OVEREXTENSION AS EVIDENCE FOR DEDUCTIVE WORD LEARNING: A THEORETICAL EXAMINATION

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OVEREXTENSION AS EVIDENCE FOR DEDUCTIVE WORD LEARNING: A THEORETICAL EXAMINATION

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ABSTRACT

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This thesis is a philosophical assessment for the status of deductive abilities in infants' object representation and naming. In the speech of children between 1:0 and 2:5, the application of early acquired words temporarily occurs in a broader range of referents i.e., more or less than conventionally accepted referents. This short period of time, namely *overextension* period, gives substantial clues in regard to our understanding of children's linguistic knowledge during one-word stage and their cognitive developments. In cases of overextension, the partial meaning of the word can somehow intersect with the semantic domain of the object labeled by that word in such a way as shape, color, taste, texture or function. Overextension on the basis of the perceptual properties of objects signals the possibility that deductive (logical) inference may play a significant role in the extensions of acquired words. Within the context of overextension as a path of development in the acquisition of language, this study is spirited by two proposals about the earliest word learning in children younger than 3 years of age. One proposal is empirically testable: the first strategy of early word learning is referential that is based on the relationship between the perceptual properties of physical objects and infants' conceptual knowledge; for creating a general hypothesis about the object-name relation, infants have to attend to basic perceptual features of physical objects with regard to their *immaturity* on visual perception, attention and semantic memory. Second proposal is theoretical: infants can be viewed as deductive learners, that is, they formulate an overview of word meaning on the basis of one or two perceptual properties of objects and assign names to objects by deductive inferences.

Keywords: early word learning, overextension, fast-mapping, deductive inference, prototypical concept .

ÖZ

TÜMDENGELİMSEL KELİME EDİNİMİNE KANIT OLARAK SEMANTİK GENELLEME: KURAMSAL BİR DEĞERLENDİRME

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Bu tez tümdengelimsel çıkarımların küçük yaştaki çocukların nesne tasarımları ve isimlendirmelerindeki rolüne ilişkin felsefi bir değerlendirmesidir. 1:0 ve 2:5 yaş aralığındaki çocuklarda, ilk edindikleri kelimeleri geçici süreliğine daha yaygın ve kapsayıcı olarak kullandıkarı ve göndergesel düzeyde genelleme yaptıkları gözlemlenir. Kısa süreliğine gözlemlenen bu olgu çocukların bir-kelime aşamasındaki dilsel bilgilerine ve çocukların bilişsel gelişimine dair önemli ipuçları vermektedir. Semantik genellemenin (Overextension) gözlemlendiği durumlarda, genellenen kelime ile imlediği nesnenin anlamsal alanı arasında şekil, renk, tat, doku ve işlevine bağlı olarak bir takım benzerlikler vardır. Nesnelerin algılanabilir özelliklerine bağlı semantik genelleme, tümdengelimsel (mantıksal) çıkarımların edinilen kelimelerin kullanımında önemli bir rol oynadığını göstermektedir. Dil ediniminde önemli bir aşama olan semantik genelleme süreci bağlamında, bu çalışma 3 yaşından küçük çocukların erken kelime edinimleri hakkında iki önermeyi içerir: İlk önerme deneysel olarak test edilebilirdir: Erken kelime edinimdeki strateji fiziksel nesnelerinde algılanabilir özellikleri ve çocukların kavramsal bilgisi arasındaki ilişki temelinde göndergeseldir; nesne-isim ilişkisinde genel bir hipotez kurmaları için, henüz gelişmekte olarak algı, dikkat ve hafıza dikkate alındığında çocukların dikkatini fiziksel nesnelerin en temel algılanabilir özellikleri çekmektedir. İkinci önerme teoriktir: çocuklar birkaç temel algısal özellik temelinde kelimelerin anlamlarına yönelik genel hipotez oluşturup, tümdengelimsel yöntemle nesneleri adlandırdıkları için tümdengelimsel öğreniciler olarak görülebilir.

Anahtarkelimeler: erken kelime edinimi, overekstensiyon, hızlı-eşleme, tümdengelimsel çıkarım, prototipik kavram

To my nephew Kıvanç

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

In consideration of the role of natural language for *rational* animals, it is possible either to explore the evolution of natural language, from the origins of homosapiens to the present, or to investigate the first three years from infancy to early childhood. However, the latter sounds more reasonable for the sake of feasibility and saving on time. Considering the stages at the process of language acquisition, the first three-year period of time probably bears the traces of evolution. Hence, every stage observed throughout language acquisition does substantially matter. Any theory must, therefore, extensively account for each critical period in terms of not only linguistic aspects, but also other cooperative mechanisms such as perception, memory, and attention. The studies on language acquisition closely involves the understanding of human mind, thus the language acquisition becomes one of the indispensable areas of cognitive science.

But first, of necessity, some clarifications on related concepts have a crucial significance for a better understanding in the context of infants' acquisition of language. The language, in a broader sense, is a sort of medium among humans and even non-humans. Bees, dogs, primates, birds and other animals obviously possess a species-specific way of communication. Humans do either. Infants cry when get hungry and thirsty in order to notify their basic (maybe instinctive) needs. Whatever the way provides the communication, thus, might be called the language. However, this sort of language which is to express only survival needs appears to be primitive. In the evolutionary aspect, it seems not a fallacy to proclaim that humans differ somehow from non-humans by means of human natural language. Natural languages consist of abstract system of rules and thus seem to be more complex than non-human languages since its usage goes beyond the basic survival needs. Despite the fact that the types of generalization as one of the linguistic abilities can be observed in non-humans, there are other linguistics abilities that have no parallel in non-humans (Gerken, 2007:186). Accordingly, any questions raised in the domain of language acquisition occur immediately to imply the issues concerning human mind. Language acquisition obviously entails a process in which infants' linguistic skills mature alongside its perceptual, cognitive and motor skills; and language learning, therefore, does not occur in isolation.

In this thesis, I do not intend to establish a brand-new theory, but reassess the current theories of early word learning from a philosophical perspective. Sometimes even a simple change in basic assumptions might bring a fresh outlook to the problems of science. And herein this study aims to challenge the entrenched assumptions about lexical

acquisition of children and attempt to reformulate the relevant questions in the light of philosophy. Since the topic of child language acquisition is too deep and wide to discuss on a paper, the research questions will address how infants name objects in terms of its perceptual aspects in order to test the possibility that deductive (logical) inference may have a role in the extensions of acquired words. Therefore, this study will explore child language patterns mostly noticed between 1;0 to 2;5 within the following questions: Is there any minimally consistent/sufficient information on objects in order for names to be learned and extended at one-word stage? If so, what are the central properties of the physical objects that infants attend to? To what extent is object perception required for lexical knowledge? What meaning has child mapped to phonological form? On what basis do infants decide how to extend the label to other objects? When does overextension strategy disappear after a period of time? Why does vocabulary spurt occur at the same time as the end of the early form of overextension?

The linguistic data that children are exposed to does not always consist of single words. Yet, there are many sources that considerably contribute infants about where to focus on or attend to in word learning process like child-directed speech, syntactic cues, stress on words, and other intentional and/or pragmatic cues. According to Macnamara (1972:4), "It is obvious that an infant has the capacity to distinguish, from the rest of the physical environment, an object which his mother draws to his attention and names." Their ability of connecting what they hear to what they see might root in evolutionary needs, but children have remarkably the capability of generalizing acquired word appropriately or inappropriately beyond the particular case in which the word is learned, in particular infants' spontaneous extensions in word use. What is stored in memory when the word is learned is, then, supposed to be more than just a mere mapping word to its referent on which they are introduced, so as they can use the word for novel objects.

Overgeneralization is a characteristic feature of early use of language observed across children from different languages. The term is used for cases in which child extends his existing knowledge in inappropriate ways**.** It may appear in different aspects such as syntactic, morphological and semantic. Overextension seems to be in the category of semantic concerning the relation between words and meanings. It occurs when a word is applied to a wider collection of objects and events than is appropriate. The devil is in the details. The analysis of the overextension patterns cast light on the word leaning process of children.

Within the context of overextension as a path of development in the acquisition of language, this study is spirited by two proposals about the earliest word learning in children younger than 3 years of age. One proposal is empirically testable: the first strategy of early word learning is referential that is based on the relationship between the perceptual properties of physical objects and infants' conceptual knowledge; for creating a general hypothesis about the object-name relation, infants have to attend to basic perceptual features of physical objects with regard to their immaturity on perception,

attention and memory. Second proposal is theoretical: infants can be viewed as deductive learners, that is, they formulate an overview of word meaning on the basis of one or two perceptual properties of objects and assign names to objects by deductive inferences.

By the way of introduction, Chapter 2 surveys the linguistic and psychological aspects of word learning at the beginning of language acquisition. From a scientific perspective, the rationale for problematizing the word learning, the observable behavioral patterns and the conceptions will be presented within this chapter. Chapter 3 is restricted to the learning and extending of object names in infancy. Here explores it the empirical evidences for justification of the role of deductive reasoning in the earliest word learning. Overextension and fast-mapping are taken as a cue for the deductive abilities in infancy with regard to developing perceptual abilities, attention demands and the capacity of semantic memory in infancy. Chapter 4 shows the weakness and limits within the scope of the thesis and posits the future works.

CHAPTER 2

LITERATURE REVIEW

> *'Cum ipsi (majors homines) appellabant rem aliquam, et cum secundum eam covem corpus ad alquid movebant, videbam, et tenebam hoc ab eis vocari rem illam, quod sonabant, cum eam vellent ostendere. Hoc autem eos velle ex motu corporis aperiebatur: tamquam verbis naturalibus omnium gentium, quae fiunt vultu et nutu ocularum, ceterorumque membrorum actu, et sonitu vocis indicante affectionem animi in petendis, habendis, rejiciendis, fugiendisve rebus. Ita verba in variis sententiis locis suis posita, et crebro audita, quarum rerum signa essent, paulatim colligebam, measque jam voluntates, edomito in eis signis ore, per haec enuntiabam.'*
>
> *Augustine, Confessions, I. 8.*[1]

The ability to understand and produce language has been focus of interest for over thousands of years in philosophy. However, the fundamental question concerning human language acquisition remains the same: How does the child come to understand a word? Augustine's words delineate only one fragment of the picture, that is, child-directed speech and social interaction are *sine qua non* in adapting to the conventionality in word uses. As far as Wittgenstein (1953) concerned, the child should be in a state of 'knowing' how it is used and 'being able' to apply it to understand a word. But the crucial query is to be when and how the child has already such knowledge and ability.

At first sight, the child's learning word meanings might be quite apparent that the child associates names with objects within the observational environment; nonetheless, there are preferentially demanding issues related to children's discovery of linguistics units, conceptual units and the mapping between them. In Section 1, the different aspects of human language acquisition and the grounds for why it goes beyond simply naming the objects will be presented. Section 2 focuses on the suggested underlying mechanism that the children might make use of at the beginning of the language acquisition.

[1] 'When they (my elders) named some object, and accordingly moved towards something, I saw this and I grasped that the thing was called by the sound they uttered when they meant to point it out. Their intention was shown by their bodily movements, as it were the natural language of all peoples: the expression of the face, the play of the eyes, the movement of other parts of the body, and the tone of voice which expresses our state of mind in seeking, having, rejecting, or avoiding something. Thus as I heard words repeatedly used in their proper places in various sentences, I gradually learnt to understand what objects they signified; and after I had trained my mouth to form these signs, I used them to express my own desires.'

2.1. Some Logical Problems of Word Learning

In Wittgensteinian sense, the fundamental relation between names and objects falls into place within the explicit context of language i.e. word meanings cannot be determined by an abstract link between language and reality but by its grammatical use (Wittgenstein, 1974). Words do not connect to the world in the same way. Some words straightforwardly refer to things in the actual world; some expresses the actions or the state of affairs; some denotes grammatical relations. Each syntactic type of words, such as nouns, verbs, pronouns, proper names and so forth, have various ways of connections to the reality in linguistic and epistemological sense. The communicative context in which child encounters the words is said to theoretically cause a form-meaning mapping problem for the child to learn and to acquire the meaning of words. In this sense, learning word meanings turns into the task of relating word forms to a concept, to a particular meaning when an unfamiliar word is heard or the task of extending it to other similar objects or actions when the meaning is once learned.

