In Search of Lexical Whorf:

A Comparison Between the Lexical Influence on Thought in

the Standard View of Whorf and Whorf's own Writings in the

Light of Empirical Evidence

Ritgerð til M.A.-prófs

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Summary

The name *Whorf* has become synonymous with Linguistic Relativism and strong linguistic determinism. Today, the views of Benjamin Lee Whorf are generally known in the form of the Sapir-Whorf hypothesis (SWH) and selected passages from his writings. This standard way of presenting Whorf fails to distinguish adequtely between lexical and grammatical influences on thought in his writings and his views are therefore considered to be extreme. This leads to a false standard image of the lexical aspect of Whorf's theories, a false lexical Whorf. In chapter 1 the theoretical roots of Whorf's views are explored, as well as the standardization of those views. Early empirical evidence in support of the SWH which led to wide acceptance of Whorf will then be reviewed. Chapters 2 and 3 describe the rejection of linguistic relativism and linguistic determinism which marginalized Whorf. Chapters 4,5 and 6 reveal the rebirth of Whorf's theories in the form of Neo-Whorfianism and a host of studies that followed which investigated the relationship between terminologies of number, spatial orientation and colour and cognition. Chapter 7 then offers an interpretation of the results of those studies which showed considerable support for a weak influence on thought. Chapter 8 reveals the differences between grammatical and lexical influences in Whorf's view where the former are strong and the latter are weak. The real lexical Whorf is then a weak kind of linguistic determinism and is therefore in considerable agreement with the empirical evidence reviewed in chapters 4-6. In chapter 9 the growing interest in Whorf's actual writings is described and three areas of future research explored.

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Introduction

The name *Whorf* has become synonumous with linguistic relativism and linguistic determinism, especially the strong or radical versions. Benjamin Lee Whorf (1897-1941) was an American fire-insurance investigator who studied linguistics under the guidance of Edward Sapir. In the 1930s he wrote a series of articles which were published in linguistic journals and he became of one the most influential linguists of his time. The central theme of Whorf's work was the linguistic influence on worldviews. His Principle of Relativity states: [A]ll observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar, or can in some way be calibrated" (Whorf 214). However, Whorf's theories are generally known in the form of the Sapir-Whorf hypothesis (SWH), which was formulated by Brown from the writings of Whorf as well as from the writings of Edward Sapir, Whorf's teacher. The SWH is a very radical hypothesis which includes Linguistic Relativism and strong Linguistic Determinism. Whorf has therefore become synonymous with a very radical relativism and it is standard practice to speak of 'Whorfian effects' when refering to strong linguistic influence on thought. Even simply the name 'Whorf' is used when refering to strong linguistic influence on thought as in 'Crying Whorf' and 'Lateralized Whorf'.

However, this standard radical version of Whorf fails in important ways to represent his theories fairly. Ironically it is also generally recognized that Whorf made more moderate or weaker claims about the linguistic influence on thinking but this apparent disrepancy is brushed aside as ambiguity or vagueness. This ambiguity at least partially disappeares if there is a distinction made between lexical and grammatical influences on thought. In Whorf's theories it is the grammar which has a firm and yet subtle hold on thinking while the lexicon has a much weaker and more overt influence. The SWH is too general to make such this distinction and therefore it is often wrongfully assumed that language strongly influences thinking at the lexical level in Whorf's view. By examining Whorf's writings and comparing them with the standard presentation of his views it becomes evident that lexical Whorf is indeed relatively weak and is, in fact, considerably in agreement with much of the empirical research which has been done on the relationship between language and thought for the last 60 years or so.

1.0 Whorf and Linguistic Relativism

1.1 Standard Whorf

The theories of Benjamin Lee Whorf on the relationship between language and thinking are some of the most provocative and controversial theories which have emerged from the field of linguistics. They are a part of a debate which goes back at least three centuries, although the relationship between language and thought has baffled the brightest of minds for a much longer time. Theories on the subject can be divided broadly into two schools of thought: the garment school and the groove school (Black, *Labyrinth* 65) . According to the garment school of thought, thought is independent of and primary to language, which is seen as but a garment for thought when the communication or expression of thought is called for. This school of thought can be ultimately traced back to Aristotle (Schlesinger 8) and was the dominant view during the Enlightenment. According to the groove school, on the other hand, language plays an important role in thinking and cognition by creating grooves, in a manner of speaking, in the mind. Thinking, in other words, is here, at least to some extent, dependent on language, and thinking thus becomes secondary to language in important ways. Whorf belongs to the latter school of thought.

Textbooks on linguistics, psycholinguistics, psychology sociolinguistics and anthropology tend to present a standard way of introducing Whorf and his views. This standard way includes discussions of Whorf's early work as a fire-insurance investigator, his famous passage where he describes how nature is analyzed by language, and his examples of this analysis from grammar (Hopi *time*) and the vocabulary (Eskimo *snow*). The initial description of Whorf's views in this essay will follow the standard format because a more faithful picture of Whorf's views will be drawn later and compared to this standard way.

Whorf was a chemical engineer and fire-insurance investigator by profession before he began to study linguistics. In his work as a fire-insurence investigator he noticed how non-linguistic behavior could be influenced by language. In one instance someone smoking a cigarette threw a lit match into an "empty gasoline drum" which caught fire. The drum of course was not really "empty" but full of gasoline vapor (Whorf 135). Whorf argued that this was an example of people mistaking the name or verbal description of a situation for its reality. In his most famous and oft-quoted passage he elaborates on the power of languages to create pictures of reality or world views:

We dissect nature along lines laid down by our native languages. The categories and types that we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary, the world is presented in a kaleidoscopic flux of impressions which has to be organised by our minds – and this means largely by the linguistic system in our minds. We cut nature up, organize it into concepts, and ascribe significances as we do, largely because we are parties to an agreement to organise it in this way – an agreement that holds throughout our speech community and is codified in the patterns of our language (Whorf 213).

According to Whorf then, our understanding of the world, our world-view or "analysis of reality", is not arrived at by observation of things. It is rather through language that we make sense of the world, "organize it into concepts", and build up a picture of reality. According to Whorf thinking is, furthermore, in the firm grip of language:

That agreement is, of course, an implicit and unstated one, BUT ITS TERMS ARE ABSOLUTELY OBLIGATORY; we cannot talk at all except by subscribing to the organization and classification of data which the agreement decrees (Whorf 213-214; small caps original).

Whorf provides both lexical and grammatical examples in order to explain how language analyzes nature. He describes how languages differ in how they "break down nature" and thus provide the "units of the lexicon" (240). As an example Whorf points to the noun class *snow* in English:

We have the same word for falling snow, snow on the ground, snow packed hard like ice, slushy snow, wind-driven flying snow – whatever the situation may be. To an Eskimo, this all-inclusive word would be almost unthinkable; he would say that falling snow, slushy snow, and so on, are sensiously and operationally different, different things to contend with; he uses different words for them and for other kinds of snow (240).

Whorf also describes differences in grammar by showing how Hopi and English differ in their grammars. Whorf's most famous grammatical example is how Hopi grammar treats time. After a "long and careful study and analysis" Whorf came to the conclusion that the Hopi language has "no words, grammatical forms, construction or expressions that refer directly to what we call "time" (57). He "assumed" that

a Hopi who knows only the Hopi language and the cultural ideas of his own society … has no general notion or intuition of time as a smooth flowing continuum in which everything in the universe proceeds at an equal rate, out of a future, through a present, into a past; or in which, to reverse the picture, the observer is being carried in the stream of duration continuously away from a past and into a future (57).

Instead, Whorf maintains, the Hopi refer to time in terms of subjectivity (objective and subjective) and manifestation (manifested and manifesting):

The objective or manifested comprises all that is or has been accessible to the senses, the historical physical universe, in fact, with no attempt to distinguish between present and past, but excluding everything that we call future. The subjective or manifesting comprises all that we call future, BUT NO MERELY THIS; it includes equally and indistinguishably all that we call mental – everything that appears or exists in the mind (59).

1.2 Theoretical Roots

1.2.1 The German Romantics

The theoretical roots of Whorf's views can be directly traced, through Sapir, back to the 18th century, to the German Romantics Herder, Hamann and Humboldt. Previously, the philosophers of the Enlightenment generally held that language and thought were two distinct activities, with thought, or reason, being prior to language, where language was the garment for the expression of thought. Locke, for example, stressed the communicative function of language, when he described language as "being the great conduit, whereby men convey their discoveries, reasonings, and knowledge, from one to another" (quoted in R.L. Brown 55). It was with the advent of Romanticism, particularly in Germany, as a reaction to the ideas of the Enlightenment, that the notion of linguistic influence on thought gains ground. However, even before the rise of the Romantic movement, as far back as 1697, Leibnitz had already argued for a closer relation between language and thought. He saw language not only as a means of communication but also as an aid to thought:

It is also the case in the matter of the use of language, to consider this matter particularly as well, that words are not only the signs of thoughts, but of things as well, and that we necessarily have signs, not only in order to convey our opinions to others, but also to help our own thoughts. (Brown 58)

According to Leibniz language aided thought by helping us to hold fast to abstract ideas: "it permits a man to consider what is not present; when a man is engaged in thought" (quoted in R.L. Brown 58). This was, however, as far as Leibiz was willing to go. He held the view that thought was separate from language as well as prior and superior to it, a view carried on by later philosophers of the Enlightenment. However, with the advent of German Romanticism there emerges a view radically opposing the traditional view.

1.2.1.1 Hamann

Johann Georg Hamann (1730-1788), the German poet-philosopher and the father of German Classicism and Romanticism, reversed this position. Influenced by both the English poet and critic, Young, who wrote that "language is the organon and criterion of reason", and Pietistic mysticism, he wrote that "with me language is the mother of reason and revelation, its Alpha and Omega" (quoted in R.L. Brown 58). Hamann not only maintained that language had "geneaological priority ... over the seven sacred functions of logical propositions and conclusions", but also that "the entire capacity to think rests on language" (quoted in R.L. Brown 61). He further argued that "the lineaments [of a people's] language will also correspond to the direction of their sort of thinking" (quoted in R.L. Brown 61). The same notion is clearly in his mind when he states: "our concepts of things are mutable by means of a new language" (quoted in R.L. Brown 62). According to Penn (51) Hamann was thus first to introduce a strong version of linguistic relativism and linguistic determinism because he argues that thinking is strongly dependent on language and that thinking is different for speakers of different or "new" languages.

1.2.1.2 Herder

Johann Gottfried Herder (1744-1803), the German philosopher, was greatly influenced by Hamann early in his career and strongly echoed the latter in his writings. Herder stressed the priority and necessity of language: "Human language carries its *thought forms* in itself; we think especially when we think abstractly, only in and with language"

(quoted in R.L. Brown 62; italics original). According to him thought was impossible without language:

> The human spirit thinks with *words*; it does not only utter its thoughts by means of *language*, but also in the same way symbolizes them to itself and arranges them...By means of language we learned to think, through it we separate ideas and tie them together, often many at a time (quoted in R.L. Brown 63-64).

Language is then, according to Herder, the medium of thought; thought is internalized language: "What is *thinking* called? *Inward language*, i.e. the signs that have been interiorized express themselves, talking is called thinking aloud" (quoted in R.L. Brown 64). Like Hamann, Herder also takes a relativist position by arguing that by studying and comparing different languages we can study different mentalities:

> The finest attempts at the history and varied characteristics of human understanding and feeling would also be a philosophical comparison of languages, since on these themselves is the understanding and character of a people imprinted (quoted in R.L. Brown 63).

