is limited.

3.1 Formalist and cognitivist assumptions about ‘non-words’.

1. The categorization of isolated segments (phonemes) is an aspect of the abstract nature of language. It is assumed that the categorization of sounds is possible because of the existence of an abstract structure of (bundles of) distinct features (Chomsky & Halle, 1968). It should be remarked that these distinct features are far more abstract than the acoustic features proposed by Jakobson, Fant and Halle in 1952 (Jakobson, Fant & Halle, 1952). The identification of segments may therefore be used for assessment of the abstract phonological

system. The functional aspects of segments – for instance minimal pairs – are degraded or neglected (this is a further example of Chomsky's increase in formalism, degrading the functional potential from Saussure).

2. The relation of phonology and phonetics is highly platonic. Phonology is abstract, phonetics are concrete. Therefore, phonology is never on the surface, it is innate. Phonological rules do not operate on the surface, but between the invariable representations (lexicon) and the phonetic surface. A platonic relation of phonology and phonetics requires a detailed and advanced mastery of how phonology is realized in phonetics (phonological rules). A problem is that the scientific study of dyslexia does not maintain such an (advanced) division, with the (paradoxical) consequence that there is no real difference between phonetics and phonology. Another result of the platonic view of phonology is that phonemes can be used as a priori measures of levels of language mastery.

3. No important division of words and 'non-words' with regard to *structure*. This is inherent in the formalist principle of arbitrariness of structure and meaning. This assumption states that words and 'non-words' have the same structure, even if only the first one is a real word. 'Non-words' thus have structure without being words.

4. Categorization of segments is easily comparable across languages, with reference to the system to which they belong. This assumption is also part of the arbitrariness principle, implicating the possibility of assessing 'clean' structure across languages.

3.2 Functional/connectionist assumptions about 'non-words':

1. Structure is a matter of language use. Therefore analogies, frequency and connections between words comes into focus. Structure is considered to be observable without assuming introspection.

2. Phonology is on the surface. Phonology is phonetic in its origin. Minimal pairs understood as functional contrasts may represent one aspect of this. Early structuralism is somewhat functionalist in its focus on the phoneme as the meaning-changing unit in a minimal pair. An important nuance of this perspective is the inseparable connection of sound unit and word. In a functional theory of language, structure is phonological in a phonetic way. According to emergent phonology (Lacerda & Lindblom, 1997) sound categories are calibrated on the base of huge phonetic variation. A consequence of this view is to consider phonetics as universal and phonology as specific.

3. No important difference between words and non-words with regard to *language*. Any structure will always carry along some traces of meaning. Structure and meaning are always connected in some way. Therefore, for the functionalist and connectionist the term ‘non-word’ represents a claim of being and not being at the same time: *contradictio in adjecto*. Lexicalization (use) is the key, driven by relative frequency. By relative frequency is meant that, besides occurrence, proximity in time and space may influence the path to lexicalization in the human mind. The continuum of lexicalization from first occurrence to convention is characteristic of language. Language is full of words without exact meaning to the individual, without being ‘non’. If one claims to have a list of ‘non-words’, it will overlap the list of a continuum of well-known, medium-known and unknown words, overlapping the less-known and unknown words. It is not controversial to say that ‘non-words’ share properties with unknown real words. What we are measuring with the examples from the lower part of this continuum, must be the same thing, that is: a response of primarily highly individual associations and analogies, highly influenced by the student’s language experience and exposition to language, especially written language. Sequences of sound and letters are never without meaning, not primarily in a traditional, lexical way, but as meaning-traces, associations and analogies. ‘Non-words’ – as well as unknown words – are handed over to private associations in a way different from common shared words. Put another way: with traditional notions of denotation and connotation, one could say that ‘non-words’ and unknown words are handed over to the domain of bare connotations – a field that the structuralist and formalist tradition for decades has rejected as uninteresting concerning what language is about, i.e. the Saussurian *parole* and the Chomskyan *performance*.