The papers on child language acquisition mostly begin by addressing Quine's formulation of the concept of meaning. Quine's argument for the referential uncertainty has gained good recognition in the domain of child language acquisition. This problem has been demonstrated by the example of *Gavagai* by Quine's (1960). In brief, the native speaker's utterance of a word (e.g. *Gavagai*) in the setting where a rabbit runs away sets up indeterminate number of hypothesis for the foreigner to get the correct meaning of the word. In the context of language acquisition, the child is said to encounter an induction problem of choosing one right hypothesis among a large number of sets of logically possible hypotheses consistent with the data in the process of lexical acquisition. Therefore, the children should follow an inductive process to figure out the meanings within the problem of word-to-world mapping. If a child hears a word like *gavagai* as someone is pointing at a rabbit, what meaning should the child assign to it? Since this utterance may possibly refer to the rabbit, to some part of the rabbit, or to any properties of the rabbit in this particular event, learning even the simplest words for objects brings forward a challenging induction problem that any word can have an infinite number of meanings. However, the child does not face the problem of induction: the child does not need possible meanings, but *likely* meanings. Why the child should only entertain the rabbit itself but not the other parts may also be involved in the nature of the child's sensory-motor interactions with the world.

It is a known fact that the child can achieve such tasks, so quickly and efficiently, at early ages, but how children triumph this challenge posed by word learning process and how language acquisition gets started still remain one of the challenging unresolved questions in psycho-linguistics and cognitive sciences. It is widely accepted that the child needs access to further source of information for successful language learning within the unavailability of negative sentences, noisiness and ambiguity in the input, uncertainty of references. The task child faces is described as first 'the logical problem of language

acquisition' by Baker and McCarthy (1981). In the following parts, these core challenges in word learning are briefly described, followed by a review of linguistic literature.

2.1.1. Referential Uncertainty

One of the challenges in word learning task is known as referential uncertainty in the available data for natural language sentence may potentially refer to many different aspects of a scene. This problem is said to make it a difficult task for a child who faces with a bundle of sounds in a scene. If children somehow have a tendency of mapping sound patterns to objects, they should be able to disassociate the bundle of sounds into conceptually meaningful sound patterns in order to assign them to related objects. However, "John, look! Dog is barking" should appear to be "XPQS FDR DFV AWE" for a child who does not 'know' which sound pattern to which object (e.g. Siskind, 1995). Furthermore, LOOK and IS do not define a name of an object. Indeed, word meanings refer to not only an entity, but also property, action or relation. Even for just word "dog", and the relevant scene that the child observes is "a small black dog, Lacey, running in the garden", the child may encounter uncertainty of referents i.e. how to infer the right hypothesis among large numbers of possible hypothesis containing the word dog that may refer to many aspects of the scene such as a running thing, a thing with tail, all animals, all small animals, all black animals, things running in the garden and so on. For a child who does not know meaning of the word yet, it is a task to discover the correct one that sentence delivers within many unrelated aspects of the scene (e.g. Quine, 1960; Gleitman, 1990).

2.1.2. No Negative Evidence Problem

This section does intentionally not address the poverty of stimulus arguments in detail, but only the motivations for why the input is regarded as impoverished in nativist conjectures. Plato have discussed that in order for certain knowledge to be acquired, it is logically necessary that information is sufficiently accessible to people as specific type of evidence in the environment. Negative evidence is linguistically termed as information that describes which utterances are not allowed in the target language. Yet, people acquire knowledge on the basis of insufficient information, then how do people have knowledge of something that experience does not provide sufficient condition? This gap between knowledge and experience is, in linguistics, what Chomsky (1986) calls "Plato's problem" or "poverty of stimulus".

The data available to children supposedly lacks information that would allow them to acquire certain syntactic principles or regularities. In linguistics debates, this view has been argued by nativist account of language acquisition that the input contains insufficient information for children to reach a reasonable level of competence in natural language grammars. Any set of sentences in a language is, in principle, inadequate as a database because the underlying structure of language is not fully revealed in surface structures of

sentences and children are not exposed to linguistic structures of certain types that are nonetheless present in their early knowledge of language.

Poverty of stimulus is a type of argument for linguistic nativism which stresses the innate linguistic knowledge of human children concerning the role of input in the acquisition of language structure (Gathercole and Hoff, 2007). The encountered nativist assertions mostly pertain to observable accomplishments of children or aspects of their environment. Following two cases are admitted as strong evidence for the nativist view: (1) the child's acquired knowledge in language overtake the information given in the input, but does not violate the boundary conditions imposed by Universal Grammar and (2) a gap exists between the linguistic principles that controls the language competence of the child and his/her language experiences (see for review, Gleitman and Newport, 1995; Crain and Pietroski, 2001). Concerning two interrelated cases, nativists claim that language is not learned but acquired by children within an innate mechanism. In contrast, the empiricist account of language acquisition posits universals of language not in innate linguistic structures, but in universal cognitive structures and universals of human condition (Gathercole and Hoff, 2007). Yet whether children require and get negative evidence has significant substantiality on this ground.

2.1.3. Noise Problem

Another problem that has to be accounted for is that child-directed data contains high level of noise and ambiguity. Beside inadequacy of information that may permit the child to acquire certain syntactic regularities, the child encounters noisy input such as false starts, slips-of-the-tongue, ambiguity of the signal, incomplete sentences and some other ungrammatical forms (e.g., Siskind, 1997). In the case that the child assigns such information to the class of positive evidences i.e. considering wrong utterances as grammatical, child-directed speech that contains noisy information might lead to errors. However, the child is capable of handling the noisiness and ambiguity successfully even though there are sometimes incorrect examples in the input. This success has been referred to some facts that the linguistic signal is redundant and several information sources are generally available that may assist children in inferring the word meanings (Levy and Jaeger, 2007).

2.2. Child Developmental Patterns in Early Word Learning

In addition to the central problem of learning the form-meaning mapping from ambiguous input, there are specific patterns of language acquisition that have been observed in child language development and studied extensively among the children from different cultures and languages. Numerous studies of early lexical acquisition have shown that the slow rate of learning new words shifts to a rapid pace at a certain stage and also children can make reasonable guesses about meanings of unfamiliar words from just one or a few positive examples. It has been a great deal of difficulty in justifying of these changing behaviors in language development, but it is, no doubt, not an arbitrary coincidence that

these behaviors tend to be present in correspondence. Any theory of word learning must account for these phenomena. In the following parts, I will give the main points of these patterns, namely overextension, fast-mapping and vocabulary spurt/explosion (at a later point in thesis, I will argue that there is a causal link between these patterns).

2.2.1. Overextension

In early stage of word learning, the use of words occurs in a broader range of referents i.e., more or less than conventionally accepted referents in the speech of children between 1:1 and 2:6 years (Clark, 1973). For example, the word *dog* is overextended to contain cats, horses and other all four-legged animals. In cases of overextension, the use of the target (nominal) word does not appear to be for just simply labeling any distinct objects, because the partial meaning of the word can somehow intersect with the semantic domain of the object labeled by that word in such a way as shape, color, taste, texture or function. Therefore, the period in which overextension is observed gives substantial clues in regard to our understanding of children's linguistic knowledge during one-word stage and their conceptual developments.

In Rescorla's (1980) longitudinal study of overextensions, the early vocabularies of six children in a diary study from 1:0 to 1:8 have been extensively analyzed with respect to types of overextension, the bases on which overextension occurs, and distribution of overextension across word classes.

The types of overextension (Rescorla, 1980:325-227) follow as:

- *'categorical overinclusion'* (e.g., *dada* for mother, *horse* for goat),
- *'analogical overextensions'* (e.g., *comb* for centipede, *ball* for round objects; see also Hudson and Nelson, 1984; Gottfried, 1997),
- *'predicate statements'* (e.g., *doll* for usual location of doll in the crib when it was absent).

And the bases on which overextension occur (Rescorla, 1980:327-328) are grouped as below (see also Clark (1973) for classifications):

- *'perceptual similarity'* (e.g., *truck* for bus),
- *'action or function similarity'* (e.g., *hat* for shirt stuck on the head),
- *'affective similarity'* (e.g., *bad* for spilling, dropping food)
- *'contextual association'* (e.g., *nap* for crib blanket).

Table 1: Restriction of overextension domain by adding new words (in Clark, 2009: 85)

Word	Initial and subsequent referents	More appropriate word
papa	father/grandfather/mother 1;0,	mama 1;3
	any man 1;2	Mann 1;5
Mann	pictures of adults 1;5, any adult 1;6	Frau 1;7
baby	self/other children 1;2, pictures of children 1;4, any child 1;8	boy 1;8
ball	balls 1;0 balloon, ball of yarn 1;4	balloon 1;10
Wauwau	dogs 1;1, stone lion 1;1,	dog 1;11
	horses (bronze bookends)/toy dog/	hottey [horsie] 1;10
	soft slippers with face 1;3	shoe 1;6
	fur-clad man in poster 1;4	Mann 1;5
	porcelain elephant 1;6	
	picture of sloth 1;8	
cake	candy 1;6	candy 1;10
	real cakes and sand cakes 1;9	
cookie	cookies and cracker 1;6	cracker 1;10
candy	candy 1;10	
	cherries/anything sweet 1;11	

As a consequence, the overextension has been noticed in about one-third of the first 75 words used by each child. The results have also indicated that overextension is more likely to happen in early words due to a decline in overextension when the vocabulary size increases (words 1-25: 45% overextended; words 26-50: 35%; words 51-75: 20% (Rescorla, 1980:329). This is also consistent with Clark's (1973) study of another diary data signifying that overextension period "lasts for up to a year for each child, but the overextension of a particular word rarely lasts much more than 8 months, and may take place only briefly" (Clark, 1973:199).

Some interpretations of these findings concerning why overextension occurs can be summarized as: (1) constraints on communicative strategy (see Bloom, 2000 for discussion), (2) difficulty in lexical retrieval (Marcus et al., 1992; Gottfried, 1997) (3) limited vocabulary (Clark, 1973), (4) constraint on the child's conceptual knowledge (Clark, 1973, Rescorla, 1981), and (5) children's linguistics flexibility (Gottfried, 1997). The overextension will be precisely examined in Chapter 3.

2.2.2. Vocabulary Spurt

The general consensus suggests that children begin producing words by their first birthday, but interestingly vocabulary growth that is slow at early stages of learning often shifts to a rapid pace at a later time.

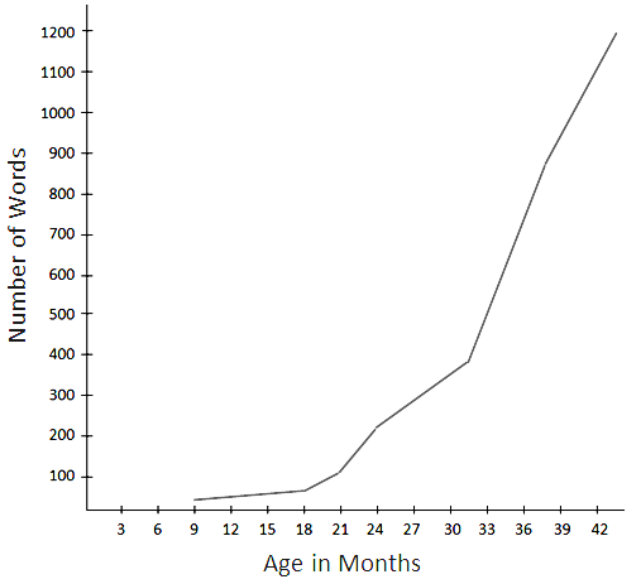

Figure 1: Vocabulary increase from nine to forty-two months.

Child's repertoire of words reaches a peak at 13-15 months, reaching about 10,000 words by the age of six (Anglin, 1993). Experimental studies of early vocabulary growth have shown that when the child has approached to an average vocabulary size of 50 words in production around 1:5 to 1:8, the sudden spurt occurs in the rate of word learning so that the child learns words at a rapid pace (e.g., Bloom, 1973**;** Reznick and Goldfield, 1992).

One explanation has been argued that behavioral change in word production highlights a remarkable stage in acquisition for this peak point might be the beginning of realizing that everything has a name (Goldfield and Reznick, 1990). On the one hand, the phenomenon has been also treated as the capacity to categorize things (Nazzi and Bertoncini, 2003) and even associated with syntactic bootstrapping (Gleitman and Gleitman, 1992) and the notion of mutual exclusivity (Markman et al., 2003), but on the other hand the recent studies challenged the assumption of a vocabulary spurt, arguing that word learning is a continuous process with a relatively constant rate of change (Bloom, 2004; Ganger and Brent, 2004).