1.2.1.3 Humboldt

It is, however, with Wilhelm von Humboldt (1767-1835), the German philosopher, that the anti-Enlightenment tradition is combined with comparative study of actual languages. In his earlier writings Humboldt argues that language and thought emerge simultaneously: "Language began therefore immediately and at once with the first act of reflection" (quoted in R.L. Brown 66), but he is careful to define them as distinct activities to some extent. However, he stresses that man "could not think without the help of speech" because "[l]anguage is the formative organ of thought" (quoted in R.L. Brown 66, 68).

It was by combining these ideas with his studies of non-Indo-European languages that Humboldt arrived at his Weltanschauung or Worldview hypothesis. By comparative study of such languages he was struck by the immense difference between cultures as revealed in their languages (Penn 19). Humboldt maintained that the Weltanschauung or Worldview of peoples differed because of differences between the inner structure of languages:

There resides in every language a characteristic world-view. As the individual sounds stand between man and the objects, so the entire language steps in between him and the nature that operates, both inwardly and outwardly, upon him. He surrounds himself with a world of sounds so as to assimilate and process within himself the world of objects (quoted in Koerner 10).

According to Humboldt, then, language is the medium through which the individual experiences the world: "man lives in the world about him principally, indeed exclusively, as language presents it to him" (quoted in Penn 22). And if the immense diversity of worldviews embedded in different languages is combined with Humboldt's statement that "thinking is not merely dependent on language in general, but, up to a certain degree, on each specific language" (quoted in R.L. Brown 68) the result can only be linguistic relativity. Linguistic relativism and linguistic determinism, the two propositions of the Sapir-Whorf hypothesis, were then first proposed by Hamann and Herder as an antidote to the rationalist doctrine of innate ideas. However, according to Brown, Humboldt was "the first to combine ideas of comparative structuralism with ideas of the identity of language, perception, and thought" (R.L. Brown 109).

1.2.2 The American Anthropological Linguists

1.2.2.1 Boas

Franz Boas (1858-1942), the German-American anthropologist was influenced by the writings of Humboldt. He emphasized cultural relativity as opposed to the cultural superiority of the West. Boas held that cultural differences were reflected in languages in the form of different conceptual classifications of the world:

Inferences based on peculiar forms of classification of ideas, and due to the fact that a whole group of distinct ideas are expressed by a single term, occur commonly in the terms of relationship of various languages; as, for instance, in our term uncle, which means two distinct classes of father's brother and mother's brother. Here also, it is commonly assumed that the linguistic expression is a secondary reflex of the customs of the people; but the question is quite open in how far the one phenomenon is the primary one and the other the secondary one, and whether the customs of the people have not rather developed from the unconsciously developed terminology (quoted in Koerner 11).

In this passage Boas clearly echoes Humboldt. He admits here the possibility of linguistic influence but he carefully keeps the channel of influence open in both

directions. In other words, he allows for the possibility of reciprocal influence between language and thought.

1.2.2.2 Sapir

Edward Sapir (1884-1939), the German-born American anthropologist and linguist was a student of Boas'. In an article based on his master's thesis Sapir discusses the works of Herder and to a lesser extent Humboldt (R.L. Brown 16). He himself worked with American Indian languages for many years which further developed his view on the interrelationship between language and world-view (Koerner 11). The following passage is often quoted as a representation of Sapir's views:

> Human beings do not live in the objective world alone, nor alone in the world of social activity as ordinarily understood, but are very much at the mercy of the particular language which has become the medium of expression for their society. It is quite an illusion to imagine that one adjusts to reality essentially without the use of language and that language is merely an incidental means of solving specific problems of communication or reflection: The fact of the matter is that the 'real world' is to a large extent unconsciously built up on the language habits of the group. No two languages are ever sufficiently similar to be considered as representing the same social reality. The worlds in which different societies live are distinct worlds, not merely the same world with different labels attached (Sapir 162).

Judging from this quotation his position seems to be "merely a cautious restatement of Humboldt's hypothesis in more modern athropological terms with the emphasis on habits of language use rather than on the structure of the language in question" as Penn (23) describes it. The social reality, the cultural world view or Weltanschauung, encoded in a language influences very much the personal world view of its speakers, according to Sapir: "We see and hear and otherwise experience very largely as we do because the language habits of our community predispose certain choices of interpretation" (Sapir 162). However, Sapir is also careful not to equate language with thought fully:

> Language and thought are not strictly coterminus. At best language can be but the outward facet of thought on the highest, most generalized, level of symbolic expression. To put our viewpoint somewhat differently, language is primarily a pre-rational function. It humbly works up to the thought that is latent in, that it may

eventually be read into, its classifications and its forms, it is not, as is generally but naively assumed, the final label put upon the finished thought (14).

But Sapir also makes a much more forceful statement. He, for example, states that "thought ... is hardly possible in any sustained sense without the symbolic organization brought by language" (14). He further argues that "the feeling entertained by so many that they can think, or even reason, without language is an illusion" (15). Not only is thought "hardly possible" and "an illusion" without language; linguistic form also has a "tyrannical hold" (quoted in Koerner 12) upon our orientation in the world which can only lead to "the relativity of concepts or, as it might be called, the relativity of the form of thought" (159).

1.2.3 The French Connection

1.2.3.1 Antione Fabre d'Olivet

Whorf recognizes the influence of Sapir and Boas in his writings but he does not mention Hamann, Herder or Humboldt explicitly as sources of influence. However, he acknowledges his indebtness to the French grammarian and mystic Antione Fabre d'Olivet (1768-1825) as the "real originator of such ideas as rapport-systems, covert classes, cryptotypes, psycholinguistic patterning, and language as part and parcel of a culture" (74). These ideas which Whorf lists play an important part in his theories, although they have not been emphasised in the standard way of presenting Whorf's views.

1.3 The Formulation of the Whorf Thesis and the Sapir-Whorf Hypothesis

The Sapir-Whorf Hypothesis[1] was originally formulated by the American psychologist Roger Brown from the writings of Sapir and Whorf (see Fishman 61-86 for a more detailed account of the systematization of Whorf's theories). Previously R. Brown and the linguist Eric Lenneberg had formulated, in the absence of a testable hypothesis, a thesis out of the various statements found in the writings of Sapir and Whorf which they called "the Whorf thesis":

> The Whorf thesis on the relationship between language and thought is found to involve the following two propositions: (a) Different linguistic communities

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[1] The actual term 'The Sapir-Whorf hypothesis' was coined by Hoijer (1951), who was a student of Sapir.

perceive and conceive reality in different ways. (b) The language spoken in a community helps to shape the cognitive structure of the individuals speaking that language (Brown and Lenneberg 491).

These two propositions were later developed by Brown (R. Brown 125-153) into the Sapir-Whorf Hypothesis, which includes linguistic relativism:

Structural differences between language systems will, in general, be paralleled by nonlinguistic cognitive differences, of an unspecified sort, in the native speakers of the language.

and linguistic determinism:

The structure of anyone's native language strongly influences or fully determines the worldview[2] he will acquire as he learns the language (128).

1.4 Early Empirical Evidence

1.4.1 Brown and Lenneberg: Color Codability

In order to test the SWH Brown and Lenneberg (454-462) narrowed the focus from lexical differences to codability and narrowed cognitive performance to the single variable of color recognition. The length of a term was measured in codability. The shorter the term the more codable it is said to be. According to Zipf it is frequency of use which determines the length of a term. Zipf's law therefore states that the more frequently a term is used the shorter it is. This phenomenon is quite apparent in such instances as when terms for new devices get shortened with frequency of use: Personal Computer becomes PC; Television becomes TV, Digital Video Disc becomes DVD and so on. These devices would then be described as being highly codable, having such short terms by which they are referred to. Brown and Lenneberg proposed that "the length of a verbal expression provides an index of its frequency in speech and that this, in turn, is an index of the frequency with which the relevant perceptual judgements of difference and equivalence are made" and they further proposed that "increased frequency of a perceptual category will mean a generally greater "availability" of the

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[2] Whorf defines worldview or Weltanscauung as the viewpoint or metaphysics underlying a language (Whorf 1956: 58-59) and it includes perception as well as conceptualization.

category" (483). The choice of color recognition would, moreover, seem to be an ideal way of testing the lexical aspect of the SWH because the color spectrum is continuous with no natural, clear cut, boundaries.

Brown and Lenneberg showed college students 24 different color chips. 8 of these color chips had been previously selected, by a set of judges, as the best examples of the color in question. 16 other colors were then included for comparison. The students were asked to name each of these 24 colors and their time of naming was measured. Brown and Lenneberg found that there is a relationship between the length of color terms and their recognition time. The Brown and Lenneberg study showed that the more highly codable colors were recognised faster and were easier to remember than the less codable ones. This study was not interpreted as providing direct evidence for linguistic relativity, however, as it did not include any cross-linguistic comparison, involving only speakers of English (Schlesinger 27).

1.4.2 Lenneberg and Roberts: Evidence for Linguistic Relativity

Lenneberg and Roberts (rpt in Brown and Lenneberg 485) conducted a cross-linguistic comparison of color recognition between speakers of Zuni, a tribe of Native Americans indigenous to western New Mexico, and speakers of English. In Zuni the yellow-orange range of the color spectrum is referred to by a single term, unlike English. The Zuni speakers were found to confuse yellow and orange in recognition and have greater difficulty in remembering these colors than the English speakers. This second study then was interpreted as showing evidence for linguistic relativity because differences in codability correlated with differences in color perception and that having a readily available color term leads to advantage in color perception and memory.

1.4.3 Acceptance of Whorf

These early studies then revealed a correlation between color codability and color recognition and memory and were interpreted as showing evidence for linguistic relativity. However, it was also recognized that strong linguistic determinism was not supported by any data (Brown and Lenneberg 491). Schlesinger (23-24) lists three further reasons for this interest and acceptance of Whorf's ideas. Firstly, there is Whorf's dramatic writings style which conveyed an infectious excitment over new

discoveries. Secondly, Whorf was more extreme in his formulations than his predecessors. And, thirdly, because of the Zeitgeist, the current intellectual climate, which emphasized relativity. A number of linguists and anthropologists had also already published writings expressing views similar to those of Whorf but these writings had not sparked the same level of interest (24). Largely due to Whorf's writings, linguistic relativism was therefore widely embraced in the 1950s and 1960s (Getner and Goldin-Meadow 4).

2.0 Whorf Rejected I: Linguistic Relativism

Ironically the same factors which lead to the acceptance of Whorf's views led to the rejection of his views. Empirical evidence, Whorf's own writings, and the Zeitgeist in linguistics and psychology all contributed to the rejection. The empirical evidence provided counterevidence to linguistic relativism on lexical grounds. The criticism of Whorf's writings revealed ambiguities and circular reasoning as well as methodological problems, both in his lexical and grammatical data. Furthermore, the Zeitgeist shifted towards an emphasis on language universals (the common universal features of languages), undermining linguistic relativism, and towards an emphasis on the study of cognitive processes in psychology independent of language and linguistic, undermining linguistic determinism.