4. Due to the highly individual aspects of not-(yet)-known words, they cannot be made comparable across languages in any scientific manner. With current phonology in mind, reading assessment of not-(yet)-known words must be considered as *phonetics without phonology*, and based on pure introspection. We lack theories for the assessment of such properties of language, yet it is an interesting challenge for a new framework. When reading of ‘non-words’ is included in assessment material for dyslexia, we may question the validity of such a test. A functional attitude to so-called ‘non-words’ is therefore not necessarily rejection, but rather inclusion in a continuum. Still, the joint venture of functionalism and connectionism does not accept the strict division of lexical /non-lexical that is implied in the term ‘non-word’. The understanding of lexical/non-lexical as a continuum represents a potential for revitalized conceptions of structure of spoken language, but it questions aspects of the strict segmental understanding of the phoneme that have occurred in this research field. This slightly changed,

but not unimportant, understanding of the phoneme is one effect of the transposition of theory from a structuralist and formalist study of language into the interdisciplinary field of dyslexia. With regard to the consequences for the diversity of terminology and assessment material, the strict segmental understanding of the phoneme must be considered unfortunate, resulting in a quasi-platonic phonology. As a consequence the formalism in the scientific study of dyslexia is neither consistent nor realized in a satisfactory way.

4. CONCLUSION

So far, we have elaborated the idea that form and function are unified in a complex way, and that lexicon and semantics therefore are highly interwoven. The relation of form, concept/meaning and reference is traditionally presented graphically as a triangle (Ogden, 1974). According to the thoughts elaborated in this paper, the triangle is reduced to a *dot*, with form/function as a unity. This view is close to Saussure's idea of the linguistic sign as a piece of paper that has two sides (Saussure, Bally, Sechehaye, & Riedlinger, 1969), but it is more literally interpreted by stressing the unity. In the outlined traditional triangle, the corner of concept/meaning is highly vague as autonomous entity and not easily accessible for study. In the proposed 'dot', meaning is highly interwoven with the word form. Concerning the vague notion of 'concept', should we not focus on words rather than concepts, when talking about language skills, reading, writing, and language acquisition? In going from an assumption of a *triangle* to a *dot*, the notions of reference and concept are degraded as insights in what signing is really about. Strict reference is considered to be of importance to signing only to a certain extent, particularly in early acquisition, while concept is considered to be an effect of signing, but none of them are parts of what signing is essentially about. A primary focus on the observable part – the word – would in the outlined context have a potential for a dynamic theory without assuming introspection. Therefore, a rather basic, but powerful, operationalization of concept and lexicon is to focus words in the outlined functionalist and connectionist way.

A joint venture of connectionism and relativism/functionalism is therefore a plausible alternative to Chomsky's idea of the 'poverty of the stimulus', claiming that input is too variable and too poor to allow the learner to construct language. The alternative could here be formulated as 'stimulus as wealth'. In my view the insights in this joint venture may be seen as prerequisites for functional approaches to the mental lexicon. The unity of form and function is

probably most important when dealing with literacy, where there is a tendency to establish and ontologize mental representations. When dealing with the written word, one should focus on the 'dot', how the word gets its traces of meaning from different senses and where the traces differ, mainly with regard to frequency and familiarity. In this view there is no 'natural' predominance for the phonological access to lexicon. Rather, there are traces of similarity that have no ontological predominance for medium (written, spoken, signed or tactile language) or ability (auding, viewing, articulating and writing).

As stated initially, the motivation for this investigation was the search for a stronger empirical base for the scientific study of written language. What seems clear is that the suggested pairing of functionalism and connectionism contains less introspection than mainstream theory in having its focus on the behavioural level. What is more, the alternative understanding of lexicon gives no *a priori* predominance to spoken language over written, but opens the way to true empirical findings on how meaning is built up from both spoken and written language.

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