2.2.3. Fast-Mapping

The other pattern of an apparently fluctuating behavior in child language development is the late onset of fast mapping that is a term usually referring to noun learning. In accordance with the empirical findings, the fast-mapping has been observed behaviorally in children at 13-15 months, but not at 12 months (Werker et al., 1998). Fast mapping behavior has been described as the ability of rapidly learning new words after one or a few representation (Carey and Bartlett, 1978). Their study concerning child's learning a single word has revealed that the preschoolers can rapidly and correctly associate a new color

word (e.g., ‘chromium’) to a novel object (e.g., ‘olive’) from a few exposures and retain this mapping for a long time. Subsequent studies have extended this phenomenon to different semantic domains (Heibeck and Markman, 1987) and age groups (Woodward et al., 1994; Werker et al., 1998). Further experiments on fast mapping –introducing new words from various categorical domains such as color, shape, or texture word – have provided a supporting evidence for the fact that children can rapidly narrow down their hypothesis space about the meaning of word not only in color, but also in other categorical domains (Heibeck and Markman, 1987). One explanation for how children can quickly hypothesize about the meaning of a word given a few examples highlights the influence of child’s observation of adult language: They focus on first the particular event that the word is used in, and then extend their early information as they learn more about mapping words to their word-class and to patterns of use in particular syntactic constructions; they also use partial information about the meaning of a word from how it is used in a sentence, what words it is contrasted with, as well as other factors (e.g., Woodward et al., 1994). The studies showing that children have difficulty in learning synonymous and homonymous words has contributed to this view that fast mapping develops as the result of observations of adult language (e.g., Huttenlocher and Smiley 1987; Liittschwager and Markman, 1994). However, research on fast mapping has also showed that word retention doesn’t last so long (see Goodman et al., 1998 for a review). On the contrary, some studies have shown that children do not forget words up to 1 month later (e.g., Carey and Bartlett, 1978; Markson and Bloom, 1997).

2.3. Underlying Mechanisms of Word Learning

The question of how the child can determine which sound segment corresponds to which concept, is one of the central questions concerning child’s acquisition of language in cognitive sciences. Adults can usually narrow down the possible meanings of unfamiliar words or at least resolve the ambiguities from contextual and referential information. For early stages of lexical acquisition, learning from contextual meaning cannot explain how the child sets off the process of language acquisition, since the child is born with empty lexicon. Therefore, the child must attempt to decide how to decompose the meaning of the whole into segments and assign those segments as the meanings of the individual words in the utterance. It is obviously non-trivial to explain how the process of learning word meanings begins without knowing the meanings of any words. Nevertheless, previously discussed challenges in child’s environmental setting and behavioral patterns observed in child language development can give theorists some significant hints for understanding the underlying mechanisms involved in learning word’s meaning. As follows, form-meaning mapping has been grounded in various learning mechanisms that each of them addresses to a particular aspect of word learning.

2.3.1. Constraint Principles

At very early ages of word learning that children don’t have a word for an object as a type, they require to rely on some a priori constraints in mapping meanings to forms (Markman,

1990). However, this reliance happens in an early preference for acquiring nouns over other word-classes, later they have to give up all of these constraints, which are incompatible with many of the semantic relations inherent in the adult lexicon (Golinkoff et al., 1994). These 'built-in' constraints are believed to facilitate the mapping task for children, as a response to Quine's (1960) indeterminacy problem how child can assign meanings to terms from the infinite set of hypothesis spaces.

Markman (1990) has put an emphasis on the notion of constraint principles in the mapping task that children can overcome the uncertainty in labeling words to correct objects by whole-object constraint, taxonomic constraint and mutual exclusivity. Within the hypothesis elimination paradigm, the whole-object constraint biases the child to eliminate word meanings related to any features of the objects, because words refer to whole objects as opposed to their features or parts; fast mapping phenomenon has been based on the principle of the mutual exclusivity, given to word learning process a priori, that is every object can have only one name; children rely on taxonomic constraint that appeals to that words to refer only to kinds of things, not individuals (Carey, 1978; Markman and Wachtel, 1988). While Markman (1992) debates the possibility that the general cognitive mechanisms are the primary source of these constraints, many studies challenge to show that the constraints are unique to word-learning contexts (Markson et al., 2008).

2.3.2. Bootstrapping Hypotheses

Bootstrapping approaches account for child's learning the general association between syntactic forms and semantic content on the basis of *a priori* knowledge and information processing capacities. This notion implies a kind of strategy that children employ the specific types of information given in the linguistic/non-linguistic input with the purpose of determining the grammar constituencies and lexicons of native language. In the coalition model of word learning in children (Hirsh-Pasek and Golinkoff, 1996), it has been suggested that there are six types of cues existing in the language environment such that *primarily* syntactic, semantic, prosodic, lexical, and *generally* social and physical, but children cannot give attention to all cues at same level in language learning process. Accordingly, various types of bootstrapping strategies have been proposed on the basis of these information that child is assumed to draw on at initial. Due to considerable discussions in the literature, three (semantic, syntactic, prosodic) bootstrapping ideas from traditional linguistic accounts, and grammatical bootstrapping derived from computational account will be at the focus of this section.

2.3.2.1. Semantic Bootstrapping

Pinker's (1984) notion of semantic bootstrapping relates to the questions of how children define tokens of abstract grammatical representations in the input and how they determine which words in the speech belong to which form class. Semantic bootstrapping hypothesis holds a nativist account that proposes the parameter setting model of language acquisition

and the role of input as a trigger for setting parameters within the theory of Universal Grammar. According to the hypothesis, the child is innately endowed with universal 'linking rules' between semantic properties and syntactic categories so that the meanings of words are utilized as an underlying support for the process of inferring their syntactic categories (Pinker 1989; Bates and MacWhinney 1989). It presupposes that children use their 'built-in' knowledge to initiate the process of language acquisition. In other words, the children are able to recognize basic semantic categories like 'action' and 'agent' through observation and to infer the semantic-syntax association of the entities by using their innately specified linking rules in such a way that 'agent' is linked to 'subject of' and 'action' to 'verb' given an utterance.

2.3.2.2. Syntactic Bootstrapping

The hypothesis known as syntactic bootstrapping approaches the child's word learning as a mapping problem, but more precisely as a process of sentence-to-world pairing rather than word-to-world pairing (Gleitman and Fisher, 2005). This view suggests that the information about the syntactic structure of utterances in which the verb occurs, aids the child to constrain the possible meaning of the words and to interpret the conceptual content of the verbs and other predicates (Landau and Gleitman, 1985; Gleitman, 1990; Fisher, 1996).

A clear demonstration of the need for syntactic bootstrapping is the linguistic evidence that verb meanings differ according to the valency and arrangement of the arguments like noun phrases (Landau and Gleitman, 1985; Naigles and Swensen, 2007). Therefore, the interpretation of verbs from only their occurrence within the scenes or the context might be necessary but not sufficient condition for determining the unfamiliar word meanings. Nothing about the syntactic bootstrapping account assumes that syntax is the only information source for inferring the meaning of words; on the contrary, syntactic bootstrapping must function with various kinds of information that are available to the children such as lexical biases and pragmatic knowledge.

As part of solution for fast-mapping phenomenon, syntactic cues may increase the rate of word learning when combined with other source of information. One example is that the acquisition of syntax and other linguistic knowledge by children at about 2 years old provides plentiful source of additional constraints that allow them to learn many additional words, both referential and non-referential (Gleitman, 1990; Gillette et al., 1999; Snedeker and Gleitman, 2004). As Naigles and Swenson (2007) have also argued, what children hear is not the only information that is available to them; there are various kinds of information as well. When they hear the words given in the utterances, they tend to observe the objects, events and relation. Later the syntax embedded in the sentences help them to figure out which aspect of the scene the word refers to. Particularly, the experiments have shown that tracking the number and type of phrases that occur with verbs is the strategy that children followed to decide the meaning of these verbs (Naigles, 1990; Fisher, 1996; Gillette et al., 1999). Eye-tracking studies of child sentence

processing in which their direction of gaze is recorded during spoken language comprehension also confirm this view that children are likely to look around as given the expressions (Trueswell and Gleitman, 2007). Accordingly, syntactic bootstrapping may have more significantly contribution in respect to these other kinds of information.

2.3.2.3. Prosodic Bootstrapping

Most theories of syntax acquisition concerning how child achieves the grammar have usually focused on the input as strings of words, but disregarded the influence of speech perception in language learning process. However, prosodic bootstrapping accounts present an alternative view of the earliest stages of language acquisition. Prosodic approaches to syntax acquisition have emphasized the role of sound patterns in speech for determining word order regularities and syntactic constituents in early grammar (e.g., Fisher and Tokura, 1996; Gleitman et al., 1988). This approach is variously known as prosodic bootstrapping, distributional bootstrapping, or phonological bootstrapping in the literature. The hypothesis essentially implies the correlation between syntactic boundaries and prosodic features (e.g., pausing, vowel lengthening, stressing, pitch contours etc.) in the speech data. In other words, the boundaries between syntactic constituents are claimed to be denoted by acoustic features during the speech. Behavioral studies have shown that even in early stages of the learning process 6-month-old children use corresponding cues of either pitch and pause or pitch and pre-boundary length for individuating the semantically functioning phrases and identifying the verb (e.g., Landau and Gleitman, 1985; Seidl, 2007). Due to the prosodic structure of child-directed speech, the child may, then, rely on the distributional analysis of sound patterns to bootstrap their attempts at parsing the speech stream. The notion of syntax-prosody mapping has received a considerable attention in the discussions of language development (e.g., Gleitman et al., 1988; Hirsh-Pasek et al., 1987). One of the arguments against the prosodic bootstrapping debates that the prosodic information in a particular sentence is not always sufficient to assign a syntactic structure, so cross-sentence comparisons and other types of information are required to arrive at the correct syntactic representation (Gerken et al., 1994). However, one problem about prosodic bootstrapping is the fact that phonological phrase boundaries don't map perfectly onto syntactic phrase boundaries, so prosody may not directly reflect the syntactic structures (e.g., Fisher and Tokura, 1996).

2.3.2.4. Grammatical Bootstrapping

Grammatical bootstrapping hypothesis is derived from a computationally motivated theory of syntax-semantics namely Combinatory Categorial Grammar (CCG; Steedman, 2000) in which "only the combinators that directly and solely bear on constituency operate in syntax freely, all others being radically lexicalized" (Bozşahin, 2012:61). This can be seen as the interaction of syntactic, semantic and prosodic information that means all language-specific information resides in the lexicon. For it is a lexicalization of syntactic and semantic bootstrapping, the earliest stages of language acquisition become the

problem of learning the categorial lexicon and the language-specific instances of the combinatory rule types (Steedman, 1996).

As distinct from traditional linguistic theories**,** grammar learning is regarded as a statistical learning concerning to build "a probabilistic parsing model over all possible lexicons over the cross-product of all possible decompositions of sentences into words and all possible decompositions of a logical form into subformulae" (Steedman and Hockenmaier, 2007:3). It is a cognitively plausible (re)formalization of the concepts about universal semantics and language-specific syntax.

> "The only notion of trigger that it requires is the notion 'reasonably short sentence with an independently accessible meaning'. The only notion of language specific grammar it needs is the lexicon for the language. The only notion of universal grammar that it needs is a universal mapping from each semantic type to the possible lexical types, together with a universal machine for merging or projecting lexical types and their meaning representations onto grammatical derivations" (Steedman and Hockenmaier, 2007:2).

Steedman and Hockenmaier suggest that arriving at a target lexicon do not require all-or-none 'parameter setting', 'trigger' and any 'subset principle' of the kind that linguistic theory presupposes. The assumption that grammar learning is parameter setting is claimed to be *meta-theoretical* for the grammar itself limits the hypothesis space of children by eliminations of incorrect hypothesis on the basis of positive evidence raising the probability of correct hypothesis at the expense of incorrect ones. In other words, the concepts of 'parameter' and 'trigger' are grounded in the grammatical information that is sufficient in order to learn target language. In this context, the unavailability of negative evidence does not constitute a problem, since the only evidence that matters in language learning is a "reasonable proportion of utterances involving sentences which are sufficiently short for them to deal with" (Steedman and Hockenmaier, 2007:4).