2.1 Empirical Counterevidence

2.1.1 Berlin and Kay: Basic Color Terms

Berlin and Kay showed that languages differ in color terminology in systematic ways, instead of variation being unconstrained and arbitrary. They first collected data from the color terminologies of twenty languages. These languages, which are genetically diverse, included Arabic, Bulgarian, Catalan, Cantonese, Mandarin, English, Hebrew, Hungarian, Ibibio, Indonesian, Japanese, Korean, Pomo, Spanish, Swahili, Tagalog, Thai, Tzeltal, Urdu, and Vietnamese (Berlin and Kay 7). Berlin and Kay found that these languages derive their color terminology from 11 basic color terms: *white*, *black*, *red*, *yellow*, *green*, *blue*, *brown*, *purple*, *pink*, *orange*, and *grey*. All other color terms are variously derived from these basic terms, being combinations (*blood-red*), variations (*scarlet*), or some kind of modifications (*fire-engine red*). They also found that these basic color terms form a hierarchy. If a language has only 2 terms they are always *black* and *white*. *Red* is always found to be the third basic term. And a language with four terms has *black*, *white*, *red* and either *yellow* or *green*. Berlin and Kay further compared their results with color terminologies from seventy-eight more languages, and although this data was not from gathered first hand from actual speakers it was deemed reasonably reliable. This secondary data confirmed almost completely the results from the primary data of twenty languages. The whole hierarchy of the 11 basic color terms follows the following pattern (4):

Number of color terms:	2	3	5	6	7	11
						Purple
		Black	Yellow			Pink
			Red	Blue	Brown	Orange
		White	Green			Gray

This implicational hierarchy was taken to demonstrate that the physiology of the human eye determined the development of color terms and placed constraints on variation. Attempting to explain how color vocabularies proceed on this hierarchy, Wardhaugh (231) maintains that the number of color terms in a given language follows the technological sophistication of the society using the language. Thus the Jalé of New Guinea use only 2 terms whereas English includes al 11. Societies of intermediate technological sophistication then use an intermediate number of color terms. For example, the Tiv of Nigeria use three terms, the Garo of Assam use four, and the Burmese use seven. Berlin and Kay, moreover, found that the most representative examples of the basic color terms, or focal colors, were the same across languages. The Berlin and Kay study was interpreted as providing evidence against linguistic relativism because it showed that color terminologies differ in systematic ways instead of arbitrarily, placing limits on variation, and that these systematic differences were due to physiological factors.

2.1.2 Heider: Focal Colors

Heider studied focal colors in more detail. She compared speakers of English, which contains all 11 basic color terms, with the Dani, a tribe of New Guinea, who speak a language which contains only 2. Heider found that English speakers remembered focal colors better than non-focal colors, such as orange-red. Even though the speakers of Dani lacked terms for basic or focal colors, its speakers learned new terms for focal colors more easily than for non-focal colors and they also memorised focal colors better than non-focal ones. Heider argued that the study showed that color perception rests, not on color terminology, but on underlying universal perceptual-cognitive factors. She concluded:

In short, far from being a domain well suited to the study of the effects of language on thought, the color space would seem to be a prime example for the influence of

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the underlying perceptual-cognitive factors in the formation and reference of linguistic categories (20)

The Heider study was taken (Hardin and Banaj 283) as decisive refutation of both linguistic relativism and linguistic determinism because it showed that there was not only no correlation between colour terminology and colour memory but also that there was no causal relationship between those two variables because differences in memory were not based on language but on perceptual salience. The studies of Berlin and Kay and Heider then shifted the emphasis away from relative linguistic factors to universal physiological factors. This state of affairs led Brown (152) to comment: "the fascinating irony of this research is that it began in a spirit of strong relativism and linguistic determinism and has now come to a position of cultural universalism and linguistic insignificance".

2.1.3 Criticism of Berlin and Kay and Heider

However, the work of Berlin and Kay and Heider was not without criticism. The original data of Berlin and Kay was very small, being based only on 20 languages and of the 20 languages studied 17 were written languages of industrialized societies, making industrialization a possible source of similarity in color terminology and thus leading to artificial universality (Harley 86). There were other methodological problems as well. The criteria used for naming basic color terms seem to have been inconsistently applied, with the basic color terms of many languages also being possibly omitted.

Heider's methodology and conclusions were also questioned. According to Lucy and Shweder the focal colors used by Heider were more perceptually discriminable than non-focal colors due to a bias in the color array:

> What we discover is that the color array used by Heider (1972) to establish the translinguistic superior memorability of focal versus nonfocal colors is discriminatively biased in favor of focal colors. Under conditions simulating "perfect memory" (that is, in the presence of visible target probes), focal chips are easier to identify in the array than nonfocal chips (582).

When Lucy and Shweder replicated Heider's experiment, controlling the discriminability factor, they found "that when Heider's array is modified to make focal and nonfocal chips equally discriminable, various linguistic indicators are better predictors of memory accuracy in both short- and long-term memory than is focality"

(582-583) and "that linguistic encodings are used in color memory and that their efficacy is not dependent on focality" (590).

2.1.4 Kay and Kempton: Name Strategy

However, the Kay and Kempton study confirmed the ruling universalist view. They conducted a cross-linguistic study comparing English and Tarahumara, a Mexican Indian language. English distinguishes lexically between blue and green whereas Tarahumara has a single term *siyóname* for the blue or green. The speakers were shown three color chips, two of which were clearly blue and green, but the third chip was somewhere in between. The speakers were then asked whether the third fuzzy chip was closer to blue or green. According to Kay and Kempton, the linguistic relativity hypothesis would predict that "colors near the green-blue boundary will be subjectively pushed apart by English speakers precisely because English has the words green and blue, while Tarahumara speakers, lacking this lexical distinction, will show no comparable distortion " (68). The experiment did indeed show effects of linguistic influence. The English speakers exaggerated the subjective distance of colors close to the blue-green boundary, whereas speakers of Tarahumara did not demonstrate such distortion effect. Thus having separate terms for blue and green seemed to have cognitive effects.

Kay and Kempton refused to accept that "the vision of English speakers is distorted in some way by the language they speak" (72). They instead proposed that the English speakers had unconsciously used a cogntive strategy, which they called ""name strategy". According to the name strategy hypothesis, "the speaker who is confronted with a difficult task of classificatory judgement may use the lexical classification of the judged objects as if it were correlated with the required dimension of judgement even when it is not, so long as the structure of the task does not block this possibility" (75). In a second experiment the naming strategy was suppressed by changing the context by showing only two color chips at a time, from a set of three, where the task was still to pick the "odd man out" (73). Kay and Hempton found no lexical influence on subjective discrimination when the name strategy was thus blocked. However, the name strategy found in experiment one implies a modest Whorfian influence.

2.2 Criticism of Whorf's Writings and Data

2.2.1 Grammatical Data

Whorf's data has received considerable criticism. For example, when discussing Apache for "dripping spring" he states:

> We might isolate something in nature by saying "It is dripping spring". Apache erects the statement on a verb ga: "be white (including clear, uncoloured, and so on)". With a prefix no – the meaning of downward motion enters: "whiteness moves downward." Then to, meaning both "water" and "spring", is prefixed. The result corresponds to our "dripping spring", but synthetically it is "as water, or springs, whiteness moves downward". How utterly unlike our way of thinking! (241)

Pinker argues that Whorf's translation of Apache is idiosyncratic because both English and Apache contain separate morphemes for "clear", "spring", and "moving downward" and can therefore, just as easily, be translated as "It is a clear dripping spring" (*Language* 60). Pinker further points out that Whorf based his translation on an analysis of written Apache grammar instead of interviews with Apache speakers.

Malotki, moreover, criticizes Whorf's analyzis of the Hopi language as a timeless language. He argues, on the contrary, that speakers of Hopi are quite conscious of time and provides lexical evidence for his argument. Malotki also reveals how in Whorf's own working Hopi-English dictionary "he lists approximately two dozen lexemes referring to the domain of time" (15). Chomsky similarly criticizes Whorf's analysis of 'time' in the English language:

> In English ... there is no structural basis for the past-present-future "worldview" that Whorf attributes, quite correctly, to SAE[3] speakers. Rather, a formal analysis of English structure would show a past-present distinction, a set of aspects (perfect and progressive), and a class of modals, one of which happens to be used to express future tense (among other devices that serve this purpose). Approaching English from a Whorfian point of view we would conclude that an English speaker has no concept of time as a doubly infinite line, he himself occupying the postion of a point moving constantly from past to future, but rather he conceives of time in terms of a basic dichotomy between what is past and what is not yet past, in terms of an aspectual system of a subtle sort, and in terms of a superimposed and independent system of modalities, involving possibility, permission, ability, necessity, obligation, future (the latter not being distinguished in any special way). (viii-ix)

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[3] Standard Average European

2.2.2 Lexical Data

Whorf's lexical data has also been criticized. In a chaper called "The great Eskimo vocabulary hoax" Pullum (159-171) describes how Whorf based his example on Franz Boas' introduction to *The Handbook of North American Indian*. There Boas states that Eskimo uses four different roots for snow: *aput* (snow on the ground), *gana* (falling snow), *piqsirpoq* (drifting snow) and *qimuqsuq* (a snow drift) (Pullum163). Whorf, however, expands this list to include at least five different words for snow: falling, on the ground, packed hard, slushy, and flying. Pullum actually counts seven in Whorf's passage because Whorf adds "and other kinds of snow". Whorf's article was heavily quoted and reprinted and with subsequent indirect reporting the number continued to grow to more than twenty. In an editorial in the *New York Times* the number even reached one hundred and later grew to a record of two hundred in a Cleveland television weather forecast (Harley 82).

Pullum's criticism includes three main points. He firstly points out that there is "no single monolithic 'Eskimo language'" (168). There are in fact several Eskimo languages, spoken by the Eskimo people who inhabit the arctic region in Greenland, Canada, Alaska and Siberia and these languages differ considerably in their vocabularies. Secondly, when counting words, there is the issue of whether only unanalyzable roots (*snow*) should be counted or whether derived word forms (*snowball*, *snowflake* etc) should also to be included (168-169). Thirdly, English has more than a single word for snow (which are not derivatives of snow): *slush*, *sleet*, *blizzard*, *avalanche*, *hardpack*, and *powder*, for example (169). Attempting to estimate the actual number of words for snow, Pullum refers to Eskimologist Anthony Woodbury "who put together a list of bases in the Central Alaskan Yupik language that could be regarded as synchronically unanalyzable and had snow-related meanings" and Woodbury's estimation is that the "list has about a dozen different stems with 'snow' in the gloss, and a variety of other words (slightly more than a dozen) that are transparently derived from these" (170)

Whorf's data is, moreover, purely linguistic, as Chomsky points out because Whorf "gives no evidence for a difference in cognitive modes corresponding to the difference in linguistic structure" (viii). Black calls this circular reasoning the "linguists fallacy" ("Linguistic" 230). Brown and Lenneberg, on the other hand, argue that such linguistic evidence constitutes inferential evidence: "The Eskimo's three 'snows' are

sufficient evidence from which to infer that he discriminates three varieties of snow. These selective verbal repsonses satisfy the conditions for inferring perceptual discrimination" (481).

However, Brown and Lenneberg are careful not to infer lesser perceptual discrimination from lack of lexical resources:

> A subject may be perfectly able to distinguish two situations and still not care to do anything about it. Consequently the fact that English speakers do not have different names for several kinds of snow cannot be taken to mean that they are *unable* to see the differences. It would seem, then, that all such comparisons are psychologically inconclusive. The Eskimo and American may or may not see the world differently (481, emphases original).

2.2.3 Ambiguity and Vagueness in Whorf's Writings

Many researchers have also found Whorf's writings to be ambiguous and vague. Sometimes his claims seem to be strong, where he speaks of "inexorable bonds" (252), "unbreakable bonds" (256), and the linguistic organization of nature as being "ABSOLUTELY OBLIGATORY" (214; capitals original) while at other times his claims are weaker as when he qualifies his statements with "largely" (214) and as well as when he speaks of thinking "inso far it is linguistic" (67). Schlessinger observes:

> What is the thesis Whorf argued for? This question is notoriously difficult to answer. Whorf all too often expresses himself in a rather vague and ambiguous fashion. He was out to make a case, to provoke, to promote a new approach, and occasionally he flouts canons of scientific circumspection. All this makes it difficult to pin him down on some crucial questions (16).

Penn (13) argues that nowhere in Whorf's writing is this ambiguity cleared up. Pinker places the problem of understanding Whorf's views partly on Whorf's "long-time leanings towards mysticism" (*Language* 63). According to Brown ambiguity is also to be found in the writings of Humboldt. He gives two reasons for Humboldt's "ambiguities and occasional straight contradictions". Firstly "Humboldt never fully resolved the tension inherent in the complex of authors and ideas on which he drew" and secondly "his ideas changed during the course of time, so that a later work often contains statements opposite in the implications to those of earlier works" (L.R. Brown 110). Lee similarly explains that Whorf's ambiguity is due to the fact that in Whorf's

early writings his ideas about linguistic relativity were not fully developed and that his definitions of the linguistic relativity principle only appear in later writings ("When" 47).

However, this apparent ambiguity in Whorf's writings can at least partially be credited to a failure to realize the difference between lexical and grammatical influences on thought. When the standard way of presenting Whorf's views is combined with the SWH a particular picture of Whorf's views emerges. On this standard Whorfian view language strongly influences or determines thinking and worldview both through the grammar and the lexicon and the apparent ambuguity arises if the grammatical and lexical influences are regarded as being equal. Whorf's strong statesments are all about the grammatical influence on thought whereas the lexial influence on thought is held to be relatively weak. There is no such thing as strong lexical determinism in Whorf's view.

2.2.4 Ambiguity and Vagueness in the SWH and WT Formulations

The very formulations of the Sapir-Whorf Hypothesis and the earlier Whorf Thesis were attempts to present Whorf's ideas in clear terms in order to provide a testable hypothesis. Brown and Lenneberg present linguistic relativisim and linguistic determinism as being the two cornerstones of Whorf's view. However, ironically, even these hypotheses are not without ambiguity because there does not seem to be an agreement on how to define the two propositions. The original definitions of linguistic relativism are:

(a)   Different linguistic communities perceive and conceive reality in different ways (Brown and Lenneberg 491)

(b)   Structural differences between language systems will, in general, be paralleled by nonlinguistic cognitive differences, of an unspecified sort, in the native speakers of the language (R. Brown 128).

And the original definitions of linguistic determinism are as follows:

(c)   The language spoken in a community helps to shape the cognitive structure of the individuals speaking that language (Brown and Lenneberg 491).

(d)   The structure of anyone's native language strongly influences or fully determines the worldview he will acquire as he learns the language (R. Brown 128).

It is possible to interpret these propositions in different ways. According to Hardin and Banaj linguistic relativism is a thesis about correlation whereas linguistic determinism is a thesis about causation because the first states that there are cognitive differences between linguistic communities and the second states that language is the cause of cognitive structures. Hardin and Banaj note that: "the observation of covariation between language and thought (linguistic relativity) does not imply causal direction, much less the direction advanced by linguistic determinism" (280), because these propositions "are logically independent of each other" as Schlesinger argues (17). He further explains that there can be linguistic relativism, or parallelism to use his own term, without linguistic determinism where linguistic patterns simply reflect cognitive patterns or cultural interests. Similarly, there can be linguistic determinism without linguistic relativism either by focusing on a single language or supposing that languages do not differ in how they structure reality. Either way, it would still, as Schlesinger puts it, "make sense to talk about the influence of the structure of this language on an individual's thinking" (17).

However, linguistic relativism is generally understood to imply causation. The following passages from standard texts on the psychology of language show such an understanding:

> **Linguistic determinism** refers to the notion that a language determines certain non-linguistic cognitive processes. That is, learning a language changes the way a person thinks. **Linguistic relativity** refers to the claim that the cognitive processes that are determined are different for different languages (Carroll 365; emphases original).

> First, *linguistic determinism* is the idea that the form and characteristics of our language determine the way in which we think, remember, and perceive. Second, *linguistic relativism* is the idea that as different languages map onto the world in different ways, different languages will generate different cognitive structures (Harley 81; italics original)

The interpretation of linguistic relativism in these two passages is that different languages cause differences in cognition. This is also Whorf's own understanding because in his own definition of the linguistic relativity principle he states: "all

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observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar, or can in some way be calibrated" (214). In this definition of linguistic relativism, language has a causal role to play in the generation of a worldview.

And just to complicate matters more some scholars define linguistic relativism as a weak version of linguistic determinism. For example, Pinker states:

> And supposedly there is a scientific basis for these assumptions: the famous Sapir-Whorf hypothesis of linguistic determinism, stating that people's thoughts are determined by the categories made available by their language, and its weaker version, linguistic relativity, stating that differences among languages cause differences in the thoughts of their speakers (*Language* 57).

This conception, however, is mistaken. Linguistic relativism is not a weak version of linguistic determinism because the influence is unspecified. It is under the banner of linguistic determinism in which discussion of the nature of the causality must take place.

Linguistic determinism is also problematic, however. There is a significant difference between how linguistic determinism is defined in the Whorf thesis and the Sapir-Whorf hypothesis. In the former the "language spoken in a community *helps to shape* the cognitive structure of the individuals speaking that language" (Brown and Lenneberg 491; italics added). However, in the latter the "structure of anyone's native language *strongly influences or fully determines* the worldview he will acquire as he learns the language (R. Brown 128; italics added). Carroll rightly argues that "any study that attempts to test the hypothesis that differences in language determine differences in thinking must, at the outset, define the three key terms" which are "differences in language", "differences in thinking" and how language "determines" thought (369). Pinker's understanding of linguistic determinism is in accord with the strong formulation of the Sapir-Whorf hypothesis and he argues that a genuine demonstration of linguistic determinism would have to show three things. Firstly, that "the speakers of one language find it impossible, or at least extremely difficult, to think in a particular way". Secondly that "the differences in thinking involves genuine reasoning". And thirdly, that "the difference in thinking must be *caused* by language" (*Stuff* 135-136; italics original).

Linguistic determinism is then no more free from ambiguity than Whorf's own writings. There is an important difference between "helps shape" and "strongly influence or fully determine". The former conception is much weaker than the latter. Miller and McNeill (in Harley 81) distinguish between three versions of linguistic determinism in order to clarify the causal relationship between language and thinking:

The Strong Version: Language determines thought.

The Weaker Version: Language only affects perception.

The Weakest Version: Language differences affect only processing on certain tasks where linguistic encoding is important such as memory and reasoning.

Miller and McNeill's model recognizes that there is not just one kind of linguistic determinism but several which differ in the degree of strength in causation and in the cognitive processes which are affected. This recognition helps to remove the ambiguity surrounding the linguistic determinism of the WT and the SWH. It also helps remove some of the ambiguity surrounding Whorf's writings because this recognition allows us to differentiate between lexical and grammatical influence.

3.0 Whorf Rejected II: Linguistic Determinism

3.1 Versions of Strong Linguistic Determinism

Whorf was initially rejected because Berlin and Kay and Heider found convincing evidence against linguistic relativism. Whorf was also rejected because research, mainly in the field of psychology, found evidence against strong linguistic determinism. In order to get a clear picture of why Whorf was rejected as strong linguistic determinism it is useful to divide strong linguistic determinism into different subclasses, which can then be compared to developments within the fields of psychology and linguistics. A discussion of strong linguistic determinism in this vein will also be very useful for the analysis of Whorf's ideas and it certainly helps in understanding how the lexical level and the grammatical level differ in his theories, for it reveals that the lexical level does not belong in the strong versions whereas the grammatical level certainly does.

In distinguishing between the strong versions of Linguistic determinism it is tempting to focus on specific cognitive processes such as perception or memory and reasoning as in the weak versions. However, the initial focus needs to be on more basic distinctions (see Schlesinger 16-23 for an alternative analysis of linguistic determinism). Strong linguistic determinism will be then here be divided into

Strongest version: Language determines all thought

Stronger version: Language determines human thought

Strong version: Language determines some human thinking

3.2 Language Determines all Thought

The strongest possible version of linguistic determinism is that all thinking requires language. On this view animals and infants are incapable of thinking altogether. Such a view has been held by philosophers such as Wittgenstein, Davidson, Dummett, and McDowell (Carruthers and Boucher 3). However, evidence from such language-less beings as animals and pre-linguistic infants refutes this strongest version of linguistic determinism.

3.2.1 Counterevidence I: Animals

Animals surely must be capable of some form of thought. How else could they survive? One objection could be that animals are not without language at all. Most linguists, on the other hand, agree that human language is qualitatively[4] different from animal communication systems, because the characteristics of human language, as described by Hockett's design features, are not to be found wholesale in any animal communication system. This could then lead to the objection that because animals do not possess human language they are not capable of abstract or propositional thought.

However, according to Cheney and Seyfarth monkeys can recognize the social relationships within their group. They found by observing vervet monkeys in the wild that if a vervet monkey witnessed a fight between a member of its own family and a member of another family, it increased the likelihood of the witnessing vervet monkey attacking some member of the other family. This behaviour shows, Cheney and Seyfarth deduce, that "Vervets act as if they recognize some similarity between their own close associates and the close associates of others. To make such comparisons the monkeys must have some way of representing the properties of social relationships" (167). According to the Cheney and Seyfarth study these vervet monkeys are then capable of abstract logic.

3.2.2 Counterevidence II: Infants

Studies have also shown that infants are capable of thought. For example, Wynn (712-713) found that five month old infants are capable of simple arithmetic. She tested two groups of infants. The first group of infants was shown a Mickey Mouse doll which was then placed behind a screen when the infants showed signs of boredom. Then they were shown another Mickey Mouse doll which was then visibly placed behind the screen. When the screen was removed, if there was only one Mickey Mouse doll, the infants stared in surprise whereas if there were two dolls the infants seemed unsurprised and became soon bored again. The second group of infants was tested in the reverse order. They were shown two dolls which were then placed behind a screen. The infants then witnessed one of the dolls being removed. If one doll was revealed when the screen was removed the infants soon lost interest. However, if there were two dolls they stared

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[4] A number of linguists regard human language and animal communication systems as being only quantitatively different although they recognize that the quantitative gap is substantial in terms of the formal properties of the system.

puzzled for a longer time. As Pinker (*Language* 68-69) suggests this means that the infants must have been keeping track of the number of dolls. Wynn argues that this indicates "that infants possess true numerical concepts, and suggests that humans are innately endowed with arithmetical abilities" (712). The absence of language then does not prevent infants from showing capacity for simple number reasoning. An all-inclusive linguistic determinism is therefore dismissed because of evidence from animals and infants.

3.3 Language Determines All Adult Human Thinking

The next step would then be to argue that language determines adult human thinking. This step allows animals and infants to entertain basic thoughts while human beings who are fully fledged language users are capable of more complex thinking because of language. It does not indeed take much introspection to experience thinking as a silent inner monologue. It is also often said that a foreign language has finally been mastered when a speaker starts to think in a new language. Many bilinguals, furthermore, claim to think differently in each language they speak. Then there is the common complaint that is is impossible to hear oneself think when there is too much noise.

The view that language determines all human thinking is for example found in the writings of Saussure, the father of modern linguistics: "without language, thought is a vague, uncharted nebula. There are no pre-existing ideas, and nothing is distinct before the appearance of language" (quoted in Devitt and Sterelny 265). And the philosopher Friedrich Nietzsche famously wrote "We have to cease to think if we refuse to do it in the prisonhouse of language[5]" (quoted in Pinker, *Stuff* 134). In this view, that language determines all human thought, languages becomes indeed a prison-house which limits thinking to linguistic constructions.

3.3.1 Visual Thinking

However, introspection not only reveals that thinking is linguistic but it also reveals that thinking can be non-linguistic. When giving someone directions, for example, the speaker first visualises the route he intends to describe and then describes the route verbally to the stranger. This is an instance of visual, non-linguistic, thinking. Other common instances where visual thinking occurs are, for example, day dreaming and

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[5] Deutscher (2010: 147) challenges this translation and argues that what Nietzsche actually wrote was "We cease to think if we do not want to do it under linguistic constraints".

recollection. Furthermore, artists such as the English poet Coleridge and modern sculptor James Surls have claimed to think in mental images (Pinker, *Language* 70). Physicists Sakharov and Einstein also claimed not to think in language in their work (Gethin 35). This suggests that, at least, some kind of thinking is non-linguistic, while it is possible that some kind of thinking is linguistic.