2.3.3. Other Suggested Learning Mechanisms

Within the assumption that language acquisition seems to be in accordance with general learning mechanisms, Saffran (2003) identifies the language learning as statistical learning by which children operate the natural statistical features of language to reach an inference about its structure. Empirical findings have shown that children and adults show sensitivity to co-occurrence statistics and thus it might be effective to deduce the right hypotheses for novel words in uncertain situations (Smith and Yu, 2007). The statistical learning has been also implicated the various aspects of language acquisition, including phrase structure (Thiessen et al., 2005), the grammatical classes of words (Mintz, 2002), phonotactic structure (Chambers et al., 2003) and word meaning (Yu and Smith, 2007). Alternatively, form-meaning mapping has been attributed to referential learning that children can handle it through attending to the referents of the words and using different

attention mechanisms to limit the possible interpretations of an utterance (see Bloom, 2000 for review). Smith (2000) considers the issue as associative learning that children can associate a word with a concept by hearing the word that are most frequently used in the presence of that concept. However, both of these mechanisms –referential and associative learning– have been criticized for not explaining learning from noisy and ambiguous input (e.g. Hoff and Naigles, 2002). Cross-situational learning bears out that the meanings of words are learnable via cross-situational observation of associations between words and the referents in the presence of noise and referential uncertainty (Pinker, 1989; Siskind, 1996; Smith and Yu, 2007). In other words, observing the consistencies across various conditions in which a word is used makes children learn word meanings from a large number of ambiguous data.

Siskind (1996) proposes a rule-based model simulating the process of child's choosing the correct meaning for an utterance and learning word meanings from ambiguous contexts where referential uncertainty follows. The model assumes the principles, a set of lexical constraints, which undertake to confine possible hypotheses about the association between word and its referents. Tenenbaum and Xu (2007) claim the word learning as domain-general learning and the principles of rational statistical inductive inference governing the domain-general learning mechanism. Their model is formulated within the Bayesian framework for concept learning and generalization (Tenenbaum, Griffiths, & Kemp, 2006). In the expectation-maximization framework, Fleischman and Roy (2005) address to the features of events in the context of how form-meaning mapping is determined when an event is described by an utterance. Their model intends to settle the components of an action (e.g. move-walk) and how an utterance describes an action through its components. Some computational models adopt the cross-situational learning mechanism in conjunction with the probabilistic approach (Yu, 2005; Frank et al., 2007). Supposing the domain-general probabilistic learning mechanisms, Frank et al. (2007) applies a Bayesian model of cross-situational learning which also learns from the correlation between social cues and word referents.

Other experimental studies highlight the significance of the social cues about what the speaker is talking about and how they can be influential in word learning. It has been indicated that social interaction plays a much more central role in language acquisition (Carpenter and Tomasello, 2000). Children can take advantage of social-pragmatic cues such as speakers' eye-gaze, position of their hands, facial expressions in order to apprehend the speaker's intention of referring and extending novel labels to their relevant referents in the case of object labels (Baldwin, 1993a, 1993b; Tomasello et al., 1996). Tomasello and Kruger (1992) stress that non-ostensive models support verb learning pertaining to the effects of communicative contexts on the learning of non-nominal. Pragmatics or intentional reasoning about how the observed patterns are produced in communicative context by observing speaker's eye-gaze and position of their hands may help to limit hypothesis spaces for inferences about word meanings. The investigations into social cues may be an alternative way of studying about learning of words and word

meanings in addition to preceding internal mechanisms, because adult speech within communicative contexts may provide a large number of cues for children to narrow down their hypothesis space (Clark and Svaib, 1997).

CHAPTER 3

REVISITING EARLY WORD LEARNING: A DEDUCTIVE ANALYSIS

"We must be systematic, but we should keep our systems open."
A.N. Whitehead, *Modes of Thought*

In the previous chapter, it has been set out the main theories of child language acquisition and how the behavioral patterns of children when they are acquiring a language are explained within these theories. My aim has been to provide a general framework. In this chapter, I examine, thus, whether the phenomena of overextension and fast-mapping in the earliest word learning can be viewed as a consequence of logical deductive inference with regard to the role of visual perception and attention and semantic memory in the pre-linguistic infants.

Most of the researches on naming in children have been conducted with 2-, 3- and 4-year-old children. Children tend to use nouns for objects in terms of taxonomic relations (e.g., a dog and a cat) and to group objects in regard to thematic relations (e.g., a dog and a bone) by 3 or 4 years of age (cf. Markman and Hutchinson, 1984). Instead of attributing this tendency to *innate* knowledge, it is worth to search for its grounds on perception. It stands to reason that the preliminary experiences in infancy from fetus to the first years underpin the latter perceptual and conceptual knowledge (see also Piaget, 1952 for cognitive-developmental stages). If it is case that, roughly, children learn the words by means of the physical entities, there is possibly a significant connection between the development in perception and word learning. In other words, infants bear the *knowledge* about object world through natural language. To explicate this hypothesis more precisely, an investigation into the early word learning lies at the heart of the current thesis.

The questions concerned throughout this chapter follow as:

(1) Is there any minimally consistent/sufficient information on objects in order for names to be learned and extended at one-word stage? If so, what are the central properties of the physical objects that infants attend to?

(2) To what extent is object perception required for lexical knowledge? What meaning has child mapped to phonological form? On what basis do infants decide how to extend the label to other objects?

(3) When does overextension strategy disappear? Why does vocabulary spurt occur at the same time as the end of the early form of overextension?

Firstly, the questions in (1) put emphasis on ontological underpinnings of early word learning. Any theory of child language acquisition should account for how children identify the physical entities before naming them. In order to understand in what ways they use their first words for objects, it is indispensable to search how they recognize and identify the objects. Secondly, the questions in (2) address epistemological aspects of concepts and representations of the object world immediately after the prelinguistic stage. Finally, in accordance with the previous questions, by the question (3), it is an attempt to redefine the mapping problem in the sense of deductive approach; to argue that word is mapped to partial property of objects despite the conjectures that word learning is a form-meaning; and to prove that the overextension observed at the early ages depends upon the perceptual similarity that is derived from basic common features like shape.

3.1. The Role of Perceptual Properties of Objects in Word Learning

The pure information that is objectively accessible to the children in the environment seems to be, in principle, insufficient to identify the meaning of any particular word, but it does not hinder the infants in their process to grasp basic-level relations between objects and words. In such circumstances, children, between 18- and 24-months, may assume what they hear as a name that refers to the object as a whole rather than as a particular part, property or anything else (Macnamara, 1982). Nevertheless, the relations established in infancy may differentiate by the time of adulthood, so infants' word meanings may not be the same as adult's word meanings. Difficulty in understanding infants' world may lie behind this fact, but it does not mean to be clutching at straws. If the performance of learning consists of enduring infinitely many information about word meaning and infants can get through it successfully, then it is probable to conclude that some perceptual properties of the object attract considerable attention of infants and be, as one of the factors, minimally sufficient so as to trigger their approximate inferences about the word meanings. (Noe, 2004:199). Considering the process of cognitive development, children are likely to be immature in terms of semantic memory, visual attention mechanism and visual perception as compared to the adults. Accordingly, they may be in a condition that it is, yet, not possible to notice further than perceptual dimensions of objects when they form their categories of the objects. This condition may give them a chance of success in avoiding the complexity in inferring the referent of an unknown object rather than struggle along the process of word learning.

For more 30 years, there has been considerable empirical and theoretical interest in the nature of infant's parsing objects into categories. For finding a way out of Quine's problem of induction in language acquisition literature, developmental psychologists and psycholinguists ingeniously attempted to search for ontology-based psychological underpinnings of word learning such as various cognitive constraints, principles, or biases on which children are said to rely for their inferences (e.g. Carey, 1982; Clark, 1993;

Markman and Hutchinson, 1984; Gelmand and Markman, 1986; Landau et al., 1988; Soja et al., 1991; Golinkoff et al., 1994; Waxman and Markow, 1995). However, researches on initial construction of category representations have turned out to understand whether early words (count nouns) refer to distinct kinds, shape or functions in the literature (e.g., Rosch et al., 1976; Landau et al., 1988; Soja et al., 1991). The nativist and empiricist accounts, unsurprisingly, propose different arguments that count nouns referring to objects, respectively, on the basis of 'kinds' (Soja et al., 1991; Soja et al., 1992; Markson et al., 2008) and on the basis of shape (Landau et al., 1988).

Despite the suggestion that children as young as 4 years old rely on 'kinds' as a basis for naming and categorizing objects (e.g., Gelman and Markman, 1986; Gelman and Coley, 1990), the nativists do not neglect the notion of shape entirely, but see shape as a reliable cue for children to identify 'kinds' in the environment. However, this is a vague idea: if names for objects are projected on the basis of 'kinds' and 'kinds' are based on the perceptual similarity (in particular shape), then the early attention appears to be on perceptual similarity, not on 'kinds'. Supposing that 'kinds' as the sets of the similar properties, 'kinds' can be reduced to perceptual properties of objects (e.g., Colunga and Smith, 2005). In Quine's inquiry to the nature of the notion of natural kinds, this has been discussed clearly.

> "The notion of a kind and the notion of similarity or resemblance seem to be variants or adaptations of a single notion. Similarity is immediately definable in terms of kind; for, things are similar when they are two of a kind. The very words for 'kind' and 'similar' tend to run in etymologically cognate pairs. Cognate with 'kind' we have 'akin' and 'kindred'. Cognate with 'like' we have 'ilk'. Cognate with 'similar' and 'same' and 'resemble' there are 'sammeln' and 'assemble', suggesting a gathering into kinds." (Quine, 1969:117)

In addition, when infant's cognitive capacity is taken into account, categorization based on perceptual properties seem to be more plausible rather than 'kinds' that develops out of high-level cognitive process. Attending to perceptual properties (especially, the shape bias for infants) may be a natural tendency. Whether the shape bias develops out of word learning task (see Colunga and Smith, 2005 for review), the shape bias appears to be dominant in labeling objects (Clark, 1973; Heibeck and Markman, 1987) and classification of basic level objects (Rosch et al., 1976). However, the reliance on perceptual appearances diminish in preferential in later stages of development but substantially serve as a basis for gradual discernment of other ways such taxonomic groupings and object functions that goes beyond the perceptual similarity. The vocabulary spurt, observed at a particular time of language development, can be seen as a natural consequence of this shift that increases the development of conceptual and linguistics skills.

Consequently, for children at the beginning of language development, the type of knowledge that an infant has about the objects being labeled implies the possibility that deductive inference plays an important role in labeling the novel objects in infancy. Their reliance on shape similarity of the objects is not adequate to induce new information within natural categories (Gelman and Markman, 1986). The partial information the children has abstracted from the encounters turns temporarily into the general assumption about the meaning of the word associated with the object and the basis for application of word to other encounters. Therefore, I suggest that in the earliest stages of word learning period, especially for basic-level concrete nouns, children deductively name the novel objects as a result of their general estimations influenced by perceptual information which is prior to state of assigning lexical terms to new objects.

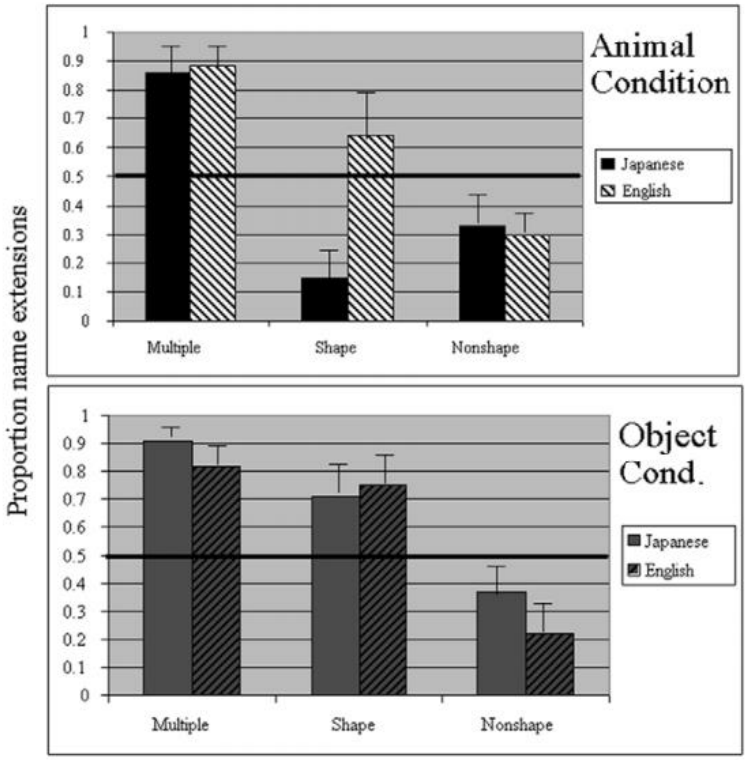

Figure 2: The proportion of name extension between Japanese and English children in object versus animal conditions. (from Yoshida and Smith, 2001:B70)

The perceptual accessibility of objects may not be sufficient but surely necessary for a deductive learner to specify the meanings of words, more importantly to extend the application of words, because the infants, when hearing a new word and seeing a new object, extend to new items on the basis of various perceptual features of the objects. While shape can serve as a reliable cue for labeling some inanimate objects, they exhibit less of shape bias in case texture may also be perceivable cue for animals; color for foods

to be extended. The results in Figure 2 also show that the extensions of exemplar's name by English-speaking and Japanese-speaking children are not on the basis of shape alone, but also multiple properties and non-shape property in the animal and object conditions (Yoshida and Smith, 2001).