3.3.2 Brain Damage and Language Disorders

Research into brain damage, moreover, supports the theory that human thinking is not entirely dependent on language. Aphasia is a language disorder were the ability to produce or understand spoken language is impaired due to brain damage, which is usually the result of an accident, a stroke, dementia, or surgery (Field 16). Pinker describes one aphasiac, a Mr. Ford, who due to a stroke, suffered from serious grammatical impairment:

> He omitted endings like *–ed* and *–s* and grammatical function words like *or*, *be*, and *the*, despite their high frequency in the language. When reading aloud, he skipped over the function words, though he successfully read content words like *bee* and *oar* that had the same sounds. He named objects and recognized their names extremely well (Language 47).

This linguistic impairment did not seem to disrupt Ford's other cognitive faculties such as calculation, map reading, drawing with the unpractised hand, and the following of verbal commands. Another language disorder occurs in children who suffer from Specific Language Impairment or SLI. It is a condition in which otherwise normal children fail to acquire language like their peers (Fields 276). This condition can include problems of comprehension and production, basic grammar errors, restricted vocabularies, and lack of context in conversation. Interestingly SLI seems only to affect language and is not accompanied by low intelligence or cognitive impairment.

The reverse condition of having normal command of language and yet suffer from intellectual impairment has also been observed. Williams syndrome is a rare genetic disorder characterized by a physical abnormality in the form of an "'elfin-faced' appearance" (Harley 72-73). The language skills of those who suffer from this syndrome are normal and they even show a particular interest in unusual words. Their IQ, however, is very low, being typically around 50. A more severe case is Laura, a young retarded woman, described by Yamada. With an IQ of only 40 her cognitive impairment was particularly strong, influencing all cognitive domains. However,

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Laura's language abilities were relatively advanced compared to her cognitive abilities. She was quite capable of producing complex syntactic constructions and lexical ones as well, although to a lesser degree. The case of Laura showed that language can develop despite serious impairment of cognitive ability and Yamada concluded that this indicates that language and cognition are distinct (109-120).

One of the central notions of the Chomskyan revolution in linguistics is the definition of language as a self-contained system largely independent of general intelligence. As far back as the early 60s at least, Chomsky argued for language faculty distinct from other mental capacities (Lyons 176). These studies on linguistic and cognitive impairment seem to support such a modular view of the mind, which posits that the mind is composed of a number of separate components or modules, one of which is language. Fodor has probably pioneered the modularity view more than anyone else. It has been known for over a century that the processing of language and speech is located in two areas in the left hemisphere of the brain called Broca's Area, in the frontal lobe, and Wernicke's Area, in the temporal area. Both language areas play a distinct and special role in language and speech processing. Broca's Area is associated with language production while Wernicke's Area is associated with language understanding. Damage to these areas can therefore lead to different types of aphasia. Patients with Broca's aphasia suffer from impaired speech production while their language comprehension is typically intact. Patients with Wernicke's aphasia suffer from the opposite condition, being capable of speech production while language comprehension is seriously impaired, which results in meaningless language (Steinberg 180).

However, these neurological findings have yet to be convincingly correlated with the modularity hypothesis, for language is also processed and stored in other regions of the left hemisphere and to some extent in the non-linguistic right hemisphere (Lyons 181). This language processing which occurs outside the main language areas has to do with secondary components of language such as understanding stress and intonation, the interpretation of emotional intentions, and the appreciation of social meaning (Steinberg 184). The discovery of these minor language areas does not refute the fact that there are two major languages areas in the brain and that they are significantly independent from general cognition.

3.3.3 Speech is not Thought

Another type of linguistic determinism according to which language determines human thinking is the Behaviourist theory that speech is the basis of human thought. Behaviourism, a school of psychology which flourished in the first half of the 20th century, sought to study and explain human behaviour without relying on speculation about internal mental states (Field 30). John B. Watson, the founder of Behaviourism, argued that "thought is nothing more than small motor movements of the vocal apparatus" (quoted in Hartley 79) because thought is "nothing but talking to ourselves" (quoted in Steinberg 160). Smith, Brown, Thomas and Goodman, however, demonstrated that thinking cannot be equated with small movements of the vocal apparatus. They conducted an experiment where all of Smith's voluntary muscles were temporarily paralyzed by the use of curare. Despite the paralysis of the speech apparatus Smith later reported no loss of his mental faculties, being able to think and reason the whole time (reported in Steinberg 162). This experiment, however, does not rule out the possibility that the speech apparatus was receiving signals from the brain despite being paralyzed, although it was established that the actual movements of the speech apparatus were not essential for thought. It is therefore possible to hold that thinking is a form of a silent inner monologue which does not depend on the movements of the larynx.

Studies on deaf individuals have provided further evidence against equating thought with movements of the vocal apparatus. According to Steinberg deaf children, who often do not start acquiring language until the age of 3 or 4, behave very similarly to their normal peers on the playground (166). Furth compared the cognitive functions of deaf children, normal children, and mentally retarded children in a series of experiments. His data showed no difference between the cognitive function of deaf and normal children. Furth therefore concluded that "intellectual functioning cannot depend basically upon language" (236). This finding is supported by the famous Helen Keller. Due to disease she became deaf and blind at the age of 18 months when she was just starting to acquire language. Keller describes in her autobiography *The Story of My Life*, how, from the age of 18 months until she was 8 years old, she lived in isolation due to lack of language. Despite the lacking language Keller tells how she experienced sorrow and repentance when she behaved badly, which, according to Steinberg, has important implications:

These were experiences for which she has no words at the time (it is unlikely that she would have learned such words in her infancy) but for which she had concepts. If she could not think, she would not have been able to remember details of her past mental states. Her memories of her past, before she had the language with which to express them, were more than just a sequence of feelings and emotions. Keller had thoughts and ideas which she had organized into a complex conceptual framework. Clearly, such mental construction as this did not require language for its establishment (Steinberg 167).

3.4 Language Determines some Human Thinking

3.4.1 Orwellian Determinism

The third version of strong linguistic determinism states that some human thinking is determined by language. This view is an integral part of the plot in Georg Orwell's novel *Nineteen Eighty-Four*, where a totaliterian government, The Party, attemps to control its subjects' thinking by manipulating language. A new language, Newspeak, is developed which has been stripped of all words which are ideologically incompatible with the ruling ideology with the aim of making the banned concepts unthinkable. In an appendix to the novel Orwell elaborates upon Newspeak:

> The purpose of Newspeak was not only to provide a medium of expression for the world-view and mental habits proper to the devotees of Ingsoc [English Socialism], but to make all other modes of thought impossible. It was intended that when Newspeak had been adopted once and for all and Oldspeak forgotten, a heretical thought — that is, a thought diverging from the principles of Ingsoc — should be literally unthinkable, at least so far as thought is dependent on words. Its vocabulary was so constructed as to give exact and often very subtle expression to every meaning that a Party member could properly wish to express, while excluding all other meanings and also the possibility of arriving at them by indirect methods. This was done partly by the invention of new words, but chiefly by eliminating undesirable words and by stripping such words as remained of unorthodox meanings, and so far as possible of all secondary meanings whatever (Orwell appendix I).

Orwell is careful not to regard all human thinking as being determined by language, because he adds the phrase "at least so far as thought is dependent on words" as a caveat. This version of linguistic determinism nevertheless leaves man's mental life very much at the mercy of language or language manipulation:

The word *free* still existed in Newspeak, but it could only be used in such statements as 'This dog is free from lice' or 'This field is free from weeds'. It could not be used in its old sense of 'politically free' or 'intellectually free' since political and intellectual freedom no longer existed even as concepts, and were therefore of necessity nameless. Quite apart from the suppression of definitely heretical words, reduction of vocabulary was regarded as an end in itself, and no word that could be dispensed with was allowed to survive. Newspeak was designed not to extend but to *diminish* the range of thought, and this purpose was indirectly assisted by cutting the choice of words down to a minimum (appendix I).

3.4.2 Requirement vs. Constitution

Carruthers makes a useful distinction between *constitution* and *requirement* when discussing how language thus determines thought (1-2). The constitution conception posits that natural language is the vehicle or medium of thought by being constitutively involved in thinking. The requirement conception, on the other hand, posits that language is a necessary condition for thought but it regards language and thought as different types of representations. Schaff distinguishes between a language-thought monism and language-thought dualism (81-119). Logically speaking monism is not linguistic determinism because there is only one kind of representation[6] whereas in dualism there are two kinds of representations where one determines the other. The idea that language is the medium of thought, where it is constitutively involved in thought, is in view of these criteria a language-thought monism, whereas the requirement conception is language-thought dualism.

3.4.2.1 A Case of Requirement: Vygotsky

The Russian psychologist Vygotsky argued that language and thinking have different origins within human beings. He proposed that up to the age of 3 speech and thought are independent, where thinking is non-verbal and words are the properties of objects instead of being symbols for objects. Such language and thought independence must be the foundation of all language and thought dualism. However, in Vygotsky's view subsequent cognitive development is partly determined by language because the child's self talk, or egocentric speech, becomes internalized as inner speech and the prelinguistic thinking becomes transformed by the inner speech:

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[6] Calling language-thought monism linguistic determinism is therefore a tautology because there must be something that determines something else

A prelinguistic period in thought and a preintellectual period in speech undoubtedly exist also in the development of the child. Thought and word are not connected by a primary bond. A connection originates, changes, and grows in the course of the evolution of thinking and speech (Vygotsky 119).

3.4.2.2 Arguments Against Requirement

The basis of requirement, however, is problematic. Firstly, if thoughts are determined by words, how are words formed initially? How did the concept which the word represents spring to mind when the word had not been created? Secondly, strong linguistic determinism would make translations very difficult or impossible. And yet the absence of a word does prevent the understanding of a concept. In other words lexical gaps do not lead to conceptual gaps. Napoli explains:

> German has the word *Schadenfreude*, which is a compound of the root for "misfortune" and the root for "joy." *Schadenfreude* is the pleasure one takes in the misfortunes of others. Although you might not have experienced this pleasure, nor might many Germans, you can understand the concept, regardless of the fact that English has no such word (45).

Thirdly, it is difficult to account for semantic change if language determines thought. In old Icelandic, for example, *frændi* used to refer to very close male relatives, such as "son" or "brother", and also to "friend" (Íslensk Orðsifjabók 214), but now it only refers to more distant male relatives as in "uncle" or "nephew". The Icelandic word *frændi* and English *friend* clearly derive from the same source, but whereas the meaning of the Icelandic term has shifted, the meaning of the English term is closer to the original meaning of the Icelandic term. If the term determines the thought or the concept how is it that the thought can change while the term remains the same?

3.4.2.3 A Case of Constitution: Carruthers

Peter Carruthers' Natural Language Hypothesis falls under the constitution conception or language-thought monism because language is, on this view, the medium of some thoughts. Carruthers acknowledges that not all thinking is linguistic: "while allowing that some thoughts (particularly visuo-spatial thoughts, and the thoughts available to animals and infants) are independent of language, it can nevertheless be claimed that other thoughts crucially implicate language" (Carruthers and Boucher 13). In his view only human conscious thinking or conscious propositional thought qualifies as being in natural language:

We mostly think (when our thinking is conscious) by imaging sentences of natural language, and trains of thought consist of manipulations and sequences of such images. We have access to the forms of our thoughts because a record or each imaged sentence is briefly held in short-term memory, so that we can recall what we have just imaged (Carruthers 228-229).

As Carruthers only maintains that conscious thoughts are linguistic his evidence rests on introspection: "Introspection informs us...that many of our thoughts are expressed entirely in natural language" (Carruthers 50). He further explains:

According to introspection, then, private and public thought are alike in that they both involve sentences of natural language. Just as a good deal of private thinking consists in the imaging of spoken or heard sentences, and in the manipulation of such images; so, too, many overt uses of language would seem to constitute a sort of *public thinking*. And both sorts of thinking operate in an essential manner – namely, in the one case in the imaging of, and in the other case in the utterance or writing of, sequences of natural language sentences (52).

Carruthers' Natural Language hypothesis then falls under the sententialist view of mental representation according to which thoughts, or mental representations, constitute a language. Just what that language is is debated among sententialists. He argues that the best explanation for conscious thinking, as revealed by introspection, is that it is in natural language.

3.4.2.4 Arguments Against Constitution

However, if Carruthers can use introspection as evidence for human conscious thinking being in natural language it also reveals that positing language as the medium of such thinking is problematic. Sometimes we seem to have difficulties finding the right words for what we have in mind. This is the so-called 'tip-of-the-tongue' phenomenon. It could be explained by saying that the thought is not fully formed and therefore lacks linguistic form (Devitt and Sterelny 143). That, however, does not explain a related experience i.e. that of saying something and then realizing afterwards that that was not what you meant to say. If language is the medium of thought, what we say must be what we thought. And we certainly do not always mean what we say on purpose; otherwise we would be incapable of lying or sarcasm. Then there is the fact we do not always remember exactly what is said to us but instead we remember the 'gist' of what was

said (Pinker, *Stuff* 149). These introspective examples suggest that there are problems with equating thought with language.

Language is also ill suited as the medium of thought because it underspecifies meaning (Pinker, *Language* 78-81). Firstly, language is ambiguous in that words can either share the same pronunciation (homophones) or the same spelling (homographs). *Son* and *sun*, for example, are homophones and *bark* is a both homophone and homograph because it can mean either the sound of a dog or the skin of a tree. If words share both pronunciation and spelling they are said to be homonyms. That fact that the same linguistic form can refer to different thoughts suggests that language cannot be the medium of thought because the thought is unambiguous regardless of whether or not language is ambiguous. Ambiguity shows, moreover, the necessity of context, or deixis, when conveying the intended meaning. Whole classes of words need contextual information for correct understanding The most common categories of deixis are Person (I, you, he/she/it/they), Place (here/there, this/that), and Time (today, later). In the phrase *I saw you there yesterday* it is not explicit who *I* and *you* are, where *there* is and when *yesterday* occurred. The thought behind this phrase, however, is explicit because the speaker knows exactly *who* saw w*hom* and *where*.

The lack of explicitness in language is further revealed by the fact that the same thought can be referred to by different terms. The four-wheeled object in the parking lot can be referred to as *the blue Skoda Octavia*, *the Skoda*, or just *it*, all within the same conversation or text. The technical term for this feature is co-reference. Synonymy is also based on multiple references. *Car* and *automobile*, for example, are synonymous, because both terms refer to the same type of thing. *Student* and *pupil* are further examples of synonymous terms. However, although terms can be synonymous the different terms tend to have different shades of meaning and used in different context. *Car* and *automobile* are not completely interchangeable terms. The sentence *The girl picked the guy who owned the most expensive automobile* sounds a bit odd. Synonymy may then not be a good example after all of different terms referring to the same thought. Co-reference, however, is a true example of multiple reference and it suggests that if the same thought can be expressed in different terms, these terms, these verbal forms, cannot be the medium of the original thought because there is only one thought.

Language is, moreover, ill suited as a medium of reasoning because it lacks logical explicitness. According to Pinker:

Language is only usable with the support of a huge infrastructure of abstract mental computation. Not only are sentences cluttered with information that is tailored for auditory communication – such as the sounds of speech, the ordering of words in time, and many devices for engaging the attention of a listener – but it fails to contain information that is essential for lucid inference (*Stuff* 150)

Pinker (*Language* 80) gives an example devised by the computer scientist Drew McDermott:

Ralph is an elephant.

Elephants live in Africa.

Elephants have tusks.

Natural language, English in this case, fails to make the distinction that Africa is a common factor and that tusks are individual factors, i.e. that Africa is the same continent but the tusks are not the same for all elephants. This example shows a lack of logical explicitness according to Pinker

Jackendoff argues, furthermore, that sense, or nonsense, is independent of the linguistic form. He shows how sentences can be grammatically correct yet at the same time completely nonsensical. *My toothbrush is pregnant* is a grammatically correct sentence and yet the meaning does not make any sense. Chomsky's famous nonsense sentence *Colourless green ideas sleep furiously,* makes the same point. But it also works the other way around i.e. a sentence can make sense and yet be grammatically incorrect. The sentence *What did Beth eat cereal and for breakfast?* makes sense and yet is ungrammatical. This discrepancy between the grammar and the meaning is only possible because language and thought are separate systems of representation, Jackendoff argues (*Patterns* 186-187).

And not only are they separate but also built out of different units he further argues. The syntactic structure of language is comprised of units such as nouns, verbs, tenses and prepositional phrases. Thought, however, uses units such as objects, actions, properties and times. In syntax, for example, *chair* and *earthquake* are both classified as nouns. In thought, however, these nouns must be distinguished because chair is an object and earthquake is an event. Language and thought then are not only distinct systems of representation, they also are built out of different classes of units.

Machery, moreover, argues that introspection is not a valid argument for sentenialism. He does not deny the validity of the subjective experience of introspection as such. The experience of hearing an inner silent monologue, of hearing oneself think in a natural language, is not contested by him. What Machery argues is that Carruthers Natural Language hypothesis confuses the content of thoughts with the vehicles of thought. He points out that the sententialist view rests on the constituency principle, namely that "a complex symbol is compounded out of other symbols" (474) and that constituency is a structural property of the vehicles of thought. Therefore, Mahcery argues, sententialism is a thesis about the vehicles of thought and not a thesis about the content of those thoughts. According Machery then the inner speech observed during introspection does not reveal the vehicles of thought but only the content of those thoughts: "*the sentences that are uttered in inner speech are part of the content of our conscious thoughts*" (476; italics original).

Slezak argues that Carruthers' Natural Language Hypothesis suffers from the same shortcomings as Kosslyn's pictorial account of visual imagery. Both accounts posit a short-term memory buffer which stores images which are available for reinterpretation and reinspection as "surrogate objects" (364). However, as Slezak explains "However different the cognitive domains, the common question concerning vehicles of thought presents common pitfalls. On Ryle's view, just as visual imagery must be explained without pictures in the head, so thought must be explained without sentences in the head" (362). Maintaining that we visualize in pictures and that we think in language are instances of the homunculus fallacy. Pictures or sentences in the head necessarily need a little man, an homunculus, inside the head to see and hear those images. Again there no denying that pictures and sentences can be the objects of thinking. The fallacy occurs when the properties of the objects are confused with the properties of mental representations, the vehicles of thought. Or as Slezak explains: "just as images representing space do not require the representations to actually have spatial properties, so imagining speech does not require the representations to actually be linguistic" (366). In the light of these arguments Carruthers' Natural Language hypothesis loses its very foundations because introspection does not reveal the vehicles of thought, the nature of the mental representations, but only the content of thought. This brief survey then suggests that not only is language ill suited as the medium of thought but also that it is fallacious to posit that thoughts have linguistic properties.

3.5 The Rejection of Linguistic Determinism

The preceding review has revealed some of the arguments against strong linguistic determinism. All the strong versions of linguistic determinism were thus rejected and Whorf's views along with them. Much of the second half of the 20th century was a period of extreme scepticism regarding Whorf's views and the possibility of any linguistic influence on thought which was in keeping with the general development within the fields of linguistics and psychology. Gentner and Goldin-Meadow explain:

In linguistics, the Chomskyan emphasis on universals of grammar, coupled with the view that language is a separate system from general cognition and with a de-emphasis of the semantic arena, discouraged any search for a relation between language and cognition. Within cognitive psychology, there was a strong sense that concepts come first and that language merely names them…In cognitive development, the Piagetian influence favoured the same direction of influence – from thought to language (5).

These developments in linguistics and psychology contributed to the dismissal of Whorf's views because he had become synonymous with strong linguistic determinism. The zeitgeist thus led to the marginalization of Whorf. "In most circles of experimental psychology", Hardin and Banaji explain, "it is impossible to mention Whorf's thesis without quick acknowledgement of its empirical disconfirmation" (279). Lakoff comments that "most 'responsible' scholars have steered clear of relativism. It has become a bête noir, identified with scholarly irresponsibility, fuzzy thinking, lack of rigor, and even immorality" (304). And according to Gentner and Goldin-Meadow "[a]dmitting any sympathy for, or even curiosity about, this possibility was tantamount to declaring oneself to be either a simpleton or a lunatic" will led to the discussion of language and thought being "about as respectable as discussions of flying saucers" (3,6). Pinker's decisive dismissal of the Whorfian hypothesis in *The Language Instinct* became an obituary of sorts and for many this book was indeed the end of linguistic relativism and determinism, although Whorf continued to be popular within the social sciences. Ironically, however, when *The Language Instinct* was published Whorf was in the process of undergoing a revival in the form of Neo-Whorfianism.

In 1991 a Symposium was held in Jamaica whose topic was the rethinking of linguistic relativity. The result of this Symposium was the birth of Neo-Whorfianism. A shift in research, away from colour terminology, to investigation of other domains such as the influence of number systems on mathematical thinking also played an important

part. The work on number systems began with the work of Miller and Stiegler but this line of research is perhaps best exemplified in Hunt and Agnoli's influential review paper which introduced a cognitive view of the SWH. At the symposium Slobin presented an influential paper on 'Thinking for Speaking' which laid important theoretical foundations for Neo-Whorfianism. Slobin's ideas motivated the work on spatial terminology and spatial orientation, which began with Levinson and colleagues and led to a series of tests within the spatial domain and a lively controversy and spatial orientation became the flagship of Neo-Whorfianism.

4.0 Neo-Whorfian Studies I: Number Terms

Stevenson, Lee and Stigler documented the poor performance of American children in mathematics as compared to their Japanese and Chinese counterparts. Miller & Stigler investigated the role of number systems on counting performance. They compared English speaking American children with Chinese speaking Taiwanese children aged 4-6 and found that Taiwanese children were better at counting, showing greater accuracy and reaching larger numbers. They found, furthermore, the 'teen' numbers were "a particular stumbling block for American children's counting" (279).

English lexicalizes number in a more complex way than the Chinese languages as well as other Asian languages such as Japanese, Korean, and Thai (Park 19). For numbers 0-10, English and these Asian languages are very similar. However, the number terms of the Asian languages are based on a base-10 number system, which means that the teens in Asian languages are represented by number terms where the decade term is followed by unit term (Carroll 374). In Chinese, for example, 11 is *ten one* and 12 is *ten two*. Similarly, in numbers 20-99: the decade is followed by a unit. In Chinese the term for 34 is thus *three ten four*. Chinese speakers must then only know 11 basic number terms (0-10) plus three special terms for a *hundred*, a *thousand*, and *ten thousand* (Harvey 84). English, on the other hand, employs more complex number terminology after 0-10. To start with, 11 (*eleven*) and 12 (*twelve*) have terms unrelated to the terms for 1 (*one*) and 2 (*two*). Then the terms for 13-19 consist of unit term followed by the decade term (*eighteen*). Terms for 20-99, furthermore, consist of the decade term before the unit term (e.g. thirty-four). The Miller and Stiegler study suggested that the number naming system influenced the development of counting ability. It was easier for the Taiwanese children to learn to count in the "teens" than their American peers because their language contained a simpler number naming system.