As a consequence, any attitude insisting on only one constraint (shape, color or kind) will be incomplete and incoherent, because the words do not refer only to objects, but also to relations, properties and events. For that reason, here the suggestions are narrow-downed to learning of words referring to the objects in the environment. It does not seem to be empirically trivial to explain their prelinguistic representations of meanings and conceptualizing the world of objects due to the impossibility of introspective outlook to their representations at this level. Nevertheless, at least some patterns that have been observed across children at the earliest stages of word learning can be described in a deductive approach.

3.2. The Deductive Object-Naming Hypothesis

I have presented how infants grasp the naïve correlation between word usage and objects by attending to superficial perceptual appearances of objects. I use the word 'naïve' advisedly, because early word extensions give the impression of the disparity between the children's meaning of word and the adult meaning. This probably relates to infant's insufficient capacity of visual attention, visual perception and semantic memory in information processing abilities. Debates on what sort of information has a privileged status in word learning have revealed that infants can take advantage of different information from observable objects such as shape, texture, color, kind and function in extension for different classes of words. But even so, the shape, among those, appears to be the most reliable cue for associating object properties with the word usage. The formation of infant's *concept world* may also depend upon mostly categorizing the object world in terms of the shapes of the objects (e.g., Rosch et al., 1976). It is important to note that, however, the theories presupposing the prominence of perceptual features in word generalization do not explain how infants identify commonalities among objects. It is not empirically trivial to explain the nature of abstraction ability of object properties. Nevertheless, the conjecture on abstraction ability is a good starting point to explain some patterns that have been observed across children at the earliest stage of word learning in deductive context.

Since understanding the meaning of words from observation is not easy for children (even for adults) who have not any linguistic knowledge, the notion of form-meaning mapping appears to be transparent. In the daily life, nobody hesitates to answer if someone asks the meaning of something. Let us suppose a foreigner heard a new word 'chesterfield', but never saw it, then asked for the meaning of 'chesterfield' to a native:

X: Hey! I don't know what 'chesterfield' is. What is the meaning of it?
Y: It is some kind of sofa.
X: What kind of?
Y: It has a padded back and padded arms.
X: Like a sofa!?
Y: Yeah, but that are of the same height and curve outwards.
X: Okay. I don't get it. I need a picture of it.

The word 'chesterfield' is the signifier of a particular object and defining the word can only be possible by describing the object's characteristic features or functional properties. X can't get completely the meaning of the word, though X has already an idea of something used for having a seat. How can we get the meaning of something without concepts? If we go back to children, how does the child come to understand a word, for example 'apple'? One may suggest that once the child sees an apple labeled by *apple,* he associates the sound and the object. Then, he hears *apple* again, but for another instance of apple. In this way of experiencing many instances, the child constructs a general idea (concept) by detecting attributes or properties that are common in all instances. After associating the concept with the word *apple,* the word is used appropriately in the presence of new instances (see Nelson, 1974 for a review). How many 'correct' instances of apple labeled by *apple* does the child need to see before getting the concept of *apple*? If conceptualization and form-meaning mapping are as a part of inductive inference, there is no reason for infants not to be skeptic about their beliefs regarding objective information. This way of thinking does not conform to the observations of how children names when a new object is seen, especially in holophrastic period. In addition, overextension and fast-mapping also appear to be paradoxical in this sense. In the current thesis, it is, therefore, assumed that the formation of early concepts in early period of language acquisition does not require more than one single exposure. In other words, it is likely that children possess a concept from one instance. The use of 'concept' is used to indicate the representation of the meaning of the objects. I also argue that early representations of meanings are perception-dependent.

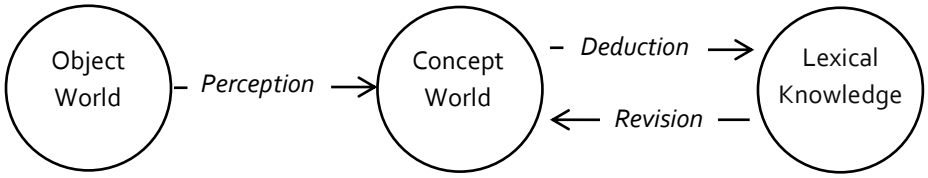

Figure 3: The deduction hypothesis model of (over)extension

The Figure 3 illustrates the link between object world and lexical knowledge. In this hypothesis, the earliest word learning period is assumed to start with experiencing the perceivable object world. The primary link between object world and concept world is established through perception. In a sense, *inner world* derives from external world**.** The

state of knowing the meaning of words emerges from the deductive abilities that concepts are detached to assign forms to meanings. Within deductive strategy, the errors in word uses seem inevitable at one- or two-word stage of language development. For strengthen knowledge base appropriate inferences are possible only by narrowing-down the conceptual domain.

3.2.1. Perception Phase

Upon hearing a new word for the unfamiliar object, easily perceivable properties of the object attract the attention of the children. Then perceptual properties serve as a prevalent starting point for extending the word usage. By observing the object labeled by linguistic sound (form), form is mapped not to *full* meaning of object, but a perceptually typical characteristic of the object. This seems to be easier way for infants to get off the ground. Hence, a typical perceptual property of an object becomes a placeholder for the meaning of the form (for example; see Table 2). The placeholder functions as the prototypical representation of the word meaning like a concept of which each member of the set of typically perceived features falls under.

Table 2: At one-word stage, early word extensions in three different languages (from Clark, 2009:83).

Word	First referent	Domain of (over)extensions
mooi	moon (Eng.)	>cakes >round marks on windows >writing on windows and in books >round postmarks >tooling on leather book covers >round postmarks >letter O
nénin	breast (Fr.)	>button on garment >point of bare elbow >eye in portrait >face in portrait >face in photo
buti	ball (Serb.)	>ball >radish >stone spheres on park gates
ticktock	watch (Eng.)	>clock >all clocks and watches >gas meter >fire hose on spool >bath scale with round dial
gumene	coat button (Serb.)	>collar stud >door handle >light switch >anything small and round
baw	ball (Eng.)	>apples >grapes >eggs >squash >bell clapper >anything round
tee	stick (Eng.)	>cane >umbrella >ruler >boards of wood >all sticklike objects
mum	horse (Eng.)	>cow >calf >pig >moose >all four-legged animals

Note: The symbol > indicates the next (over)extension for the word in question.

The words in the left-hand column of the tablature appear to be more inclusive than their lexical meanings. For example, the referent of *mooi* is the object ‘moon’, but the application exceeds the word’s exact referent in a way that *mooi* refers to the other entities

that have commonality to some extent like ‘cakes’, ‘round marks on windows’ and so on. Rescorla (1981:235) also indicates the contribution of functional equivalence and contextual contiguity in determining ‘cluster’ formation besides perceptual similarity, and these types of information are the basis for word applications.

Having said that the early meanings in infancy overlap with the adult meaning, but mostly less or more than the conventional meaning, I suggest the term *placeholder* for their meaning of words at the early stage, because the meanings undergo a constructive change with the constriction of early concepts. However, we can only be sure about the inputs and the outputs, but not definitely about what is going on in their ‘head’, in *the blackbox*. The suggestions from behavioral studies attempted to compare the comprehension and the production seem to raise as many problems as they answer and make the understanding of its essence difficult. In this study, I refused to consider the overextension as the one in comprehension and the one in production, because this study concerns the *how* as much as the *why*. In other words, it is inevitable to seek the external world when we ask *why does overextension occurs*, whereas the question, *how*, is directly related to the internal mechanism in which overextension occurs as a result. Therefore, the answers will depend on how you look at it.

First of all, it is important to note that the generalization (overextension at the focus on purpose) points out the verity of two things: (1) the similarity based on many different dimensions and (2) deductive strategy in word (over)extension. Non-linguistic deductive strategy may emerge by infants’ tendency to extract perceptual information from entities and to associate the properties or features of the initial entity to novel entity.

3.2.2. Deduction Phase

This is a crucial part of word extension. Deductive inferences play a significant role in extending the word to other object sharing the similar properties, because the representation of the object labeled by a word covers all objects sharing the similar properties. “The concept develops on the basis of the experience of a single instance; it does not depend on comparing instances and similarities” (Nelson, 1974:277). The concepts can be considered as the sets of the abstractions from objects e.g., *things having the property or relation of X, Y or Z*. The words acquired refer to the object in one of the set of properties/relations that define the concept. In this sense, labeling these objects in early stages indicates the ability to deduce from the prototypical concepts. If they encounter a novel object that has the similar property, they draw an inference by deductive inference in Modus Ponens. The conclusion may not be true, but the inference is always valid. It does mean that children are aware of this logical necessity. The reasonable ground for defense of this notion appears to be one of the behaviors observed across children, that is, overextension. As observed in the overextension, they can use words in inappropriate ways, but it is always systematic (e.g., Rescorla, 1980).

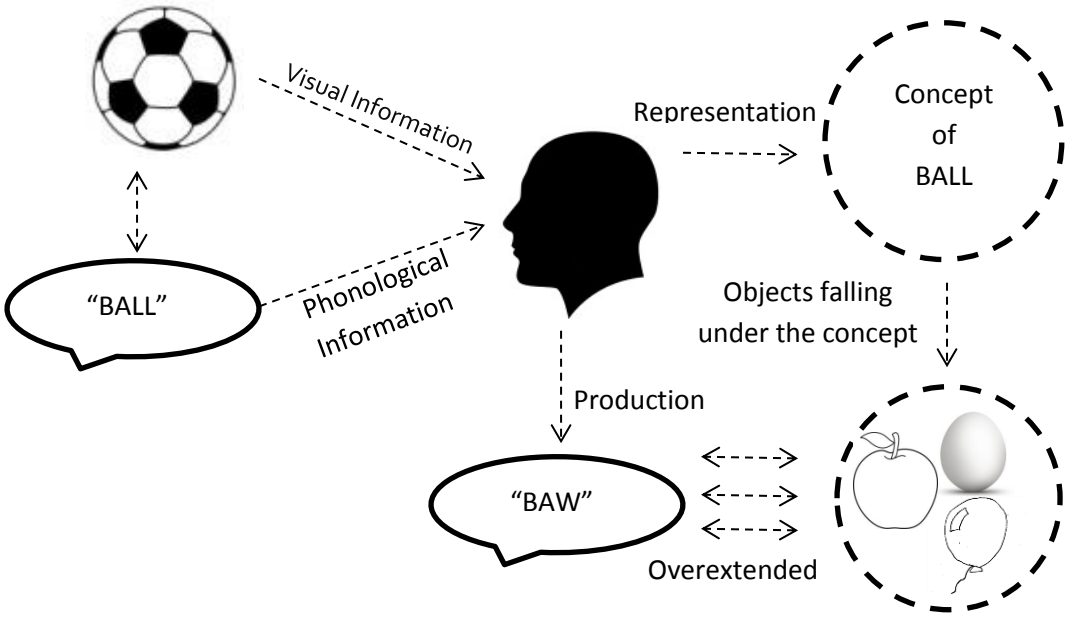

Figure 4: Representation of overextending process of the word 'ball'

As in Figure 4, the perceptual properties associated with a word (via visual information) are assumed to represent the infant's concept of the object associated with the word. In this example, 'ball' is a prototype or a reference point for infant to extend the word to other objects. Its perceptual characteristics are used as a basis for non-linguistic strategy to convey relational meaning. Deductive ability takes in applying the general supposition to a particular situation. That is, the general supposition about the concept of ball (i.e., the concept that includes round/spherical objects) is being detached to apply it to the novel objects. For such a concept that can be taken as a set of objects that have something in common (e.g., shape), the novel objects like balloon or cake are believed to be the members of that set, and as a consequence, the word 'ball' is mapped to them. However, once the child learns balloon and cake, these are no longer called 'ball' (see the example of "bow-wow" in Table 3). The reference point which is the object 'ball' in this example may be something else, but the syllogistic strategy used to extend the sense of the word is observed across children.

3.2.3. Revision Phase

Revision phase indicates the reformation of prototypical representation of early words through gaining more access to new words as the capacity of memory enhances. For the representations become more elaborative as the vocabulary increases, lexical growth can be linked to conceptual knowledge. This assumption is also supported by the results indicated in Figure 3.

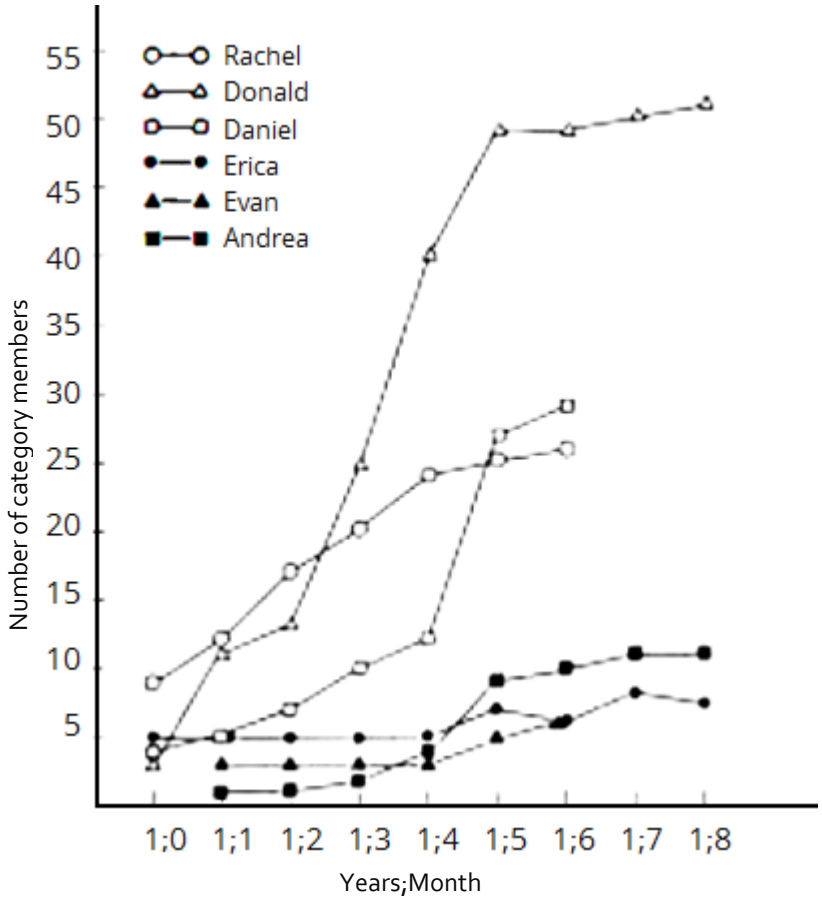

Figure 5. Animals: number of category members per child across months of acquisition (in Rescorla, 1981:230).

This shows the lexical development of six children in animal category from a diary of productive language recorded by each mother (Rescorla, 1981). More importantly, it reveals the dominance of overextension before the narrowing the concept with the addition of new words to lexical knowledge. The diary of each child covers the period of time between around 1;0 and that each child had reached to the vocabulary of 75 words (between 1;6 and 1;8). The number of category members for each child implies the number of distinct objects that has been observed in either comprehension or production. Rescorla (1982:231) claims that "the three children with many animal concepts (Donald, Daniel and Rachel) did not show any single dominating animal concept overextended to cover most of the domain." However, this conclusion is based on the assumption that if the child does not overextend the word in comprehension task, the object name is accepted as a distinct category member. Rescorla does not explicitly describe whether the words in the data of these three children are overextended only in production or never overextended

in both cases. Therefore, I will consider the data only from the diaries of the other three who are said to overextend one animal name to a wide range of animals.

It is significant to note that their (Evan, Andrea and Erica) gradually minimizing the referents of overextended words is the manifestation of the semantic domain that has been constrained, at some point in their development, shortly after they acquired the right words for animals. For example, the word *dog* is used over extensively for cats, giraffes and other four-legged animals by Evan (from 1;2 to 1;5) and Andrea (from 1;0 to 1;4); *cat* for dogs and non-mammals by Erica (from 1;1 to 1;8). The peak at about 1;5 demonstrates that they cease to overextend the words as they acquire the right words, and start to use early word mostly in consistent with adult language (Rescorla, 1981:235).

In the revision phase, the child revises the early concept with the addition of new words to the lexical knowledge; the overextensions of early word become more restricted in their denotation and the referent that had been in the overextension of an earlier word is excluded from the domain of concept (as illustrated in Table 3). The phase that children pass through the overextension may be interpreted as "they are better characterized as stages of organizing knowledge rather than as maturational stages defined by age" (Carpenter 1991:109), but it is also the fact that the older they get, the more capacity of semantic memory and attention they have.

Table 3: A sample instance of overextension and narrowing down the semantic domain through stages (in Clark, 1973:204).

	Word	Semantic domain	Possible criterial feature(s)
Stage I	bow-wow	dog(s)	Shape
Stage II	bow-wow	dogs, cows, horses, sheep, cats	Shape
Stage III	(a)bow-wow	dogs, cats, horses, sheep	
	(b)moo	cows	sound, (horns?)
Stage IV	(a)bow-wow	dogs, cats, sheep	
	(b)moo	cows	sound
	(c)gee-gee	horses	size, (tail/mane?)
Stage V	(a)bow-wow/doggie	cats, dogs	size
	(b)moo	cows	
	(c)gee-gee/horsie	horses	
	(d)baa	sheep	sound
Stage VI	(a)doggie	dogs	
	(b)moo	cows	
	(c)gee-gee/horsie	horses	
	(d)baa lamb	sheep	
	(e)kitty	cats	shape, sound

This restriction in the concept of overextended terms with the addition of new words for the objects in the domain of overextended word conforms to the hypothesis that a typical perceptual property of an object is the placeholder for the meaning of the form. Since the prototypical representation of the word meaning adds up to the early concepts, the structure of the concepts can change with experience and cognitive development. The faculty of conceptualization may be *a priori*, but the concept itself is nothing more than perception-dependent (e.g., Noe, 2004).

By grounding the infants' empirical knowledge of the world in sensory perception, it is assumed that external data from perceptual properties of objects appear to provide the necessary conditions for the possession of early concepts. Deduction at early stage is on ground-level properties such as shape. Then it grows to depend on internal assumptions such as names, rather than external ones. Language skill enables to transcend the external information in a way that words dominate, or filter, the perceptual information, and support the abstract representations. To put it differently, "words advance infants from forming primarily perceptually based groupings to gaining a richer appreciation of the important nonobvious commonalities that characterize our most powerful and inclusive categories of objects (Waxman and Markow, 1995:298). The grammar itself may be the trigger for children to gain access to the concepts that are not available by prelinguistic sensory-motor skills. Therefore, early word learning is at the center of understanding the relation between natural language and conceptual development.

3.3. Overextension Phenomena in Neurodegenerative Condition: Semantic Dementia

The main factor that causes the inappropriate level of generalization (*namely* overextension errors) in early childhood, therefore, is basically the inadequacy of lexical knowledge about the object world. This assumption is strongly supported with the analyses from longitudinal studies of child speech that, with the addition of new object label to the lexical knowledge (i.e., with increasing vocabulary), the object is excluded from the overextension domain. In case that there is no access to appropriate lexical item for object-naming, children are tended to extensively use the most frequent and typical names, which are semantically or categorically related to the concept of the unfamiliar object. The deduction hypothesis model (in Figure 3) can partially explain the underlying mechanism of this pattern. If this notion is correct, the model should also predict the similar pattern in different neuropsychological cases such as:

(a) Difficulties for the retrieval of object label that implies no lexical access,
(b) Serious problems in conceptual knowledge as the basis for lexical loss,
(c) Abnormalities in visuoperceptual skills and object recognition as the basis for conceptual breakdown.

In neuroscience and neuropsychology literature, it is possible to find the subjects who have such disorders as in these cases. The current hypothesis which proposes a deductive-

based connection between concept and lexical knowledge, receives impressive support from various studies on neuropyschological disorders (e.g., Semantic Dementia, Deep Dyslexia and Visual Associative Agnosia). What do such disorders, then, tell us about the overextension phenomena in child language development? The behavioral and neurological data on these studies disclose remarkably more on the issue in language process. The current hypothesis implicitly postulates that an appropriate object-naming requires the precise knowledge of concept of object along with the precise lexical knowledge for target object in semantic memory; this is another way of saying that, for whatever reason, the loss in preciseness of knowledge causes inappropriate object-naming. Hence, studies on the problems of cognitive and language-processing mechanisms provide empirical data for understanding the underlying mechanisms in language process, but more importantly the feasibility for testing the validity of any models concerning language development.

Semantic Dementia (SD) is characterized as a type of language disorder on the basis of *profound* and *pervasive* deterioration of semantic knowledge (Schwartz et al., 1979; Hodges et al., 1992; Rogers et al., 2004). "The most prominent neuropsychological feature of this syndrome is a striking loss of vocabulary, both receptive and expressive, affecting particularly nouns" (Hodges et al., 1992:1798). The neuropsychological studies reveal that a breakdown in semantic knowledge disrupts language process, factual knowledge and memory, and object recognition, but there are no abnormalities in terms of phonological and syntactic aspects of language and visuoperceptual and visuospatial skills (Schwartz et al., 1979; Hodges et al., 1992). This breakdown causes word (noun) finding difficulties that the patients are unable to identify the objects by names due to the impoverished knowledge of objects. The results in neuropsychological tests (e.g., drawing, word-to-picture matching, word and picture sorting) for semantic memory of SD patients implicate two types of errors in patients' production: (1) subordinate class error and (2) semantic error.

First type of error indicates that general knowledge is preserved despite the lexical loss. In other words, the applications of the labels are systematically correct but more inclusive than conventional usage. The concepts are assigned to superordinate categories rather than their subordinate categories. For example, patients name the picture of animal *dog* as 'animal' instead of 'dog' (Warrington, 1975; Hodges et al., 1995). This pattern has been observed in an 18-month longitudinal study of object naming in SD in which the pattern of naming, for instance, the *duck* exhibited a progressive deterioration in assigning specific names to the referents (e.g., the names assigned to the animal in each period of 18-month study, respectively 'duck', 'swan', 'bird' and 'animal' (Hodges et al., 1995; for review Bozeat et al., 2003). Second type refers to the systematic overextension errors in which more familiar or frequent names are often inappropriately produced for semantically related objects (e.g., dog for cat, sheep or horse; Hodges et al., 1995). According to the multiple-choice task of word-to-picture matching in the experiment (Schwartz et al., 1979:283), 46 out of 51 errors on the 140 trials are with respect to

matching pictures to the words in the category of semantic distractors (e.g., 'spoon' to *fork*, 'comb' to *brush* and 'dog' to *cat*).

It is significant to note that the deterioration in semantic knowledge appears to be from specific differentiating features of the objects to more general or central ones, which give the impression of "regression to an early stage of semantic knowledge, in which an incomplete set of attributes is used criterially in naming" (Schwartz et al., 1979:279). With respect to the observation of such non-random errors in SD condition, it might be suggested that the progressive loss of distinguishing semantic features serves as the basis for lexical loss (Schwartz et al., 1979; Rogers and McClelland; 2004). Similarly, for both children at early stage of language acquisition and patients with SD, it has been observed that typical perceptual properties are overextended to related objects but inappropriately. In both cases, subjects lack the lexical knowledge for labeling the object with the appropriate name. In the current hypothesis, the typical properties are suggested to be considered as the placeholder for the concept of unfamiliar objects. Since the prototypical concepts appear to be more general and inclusive, the object for which the child has no lexical item to assign becomes the member of overextension domain of the prototypical concept in case of the shared-similarity. It is plausible to interpret the errors of SD patients in terms of this notion, but first it should be noted that the general knowledge about objects is sufficiently preserved and the visual perception skills are reasonably intact. Therefore, we may suppose that their naming performances exhibit overextension pattern on the basis of intact conceptual knowledge that can also be considered as prototypical concepts, as in child case. In this respect, the patients are required to rely on the intact concepts (viz. prototypical concepts) in order to label the objects. This interpretation is also consistent with the observations from various studies. Schwartz and the colleagues (1979:286) demonstrated that the word 'cat' seems to have disappeared from her vocabulary; hence the word 'dog' is overextended to the picture of *cat.* Another study correspondingly suggests that "naming performance of patients with semantic dementia is strongly influenced by concept familiarity and word frequency" (Roger and McClelland, 2004:218). Consequently, it seems acceptable to interpret, to some extent, the language errors in neurodegenerative cases within the scope of deductive object-naming hypothesis model.