4.1 The Miura Studies: Better Performance of Asian Children

Miura investigated the relationship between number word systems and mathematical cognition in a series of studies. In these studies children were asked to construct various numbers using base 10 blocks and unit cubes. Miura et al ("Effects" 1445-1450) compared how American, Chinese, Japanese, and Korean children cognitively represent number in order to determinine whether Asian and non-Asian languages lead to

differences in mathematical cognition. They found that the Asian children were more likely to use base 10 blocks rather than unit cubes when constructing numbers whereas the American children preferred to use unit cubes. This suggested that the number naming system affected how the children represented number cognitively because these Asian languages use the base 10 number counting system.

Miura and Okamoto tested American and Japanese children in order to see whether differences in the understanding of place value as well as the cogntive representation of number, due to language differences, would explain differences in the mathematical performance between students from those countries. They found that the Japanese children were better than their American counterparts in constructing correct representations of number using base-10 blocks as well as understanding the concept of place value (109-114). Miura et al ("Comparisons") study showed similar results, which led Miura et al to conclude that "variability in mathematics performance may be due to differences in cognitive representation of number that is affected by numerical language characteristics differentiating Asian and non-Asian language groups" (402). It must be emphasized however that Miura et al do not claim that language is the sole determining factor, but rather that other factors may also play a role in cross-linguistic differences in mathematical performance.

4.2 Towse and Saxton: The Importance of Cultural Factors

Towse and Saxton criticised the methodology used in the Miura studies. They firstly argued that the studies failed to show a direct relationship between language and cognition in the number matching tasks. They pointed out that the Miura et al ("Comparisons") study used a standard paradigm where the children were first shown how to use cubes with two examples, 2 and 7. Towse and Saxton argued that the use of examples with units "would further reinforce the salience of units as a method for constructing number values" (367). The implication here is that English-speaking children were not lacking in understanding in base 10 or multidigit numbers but rather that they were more prone to follow instructions. According to Towse and Saxton the reason for this was perhaps due to English-speaking children having less exposure to and practice with working with numbers than their Asian counterparts. They argued that the less experienced English-speakers "would therefore require more powerful cues to reveal their cognitive competencies" (367). In a number of experiments involving English-speaking children Towse and Saxton attempted to find out whether the

children's performance would vary according to differences in instructions. In testing this "cuing hypothesis" the children were given examples where both units and ten blocks were used. If the children still used only units, despite having been give examples with ten blocks, then that would indicate that they did not understand multiple units. However, the experiments showed that the use of units varied significantly with the examples provided. They concluded: "the data are consistent with the notion that English-speaking children may lack confidence, and not necessarily competence, in using number" (370).

Towse and Saxton further investigated the role of number experience by testing younger English-speaking children. By comparing their performance with that of older children the variable would not be a difference number naming system but number experience. And it was indeed demonstrated that the exact form of the instruction had a significant impact on the performance of young children (372). These experiments then led Towse and Saxton to suggest that differences in mathematical performance may be due to more factors than simply differences in number naming systems. Apart from number experience and experimental conditions they also point to differences in "cultural experiences and teacher experience" (372). This is in keeping with the work of Stevenson. Lee and Stiegler who found that the cognitive abilities of Chinese, Japanese and American children are similar but that "large differences exist in the children's life in school, the attitudes and beliefs of their mothers, and the involvement of both parents and children in schoolwork" (693).

4.3 Brysbaert et al: Autonomy of the Number System from the Language System

Brysbaert, Fias and Noel bypassed some of the methodological and cultural issues when they compared the mathematical competence of Dutch and French speakers. The Dutch and the French cultures are much closer in similarity than the English and Asian cultures. However, in the Dutch number naming system, like the Asian languages already described, units are placed before tens, and 24 is therefore read 'four-and-twenty'. In French, however, as in English, the order is reverse, where 24 is read 'twenty-four'. Brysbaert et al first tested whether this difference in order was reflected in verbal solutions to simple addition tasks. The tasks involved the addition of two-digit numbers with a one-digit number and the order of the digits was manipulated, e.g. 20+4 vs. 4+20. All sorts of combinations of single and multiple digits were used and the order

was arbitrary. The tasks were, furthermore, presented in both a verbal form as well as in a written number form (Arabic). The speakers were asked to provide a verbal solution as fast as they could to these tasks. If addition was based on language then the expected results would be that for the Dutch speakers the 4+20 problem was easier to solve than the problem of 20+4 whereas the opposite would be true for French speakers (60).

> The results showed that the French speaking subjects experienced an advantage of 114 ms when the problems were presented in the T&U order (20+4) than when they were presented in the U&T order (4+20). This effect was the same whether the problems were presented in the Arabic or verbal format (110ms vs. 118 ms). In contrast, the Dutch-speaking subjects only showed a 74 ms advantage for the T&U order when the problems were presented in Arabic code. For the verbal code, there was no difference between the T&U and U&T order (2 ms) (65)

Brysbaert and colleges concluded that there was indeed a language difference for the T&U problems which indicated that "mathematical operations are not completely impervious to language influences" (66).

In a second experiment, Brysbaert, Fias and Noel tested whether the differences in mathematical performance were due to differences in mathematical thinking or due to output form. The difference in mathematical performance disappeared when the Dutch and French speakers were asked to type the solution on a keyboard instead of verbalizing it which demonstrated that the differences were due to input-output form rather than mathematical thinking. Brysbaert and colleges concluded:

> All in all, instead of showing a Whorfian effect, our study has demonstrated how careful one must be in interpreting a language difference in a numerical task as the result of a difference in the semantic number system. Only by carefully controlling all input and output factors, is it possible to disentangle a real Whorfian effect from peripheral language differences. As such, our results add evidence to the idea that the numerical system is largely autonomous of the language system (except maybe during the acquisition phase) (74-75).

4.4 The Word Length Effect

Another line of research has focused on the relationship between number terminology and memory. Ellis and Hennell conducted 5 experiments which demonstrated that Welsh number terms take a longer time to pronounce than English number terms, even though they share the same number of syllables. Ellis and Hennelly also found that when bilingual speakers used Welsh number terms they showed worse performance on digi-span tests, which measure short term memory, than when they used English number terms. They also showed slighly worse performance in mental arithmetic tasks when using Welsh number terms. "This finding", they concluded, "is an effect of word length, and leads to the suggestion that any operation which involves remembering numbers (anything from mental arithmetic to the remembering of telephone numbers) will be more difficult to perform in the Welsh language than in the English language" (51).

Hoosain and Salili compared English-speaking and Chinese-speaking undergraduates. They found that the Chinese-speakers pronounced number terms faster and scored higher on digi-span tests. Hoosain and Salili suggested "that observed differences in digit span norms between language communities might be due to differences in pronunciation speed for numbers in the respective languages and that the latter might also affect capacity for mental manipulation of numbers" (34). More recently, Chan and Elliott studied the difference between performance of Chinese and Malay participants in digit memory span tasks. Chinese number terms have shorter pronunciation duration than Malay number terms and the results showed that the Chinese scored higher on the digit memory span tasks than the Malay. According to Chan and Elliott these results support the phonological loop hypothesis as an explanation for these cross linguistic differences. The phonological loop is the sound-based-aspect of working memory, which temporarily stores and processes information. These investigations of word pronunciation length and memory span show that they are inversely related: the shorter the pronunciation of the word the larger the short term memory span. This phenomenon has been called "word-length effect" (Chan and Elliott 25).

The research on number terminology has then shown that the codability of the number system may influence the relative ease of learning number systems. The complexity of the number system, which can be described as being one aspect of

codability, seems to influence how fast children learn the number terminology of their respective languages, although influence on actual mathematical performance is disputed. The word-length-effect, however, seems to support Lennerberg and Brown's work on codability and memory: the shorter the term, or the higher the codability, the greater the memory. This leads to a kind of linguistic relativity according to which certain mental processes, such as memory in this case, are easier or more difficult in different languages. So far the studies reviewed have at most shown support for the weaker, where language influences memory, and weakest, where language influences reasoning, forms of linguistic determinism. However, research on number terminology also led to a claim of strong linguistic determinism.

4.5 Gordon: The Piraha as a Case of Linguistic Determinism

Gordon studied the Piraha tribe of Brazil. He found that they have only three number terms with which they count: *one (hói)* , *two (hoí)*, and *many* (497), which are, moreover, used imprecisely, depending on the context. One means "roughly one" and can be used for small quantities two, three or even more. Two always means more than the term for one, similarly to how the term *a couple* is used both for *two* and also for varous small numbers. This suggests, however, that these are quantifiers rather than actual number terms. Gordon tested the Piraha in various number tasks and found that they performed well when dealing with 2 or 3 items, but when dealing with larger numbers their performance was poor. The Piraha, however, showed a curious anomaly in performance. When they encountered numbers 7 through 10 their performance shot up to near perfect. According to Gordon the best intrepretation of the anomaly is that the Piraha were using a "chunking strategy" to reduce the cognitive demands of larger sizes. This latter numerical competence, sometimes called analog magnitude estimation, seems to be independent of the linguistic number system and it has been demonstrated by prelinguistic babies and animals. Based on these experiments Gordon asked "whether humans who are not exposed to a number system can represent exact quantities for medium-sized sets of four or five. The answer appears to be negative". Gordon argued that because of their impoverished number system the Piraha only had the ability of conceptualize exact numbers up to 3. "The present study", he concluded, "represents a rare and perhaps unique case for strong linguistic determinism" (498).

Casasanto criticised Gordon's methodology and describes the conclusions as a case of "Crying 'Whorf'". He firstly points out the lack of an appropriate control group, which is this case, "might be members of another tribe whose culture and habitat are similar to the Piraha's, but whose language includes exact number words". Without such controls, Casansanto argues, "it is impossible to tell whether Gordon's results reveal a limitation of the Piraha's numerical competence or only a limitation of the tasks used to measure their competence" ("Letter" 1721). He also argues that Gordon fails to demonstrate that the impoverished numerical system causes the poor numerical capacity and that the results can be interpreted in an opposite way, namely that the Piraha did not develop the capacity to keep track of large exact quantities because it was not a critical capacity in their society and therefore they never developed the vocabulary.

4.6 Pica et al: Approximate vs. Exact Number Sense

Pica et al studied the numerical cognition of the Munduruku, an Amazonian tribe in order to "clarify the relation between language and arithmetic" (499). Despite the Munduruku and the Piraha being very similar tribal cultures, the Munduruku language has more number terms than the Piraha language.The Munduruku would then seem to be an ideal comparison group, being a similar culture differing only in number terms. However, the Munduruku had had more outside contact than the Piraha. Some of the Munduruku spoke some Portugese due to contact with government officials and missionaries and a few, mainly children, had received some schooling (500). In order to assess the possible influence of these factors two groups were formed: one which consisted of strightly monolingual adults and children without schooling and the other which consisted of bilingual and educated Munduruku.