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CHAPTER 4

DISCUSSION AND CONCLUSION

This study has intended to investigate the status of deductive reasoning in the application of words at the beginning of language acquisition. This is no doubt a challenging attempt for empirically based assessments, because the target subjects have no language competence. Yet, the behavioral studies on pre-linguistic children are remarkably informative about their interaction with the environment.

Let's remember the research questions and sum up the assessments:

1. Is there any minimally consistent/sufficient information on objects in order for names to be learned? What are the central properties of the physical objects that infants attend to?

With regard to the early word learning, the information accessible within the referents of words has a significant role in representations of the words such as objects' (1) appearances, (2) functions, (3) action properties, and (4) organization with event in time and space. Among all these possibilities, the perceptual similarity (especially, shape) becomes the most reliable cue for conceptualizing the words and especially extending the concrete nouns to novel objects. In a strict sense, the shape may be taken as a central property of the physical entities for early categorization. For abstracting away the complexity in the issue of shape (e.g., Marr, 1982), the nature of the shape bias is not discussed. Yet, it seems to be minimally sufficient for such purpose, because infants' perceptual and cognitive abilities restrict them to go beyond observable information. Word learning process in congenital blindness was out of the picture. I will refrain to make such a claim that the world without sight and/or sound will be more complicated for infants to acquire the language, though it might be challenging. Vision is, of course, not a prerequisite for language. Blind/deaf children may follow a different path of language development due to their different way of perceiving the world. This can be an exciting topic for further studies. Therefore, before searching for any possible constraints or whatsoever in child's early word learning, it is first necessary to focus more precisely on nature of perceptual experience and then infant's theory of object world.

2. To what extent is the object perception required for lexical knowledge? What is stored in memory when infants learn a novel name? On what basis do infants decide how to extend the label to other objects?

How children begin word learning is directly related to how they perceive the objects at beginning of their development. As a result, learning is more likely elementary and information sensitive. Perceptual knowledge in pre-linguistic infancy facilitates the word learning in a referential way. Understanding of their perceptual knowledge before word learning process may explicate how children deal with the complexity in inferring the right conclusions. According to their perceptual and memory capacities, children cannot be able to process and store all information at the beginning and this developing capacity of children may turn into an advantage to decrease the large amount of possible hypotheses that the child has to consider (see also; Newport, 1990). Children are neither scientist nor logician. Their early representations are more likely inclusive: they may overlap with, but do not completely correspond to adults' representations. These representations and overextended usages may be distilled through development and experience and conformed to conventional adult usage. And vocabulary spurt occurs probably at the time that they drop the non-linguistic deductive strategy of word learning. However, the early vocabulary also involves proper nouns, action names, verbs and adjectives. Since the focus of the study is on the object names, deduction hypothesis is argued only in this context.

3. When does overextension strategy disappear? Why does vocabulary spurt occur at the same time as the end of the early form of overextension?

In fact, it has not been empirically justified that the infants do really face the fundamental problem of induction within the numerous hypotheses arisen, in principle, from referential uncertainty and also not explained how children arrive at a number of hypotheses space of possible concepts. 'Overextension' and 'fast-mapping' appears to be a crucial paradox in case that inferring the referent of an unfamiliar word is complicated. Therefore, the deductive strategy may appear to be involved in infants' labeling the objects. The notion of hypothesis elimination (Markman, 1990), as one of the deductive approaches, that children have to figure out one possible hypothesis by ruling out incorrect ones from unlimited number of hypotheses about each word given the complexity involved in inferring the referent of an unknown word, does not provide an adequate framework for explaining how children generate the hypothesis space and learn the meanings of words, but only works in the testing of hypotheses. This notion makes a case for *a priori* knowledge in order for infants to use the principles. However, the deductive hypothesis suggested in this study requires nothing *a priori*, because the infants are considered to be in a status of *tabula rasa*. This view, of course, does not neglect the abilities coming from genetic information. Induction is prediction oriented. It goes beyond the accessible information i.e., what it is actual and observable. It is impossible to verify these predictions. On the contrary, children extend the accessible information in appropriate cases and if required, falsify their hypotheses under the condition that conflicting information is existent. It appears to be the fact that children go beyond the available data, but it is an open question whether it is the fact or just a myth. A strong empirical confirmation for this assertion has not been provided yet.

Suppose the foreigner somehow managed to grasp the correct meaning of *Gavagai* and it means a rabbit i.e. a small animal with long ears and large front teeth that moves by jumping on its long back legs. Next day, he hears the same word, but there is rabbit B, not rabbit A that was in the garden yesterday. Probably, he doesn't hesitate before thinking that it is rabbit A or rabbit B, because once he learned that Gavagai means a rabbit. But logically speaking, rabbit A is not rabbit B. They are not identical. What is rabbit, then? Any attempt to define the rabbithood will of course fail to satisfy, and we can only describe it one way or the other. This question of 'what' might help to demonstrate the problem of universality in terms of infants' word learning. How infants can conceptualize the things correctly or wrongly, given that they could only see a finite number of actual ones is another problem that I have suspended the judgment here. How to represent this process and what is in the head is a big issue. Consequently, the deduction hypothesis address to only some behavioral patterns in infancy, but some core problems still remain unanswered and demand for a clear formulation. It is obvious that more definite and empirically validated theories will straighten out the knowledge about learning.

Further research should concern collecting behavioral and neuroimaging (e.g., fMRI, eye-tracking, reaction times) data in line with linguistic study (e.g., cross-linguistic analysis of corpus data) in order to find any possible relationship or correlation with visual perception, semantic memory and language acquisition in early infancy.

REFERENCES

Anglin, J. M. (1993). Vocabulary development: A morphological analysis. *Monographs of the Society for Research in Child Development*, Serial No. 238, 58. 1-165.

Baker, C. L., and McCarthy, J. J. (1981). *The Logical Problem of Language Acquisition.* Cambridge, MA: MIT Press.

Baldwin, D. A. (1993a). Early referential understanding: Infants' ability to recognize referential acts for what they are. *Development Psychology, 29*, 832–843.

Baldwin, D. A. (1993b). Infants' ability to consult the speaker for cues to word meaning. *Journal of Child Language, 20*, 395–418.

Bates, E., and MacWhinney, B. (1989). Functionalism and the competition model. In B. MacWhinney, and E. Bates (Eds.), *The Crosslinguistic Study Of Sentence Processing* (pp. 3-76). New York: Cambridge University Press.

Bloom, P. (2004). *Descartes' Baby: How the Science of Child Development Explains What Makes Us Human*. New York: Basic Books.

Bloom, P. (2000). *How Children Learn the Meanings of Words*. Cambridge, MA: MIT Press.

Bloom, L. (1973). *One Word at a Time*. The Hague: Mouton.

Bozeat, S., Lambon Ralph, M. A., Graham, K. S., Patterson, K., Wilkin, H., Rowland, J., Rogers T.T. and Hodges J.R. (2003). A duck with four legs: Investigating the structure of conceptual knowledge using picture drawing in semantic dementia. *Cognitive Neuropsychology, 20*, 27– 47.

Bozsahin, Cem (2012). *Combinatory Linguistics*. Berlin/Boston: Mouton de Gruyter.

Carey, S. (1982). Semantic development: The state of the art. In E. Wanner and L. R. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 347-389). Cambridge, UK: Cambridge University Press.

Carey, S. (1978). The child as word learner. In M. Halle, J. Bresnan, and G. A. Miller (Eds.), *Linguistic theory and psychological reality* (pp. 264-293). Cambridge, MA: The MIT Press.

Carey, S., and Bartlett, E. (1978). Acquiring a single new word. *Proceedings of the Stanford Child Language Conference, 15*, 17–29.

Carpenter, M., and Tomasello, M. (2000). Joint attention, cultural learning, and language acquisition: Implications for children with autism. In A. M. Wetherby and B. M. Prizant (Eds.), *Communication and language issues in autism and pervasive developmental disorder: A transactional developmental perspective* (pp. 31–54). Baltimore: Brookes.

Carpenter, K. (1991). Later rather than sooner: extralinguistic categories in the acquisition of Thai classifiers. *Journal of Child Language, 18*, 93-113.

Chambers, K, Kristine H. O., and Cynthia F. (2003). Infants learn phonotactic regularities from brief auditory experience. *Cognition 87*, 69–77.

Chomsky, N., *Knowledge of Language*, Praeger, 1986.

Clark, E. V. and Svaib, T. A. (1997). Speaker perspective and reference in young children. *First Language, 17*, 57-74.

Clark, E. V. (2009). *First Language Acquisition*. Cambridge: Cambridge University Press.

Clark, E. V. (1993). *The Lexicon in Acquisition*. Cambridge: Cambridge University Press.

Clark, E. V. (1973) What's in a word? On the child's acquisition of semantics in his first language. In T. E. Moore (Ed.), *Cognitive Development and The Acquisition of Language* (pp. 65-110). New York: Academic Press.

Colunga, E. and Smith, L. B. (2005). From the lexicon to expectations about kinds: A role for associative learning. *Psychological Review, 112 (2)*, 347-382.

Crain, S. and Pietroski, P. 2001. Nature, nurture and universal grammar. *Linguistics and Philosophy, 24*, 139-185.

Fisher, C. 1996. Structural limits on verb mapping: The role of analogy in children's interpretation of sentences. *Cognitive Psychology, 31*, 41–81.

Fisher, C., and Tokura, H. (1996). Prosody in speech to infants: Direct and indirect cues to syntactic structure. In J. Morgan and C. Demuth (Eds.), *Signal to Syntax* (pp. 343-364). Mahwah, NJ: Erlbaum.

Fleischman, M., and Roy, D. (2005). Intentional Context in Situated Language Learning. *Proceedings of the 9th Conference on Computational Natural Language Learning*, (CoNLL-2005), 104–111.

Frank, M. C., Goodman, N. D., Tenenbaum, J. B. (2008). A Bayesian framework for cross-situational word-learning. *Advances in Neural Information Processing Systems 20*. Cambridge, MA: MIT Press. 457-464.

Ganger, J. and Brent, M. (2004). Re-examining the vocabulary spurt. *Developmental Psychology, 4*, 621-632.

Gathercole, V. M., and Hoff, E. (2007). Input and the acquisition of languages: Three questions. In E. Hoff and M. Shatz (Eds.), *Handbook of Language Development* (pp. 107-127). Oxford, UK: Blackwell.

Gelman, S. A., and Coley, J. D. (1990). The importance of knowing a dodo is a bird: categories and inferences in 2-year-old children. *Developmental Psychology, 26*, 796-804.

Gelman, S. A., and Markman, E. (1986). Categories and induction in young children. *Cognition, 23*, 183-209.

Gentner, D., and Namy L. L. (2006). Analogical processes in language learning. *Current Directions in Psychological Science, 15*, 297-301.

Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In S. Kuczaj (Ed.), *Language Development: Language, Thought and Culture* (pp. 38-62). Hills-dale, NJ: Erlbaum.

Gerken, L. (2007). Acquiring linguistic structure. In E. Hoff and M. Shatx (Eds). *Blackwell Handbook of Language Development* (173-190). 2007. Blackwell Publishing.

Gerken, L. A., Jusczyk, P. W. and Mandel, D. R. (1994). When prosody fails to cue syntactic structure: Nine-month-olds' sensitivity to phonological versus syntactic phrases. *Cognition, 51*, 237-265.

Gillette, J., Gleitman, H., Gleitman, L., and Lederer, A. (1999). Human simulations of vocabulary learning. *Cognition, 73*, 135-176.

Gleitman, L. R. and Fisher, C. (2005). Universal aspects of word learning. In J. McGilvray (Ed.), *The Cambridge Companion to Chomsky* (pp. 123-142). Cambridge: Cambridge University Press.

Gleitman, L. R., and Newport, E. L. (1995). The invention of language by children: Environmental and biological influences on the acquisition of language. In L. R. Gleitman and M. Liberman (Eds.), *An Invitation to Cognitive Science: Vol. 2. Language* (2nd ed., pp. 1–24). Cambridge, MA: MIT Press.

Gleitman, L. and Gleitman, H. (1992). A picture is worth a thousand words, but that's the problem: The role of syntax in vocabulary acquisition. *Current Directions in Psychological Science, 1*, 31-35.

Gleitman, L. R., Gleitman, H., Landau, B., and Wanner, E. (1988). Where learning begins: Initial representations for language learning. In F. J. Newmeyer (Ed.), Linguistics: The Cambridge survey, Vol. 3. *Language: Psychological and Biological Aspects* (pp. 150-193). New York: Cambridge University Press.

Gleitman, L. (1990). Structural sources of verb learning. *Language Acquisition, 1*, 1–63.

Goldfield, B. A. (2000). Nouns before verbs in comprehension vs. production: the view from pragmatics. *Journal of Child Language, 27*, 501-520.

Goldfield, B. A., and Reznick, J. S. (1990). Early lexical acquisition: Rate, content, and the spurt. *Journal of Child Language, 17*, 171–183.

Golinkoff, R. M., Mervis, C. V., and Hirsh-Pasek, K. (1994). Early object labels: The case for a developmental lexical principles framework. *Journal of Child Language, 21*, 125-155.

Goodman J. C., McDonough L., Brown N. B. (1998). The role of semantic context and memory in the acquisition of novel nouns. *Child Development, 69*. 1330–1344.

Gottfried, G. M. (1997). Comprehending compounds: evidence for metaphoric skill? *Journal of Child Language, 24*, 163-186.

Halberda, J. (2006). Is this a dax which I see before me? Use of the logical argument disjunctive syllogism supports word-learning in children and adults. *Cognitive Psychology, 53 (4)*, 310-344.

Heibeck, T. H., and Markman, E. M. (1987). Word learning in children: An examination of fast mapping. *Child Development, 58*, 1021–1034.

Hirsh-Pasek, K., and Golinkoff, R. M. (1996). *The Origins of Grammar: Evidence From Early Language Comprehension*. Cambridge, MA: MIT Press.

Hirsh-Pasek, K., Kemler-Nelson, D. G., Jusczyk, P. W., Cassidy, K. W., Druss, B., and Kennedy, L. (1987). Clauses are perceptual units for young infants. *Cognition, 26*, 269–286.

Hodges, J. R., Graham, N., and Patterson, K. (1995). Charting the progression in semantic dementia: Implications for the organization of semantic memory. *Memory, 3*, 463–495.

Hodges, J. R., Patterson, K., Oxbury, S., and Funnell, E. (1992). Semantic dementia: Progressive fluent aphasia with temporal lobe atrophy. *Brain, 115,* 1783–1806.

Hoff, E. and Naigles, L. (2002). How children use input to acquire a lexicon? *Child Development, 73, (2),* 418-433**.**

Huttenlocher, J., and Smiley, P. (1987). Early word meanings: the case of object names. *Cognitive Psychology 19,* 63-89.

Landau, B., Smith, L. B., and Jones, S. S. (1988). The importance of shape in early lexical meaning. *Cognitive Development, 3,* 299-321.

Landau, B., and Gleitman, L. R. (1985). *Language and Experience: Evidence from the Blind Child*. Cambridge, MA: Harvard University Press.

Levy, R., and Jaeger, T. F. (2007): Speakers optimize information density through syntactic reduction. In B. Schölkopf, J. Platt, T. Hofmann (Eds): *Advances in neural information processing systems, 19* (pp. 849-856). Cambridge, MA: MIT Press.

Liittschwager, J. C., and Markman, E. M. (1994). Sixteen and 24-month-olds use of mutual exclusivity as a default assumption in second label learning. *Developmental Psychology, 30,* 955–968.

Marcus, G., Ullman, M., Pinker, S., Hollander, M., Rosen, T. J., and Xu, F. (1992). Overregularization in language acquisition. *Monographs of the Society for Research in Child Development, 57*.

Markman, E. M., Wasow, J. L., and Hansen, M. B. (2003). Use of the mutual exclusivity assump-tion by young word learners. *Cognitive Psychology, 47,* 241–275.

Markman, E. M. (1992). Constraints on word learning: Speculations about their nature, origins and domain specificity. In M. R. Gunnar, and M. P. Maratsos (Eds.), *Modularity and constraints in language and cognition: The Minnesota symposium on child psychology* (pp. 59–101). Hillsdale, NJ: Erlbaum.

Markman, E. M. (1990). Constraints children place on word learning. *Cognitive Science, 14,* 154-173.

Markman, E. M. and Wachtel, G. A. (1988). Children's use of mutual exclusivity to constrain the meanings of words. *Cognitive Psychology, 20,* 120-157.

Markman, E. M., and Hutchinson, J. E. (1984). Children's sensitivity to constraints on word meaning: Taxonomic vs. thematic relations. *Cognitive Psychology, 16,* 1-27.

Markson, L., and Bloom, P. (1997). Evidence against a dedicated system for word learning in children. *Nature, 385 (6619),* 813-815.

Markson, L., Diesendruck, G., and Bloom, P. (2008). The shape of thought. *Developmental Science, 11,* 204-208.

Marr, D. (1982). *Vision: A Computational Investigation into the Human Representation and Processing of Visual Information*. San Francisco: Freeman.

Mintz, T. H. (2002). Category induction from distributional cues in an artificial language. *Memory and Cognition, 30,* 678-686.

Naigles, L. R. and Swensen, L.D. (2007) Syntactic supports for word learning. In E. Hoff and M. Shatz (Eds.) *The Handbook of Language Development* (pp. 212-231). New York: Blackwell.

Naigles, Letitia. (1990). Children use syntax to learn verb meanings. *Journal of Child Language, 17*, 357-374.

Nazzi, T., and Bertoncini, J. (2003). Before and after the vocabulary spurt: Two modes of word acquisition? *Developmental Science, 6*, 136–142.

Nelson, K. (1974). Concept, word and sentence: Interrelations in acquisition and development. *Psychological Review, 81(4)*, 267-285.

Newport, E. L. (1990). Maturational constraints on language learning. *Cognitive Science, 14*, 11-28.

Noe, A. (2004). *Action in Perception*. Cambridge, MA. The MIT Press.

Pinker, S. (1984). *Language Learnability and Language Development*. Cambridge: Harvard University Press.

Pinker, S. (1989). *Learnability and Cognition: The Acquisition of Argument Structure.* Cambridge: The MIT Press.

Quine, W. V. O. (1960). *Word and Object*. Cambridge, MA: MIT Press.

Quine, W. V. O. (1969). *Ontological Relativity and Other Essays.* Columbia University Press.

Rescorla, L. A. (1980). Overextension in early language development. *Journal of Child Language, 7*, 321-335.

Rescorla, L. A. (1981). Category development in early language. *Journal of Child Language, 8*, 225-238.

Reznick, J. S., and Goldfield, B. A. (1992). Rapid change in lexical development in comprehension and production. *Developmental Psychology, 28*, 406–413.

Rogers, T. T., Lambon Ralph, M. A., Garrard, P., Bozeat, S., McClelland, J. L., Hodges, J. R., and Patterson, K. (2004). Structure and deterioration of semantic memory: A neuropsychological and computational investigation. *Psychological Review, 111*, 205–235.

Rogers, T. T. and McClelland, J. L. (2004). *Semantic Cognition: A Parallel Distributed Processing Approach*. Cambridge, MA: MIT Press.

Rosch, E. H., Mervis, C. B., Gray, W.D., Johnson, D.M., and Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology, 8 (3),* 382–439.

Saffran, J. R. (2003). Statistical language learning: Mechanisms and constraints. *Current Directions in Psychological Science, 12*, 110-114.

Schwartz, M. F., Marin, O. S., and Saffran, E. M. (1979). Dissociations of language function in dementia: A case study. *Brain and Language, 7*, 277–306.

Seidl, A. (2007). Infants' use and weighting of prosodic cues in clause segmentation. *Journal of Memory and Language, 57*, 24-48.

Siskind, J. M. (1995). Grounding Language in Perception, *Artificial Intelligence Review, 8*, 371-91.

Siskind, J. M. (1996). A computational study of cross-situational techniques for learning word-to-meaning mappings. *Cognition 61(1),* 39-91.

Siskind, J. M. (1997). Visual Event Perception. In K. Ikeuchi and M. Veloso (Eds.). *Symbolic Visual Learning* (pp. 225-263). Oxford University Press.

Smith, L. B. (2000). Learning how to learn words: An associative crane. In R. M., Golinkoff and K. Hirsh-Pasek (Eds.). *Becoming a Word Learner* (pp. 51-80). New York: Oxford University Press.

Smith, L. B. and Yu, C. (2007) Infants rapidly learn word-referent mappings via cross-situational statistics. In D. S. McNamara and J. G. Trafton (Eds.) *Proceedings of the 29th Annual Conference of the Cognitive Science Society* (pp. 653-658). Austin, TX: Cognitive Science Society.

Snedeker, J. and Gleitman, L. (2004). Why it is hard to label our concepts. In G. Hall and S. Waxman. (Eds), *Weaving a Lexicon* (pp. 257-294). Cambridge, MA: MIT Press.

Soja, N., Carey, S., and Spelke, E. S. (1991). Ontological categories guide young children's inductions of word meaning: Object terms and substance terms. *Cognition, 38*, 179-211.

Soja, N., Carey, S., and Spelke, E. S. (1992). Perception, ontology, and word meaning. *Cognition, 45*, 101-107.

Steedman, M., and Hockenmaier J. (2007). The Computational Problem of Natural Language Acquisition. Ms., University of Edinburgh.

Steedman, M. (2000). *The syntactic process*. Cambridge, MA: MIT Press.

Steedman, M. (1996). Computational Aspects of the Theory of Grammar. In Gleitman, L., and Liberman, M. (Ed.), *An Intivation to Cognitive Science, Vol.1: Language* (pp. 247-282). Cambridge, MA: MIT Press.

Tenenbaum, J. B. and Xu, F. (2007). Word learning as Bayesian inference. *Psychological Review, 114 (2)*, 245–272.

Tenenbaum, J. B., Griffiths, T. L., and Kemp, C. (2006). Theory-based Bayesian models of inductive learning and reasoning. *Trends in Cognitive Science, 10*, 309-318.

Thiessen, E. D., Hill, E., and Saffran, J. R. (2005). Infant-directed speech facilitates word segmentation. *Infancy, 7*, 53-71.

Thomson, J. R. and Chapman, R. S. (1977). Who is 'Daddy' revisited: the status of two-year-olds' over-extended words in use and comprehension. *Journal of Child Language, 4*. 359-375.

Tomasello, M., and Kruger, A. (1992). Joint attention on actions: Acquiring verbs in ostensive and non-ostensive contexts. *Journal of Child Language, 19*, 311-334.

Tomasello, M., Strosberg, R., and Akhtar, N. (1996). Eighteen-month-old children learn words in non-ostensive contexts. *Journal of Child Language, 22*, 1-20.

Trueswell, J. C., and Gleitman, L. R. (2007). Learning to parse and its implications for language acquisition. In G. Gaskell (Ed.) *Oxford Handbook of Psycholing*. Oxford: Oxford Univ. Press.

van der Zee, E., Zulch, H., Mills, D. (2012). Word Generalization by a Dog (*Canis familiaris*): Is Shape Important? *PLoS ONE 7(11)*, 1-6.

Warrington, E. K. (1975). The selective impairment of semantic memory. *Quarterly Journal of Experimental Psychology, 27*, 635– 657.

Waxman, S. R. and Markow, D. B. (1995). Words as invitations to form categories: evidence from 12- to 13-month-old infants. *Cognitive Psychology 29, 257-302.*

Werker, J. F., Cohen, L. B., Lloyd, V., Stager, C. L., and Cassasola, M. (1998). Acquisition of word-object associations by 14-month-old infants. *Developmental Psychology, 34 (6),* 1289-1309.

Wittgenstein, L. (1953). *Philosophical Investigations* (G. E. M. Anscombe.trans.). New York: Macmillian.

Wittgenstein, L. (1953). *Philosophical Grammar* (A. Kenny. trans.). Oxford: Basil Blackwell.

Woodward, A. L., Markman, E. M., and Fitzsimmons, C. M. (1994). Rapid word learning in 13-18-month-olds. *Developmental Psychology, 30,* 553-566.

Yoshida, H. and Smith, L. B. (2001). Early noun lexicons in English and Japanese. *Cognition, 82,* B63-B74.

Yu, C. and Smith, L. B. (2007). Rapid word learning under uncertainty via cross-situational statistics. *Psychological Science, 18 (5),* 414-420.

Yu, C. (2005). The emergence of links between lexical acquisition and object categorization: A computational study. *Connection Science, 17 (3–4),* 381–397.

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YAZARIN

Soyadı : .....

Adı : .....

Bölümü : .....

TEZİN ADI

(İngilizce) : .....

.....

TEZİN TÜRÜ : Yüksek Lisans ☐ Doktora ☐

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. ☐

2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullanıcılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

Yazarın imzası ..... Tarih .....