Pica et al first attempted to establish the verbal expressions for number in Munduruku. They presented the participants with displays of 1 to 15 dots in randomized order and then asked how many dots were present. As anticipated, the results showed that the Munduruku language has "frozen expressions only for numbers 1 to 5" (500): *pug/pug ma* (one), *xep xep* (two), *ebapug* (three), *ebadipdip* (four), and *pug pogbi* (five or one hand). However, of these five number terms, only terms for 1 and 2 were used precisely, whereas other number terms were used approximately. The term for 5, for example, was sometimes used for 6, 7, 8 or 9 dots and when 5 dots were shown the term for 5 was used only in 28% (500). There are three terms for numbers above five, i.e. *xep*

xep pogbi (two hands), *adesu/ade gu* (some, not many), and *ade/ade ma* (many, really many), but these terms are used very inconsistently. It also became apparent that the Munduruku did not use their number terms for counting. Usually they uttered a number term without any sign of counting, which suggested that they were using the terms appromixately. As in the case of the Piraha this suggests that these are not number terms which are used vaguely or imprecisely but rather than these terms are quantifiers. Some of the Munduruku did show that they were able to count but they did so with great difficulty by a nonverbal process of matching their fingers and toes to the dots. Pica et al summarized the Munduruku number resources: "Thus, the Munduruku are different from us only in failing to count and in allowing approximate use of number words in the range 3 to 5, where Western numerals usually refer to precise quantities" (501).

Pica et al also found that the Munduruku capacity to use approximate number was not limited by their small number vocabulary. In a number comparison test the Munduruku were shown two sets of 20 to 80 dots and asked to point to the more numerous set. Their responses were far above chance level which showed that the Munduruku used approximation for numbers far beyond the limits of their number vocabulary. Bilingualism and education had also very little effect because there was no significant difference between the performance of the Munduruku groups. The Munduruku also performed considerably above chance (501) when tested on addition tasks for approximate numbers.

Pica et al finally tested the exact number sense of the Munduruku. In an exact subtraction task, the participants were asked to predict the result of a subtraction of sets involving one to eight items. The results were small enough to be named: 0,1, or 2 items left. When the initial number was below four the Munduruku's performance was close to 100% (502) but when five or higher their performance plummeted. According to Pica et al these findings add to previous evidence which shows that there is a distinction between approximate and exact number sense. According to this larger set of data, preverbal infants and many animal species have demonstrated number approximation which has led researchers to believe that this is a more basic non-linguistic number competence.

According to Pica et al, three important points emerge from this study. Firstly, it is significant that even though the Munduruku had terms for 3, 4, and 5 they used these terms approximately. Having number terms then does not then automatically provide access to mental representation of exact number. The Piraha and Munduruku languages

may thus differ in number terms and yet the speakers of these languages show very similar number performance. Secondly, the Munduruku were able to mentally represent and manipulate very large numbers, far beyond the range of their number terms. According to Pica et al this second point "provides an important qualification of Gordon's version of Whorf's hypothesis according to which the lexicon of number words drastically limits the ability to entertain abstract number concepts" (503). The last important point is that the Munduruku do not have a counting routine. According to Pinker (*Stuff* 141) a counting algorithm is a prerequisite for exact number concepts beyond the number 2, not a number vocabulary and the Pica et al study seems to support that.

4.7 Everett: Cultural Contraints of the Piraha

Everett also studied the Piraha but was also unconvinced that linguistic determinism was the best explanation of the Piraha Numerical performance. According to Everett's analysis the Piraha language actually lacks number, numerals and counting. However, he acknowledges that there "are three words in Piraha that are easy to confuse with numerals because they can be translated as numerals in some of their uses" : *hói* (small size or amount), *hoí* (somewhat larger size or amount), and *bá a gi so* (cause to come together or many) (623). Everett's analysis also revealed that the Piraha also lacks other forms of precision:

> It also lacks terms for quantification such as "all," "each," "every," "most," and "some". It is the only language known without color terms. It is the only language known without embedding....It has the simplest pronoun inventory known, and evidence suggests that its entire pronominal inventory may have been borrowed. It has no perfect tense. It has perhaps the simplest kinship system ever documented. It has no creation myths – its texts are almost always descriptions of immediate experience or interpretations of experience; it has some stories about the past, but only of one or two generations back. Piraha in general express no individual or collective memory of more than two generations past. They do not draw, except for extremely crude stick figures representing the spirit world that they (claim to) have directly experienced (622).

As Everett remarks, each of these aspects of the Piraha culture and language would warrant further investigation. He suggests that the fact that they all occur within the same language suggests "the existence of a common unifying generalization behind them" (622). Everett proposes that all these characteristics of the Piraha language follow

from common cultural constraints. He describes how, at the Piraha's own initiative, he tried to teach them to count in Portugese. The Piraha wanted to know whether they were being cheated by some of the traders who came during the Brazil nut season. In their usual trading there was "no evidence whatsoever of quantification or counting or learning of the basis of trade values" (626) so cheating the Piraha should not have been so difficult. However, after eight months of daily classes "the people concluded that they could not learn this material, and classes were abandoned. No one learned to count to ten, and not one learned to add 3+1 or even 1+1" (626).

There are several explanations possible for Piraha performace. Everett rejects Gordon's Whorfian explanation that the Piraha's lack of counting abllity is due to lack of number words because many other Amazonian tribes have borrowed number words when the need arose. Everett's hypothesis is that the Piraha's counting 'deficiency' and their failure to borrow words are due to a cultural value which the Piraha share which is to refer only to immediate experience (634). This cultural constraint and not the linguistic factor is the best explanation according to Everett. Pinker also argues that hunter-gatherer tribes do not need exact number because "they keep track of things as individuals, one by one. A hunter, for example, recognizes each of his arrows, and thereby knows whether one is missing without having to count them" (*Stuff* 138).

4.8 Frank et al: The Piraha Can Understand Exact Matching

Frank et al investigated the Whorfian claim that only by learning number terms can the concept of exact quantity be grasped. They distinguished between a weaker claim, that number terms allow accurate memory and use for exact number, and a stronger claim, that number terms creates the concept of exact quantity (820). They first investigated the number vocabulary of the Piraha and found that none of the three words were used consistently. These terms were rather used as relative or comparative terms (few or fewer) than as exact terms (one) or even as approximate terms (roughly one), which again suggests that these are not number terms but terms of quantification. According to this description then Gordon's translation of *moi* as roughly one is inaccurate. The investigation further revealed that the Piraha language lacked altogether terms or morpehemes for exact number.

The numerical abilities of the Piraha were also investigated (821). Fourteen adult Piraha speakers were tested in 5 matching tasks: hidden, uneven, orthogonal, one-to-one, and nuts-in-a-can. Special care was taken to ensure that the parcticipants

understood the tasks. The results of the orthogonal match, hidden match, and nuts-in-a-can task were consistent with those reported by Gordon where performance decreased as quantity increased. Performance in the one-to-one matching and uneven match task, however, was close to perfect. Frank et al suggest the difference in performance reflects the demands of the tasks (822). The orthogonal, hidden, and nuts-in-a-can tasks require understanding of exact matching as well as memory for exact numbers. The uneven match task and the one-to-one matching, on the other hand, require only the understanding that exact match was necessary and no memory of the exactness of the matching.

According to Frank et al "this evidence argues agains the strong Whorfian claim that language for number creates the concept of exact quantity" (823). On the contrary, this study showed that the Piraha, without the necessary linguistic resources, could indeed understand exact matching. What the relevant number vocabulary does is allow speakers to remember and compare exact quantity. "Thus, numbers may be better thought of as an invention:", they conclude, "a cognitive technology for representing, storing, and manipulating the exact cardinalities of sets" (823). The study revealed that the Piraha do not possess this cognitive technology.

4.9 Discussion

Some of the strongest claims for linguistic determinism in recent years have then come from research into the number terminologies and mathematical reasoning of tribal cultures. Gordon claimed that the Piraha language lacks terms for exact numbers and as a result the Piraha do not have the capacity to grasp the concept of exact number. Yet Pica et al studied the Munduruku and found that even though the Munduruku language has more number terms than the Piraha language, including two terms for exact number (1-2), the members of the Munduruku tribe do not have a greater sense for exact number than the Piraha. Further research of the number sense of the Piraha (Everett, Frank et al) revealed that other explanations than strong linguistic determinism are more plausible, i.e. that the number vocabularies of these tribal languages reflect the needs of their speakers. As Casasanto ("Letter" 1721-1722) argued these cultures have not had any need for exact number above 3 or 4. The basic number sense, inherited from our ancestors, which small children and some animals employ, has been sufficient to their needs. It consists of two systems for keeping track of quantities. Pinker explains:

One is an analogue estimation system, in which quantities are gauged in an approximate manner by relating them to some continuous magnitude in the head, such as a vague sense of "amount of stuff," or the extent of an imaginary line. The second system keeps track of exact quantities, but only up to a small limit, around three or four (*Stuff* 133).

This is exactly what the number vocabularies of the Piraha and the Munduruku reflect. Neither language has any terms for exact number containing instead a limited number of quantifiers. The speakers of Piraha and Munduruku understood approximate quantities and exact number up to 4. In order to think about exact numbers beyond the basic number sense what is needed is a counting algorithm and training in arithmetic operations. However, as has already been described, the Piraha could not learn how to count in Portuguese despite months of training. Access to exact number terms did not then enable them to think in exact quantities and, interestingly, neither did access to a counting routine. The most plausible explanation is that the Piraha were unable to learn exact number because of cultural constraints.

5.0 Neo-Whorfian Studies II: Spatial Orientation Terms

5.1 Pederson et al: Diversity in Spatial Orientation Lexicalization

Studies on spatial orientation terminologies and performance on spatial orientation tests have been the flagship of neo-Whorfian studies. The Pederson et al survey was the first cross-linguistic study on the relationship between spatial language and spatial orientation. They started with a cross linguistic survey of spatial vocabulary using data from ten different language families collected in thirteen different language communities. Except for Netherlands (Dutch), Japan (Japanese), and Tamil Nadu (Tamil), the linguistic communities were "small-scale 'traditional' and often nonliterate societies": Mopan (Belize), Tzeltal (Mexico), Yucatec (Mexico), Totonac (Mexico), Kilivila (Papua New Guinea), Longgu (Solomon Islands), Kgalagadi (Botswana), Hailom (Namibia), Arandic (Australia), and Belhare (Nepal) (Pederson et al 560). All data was drawn directly from native speakers and the researchers focused on language use rather than relying on lexical or grammatical descriptions.

They found three kinds of frames of reference in the data:

- <u>Egocentric/relative frame of reference</u>, which uses the body or organism as the frame of reference. Thus objects seen from a subjective perspective; they are to the *left* or *right*, or they can be *front* of or *back* of the speaker or viewer. This frame moves with or rotates with the viewer and is therefore said to be egocentric; it is always relative to the viewer. However, it can be projected onto other viewers or objects so for example *right* and *left* have opposite meaning for two viewers facing each other.
- <u>Intrinsic frame of reference</u> which is based on object orientation such as *in front of the car*, *behind the house*, where the objects have intrinsic facets because the front of the car, for example, is always the front and is not subjective to the viewer.
- <u>Absolute frame of reference</u> which uses fixed bearings or geographic features such as the four cardinal directions (*east*, *west*, *north*, *south*) or a landmark (*uptown*, *downtown*) for reference. (572).

Six languages, roughly half, use both relative and absolute frames of reference, where speakers either used both systems or the frame used varied among the speakers: Belhare, Hailom, Kgalagadi, Tamil, Totonac, and Yucatec. In the rest of the languages the speakers used exclusively one type of frame of reference: Kilivila and Mopan used only intrinsic, Japanese and Dutch used only relative, and Arandic, Tzeltal, and Longgu used only absolute.

The egocentric frame had previously been considered to be universal. It certainly appears easier to use because this frame is based on the viewer's body and visual field (Deutscher 163). The viewer always knows were left, right, front, and back are[7]. In this frame there is no need to take notice of the environment. For this reason all spatial thinking had been considered, from Kant onwards (Levinson, *Space* 8) to be essentially egocentric. Levinson's study of the Australian aboriginal language Guugu Yimithirr, however, led to a revision of the supposed universality of spatial description because this language only lexicalizes the absolute frame of reference. Describing the speakers of Tseltal, another language which only lexicalizes the absolute frame, Levinson described them as having a "learned ability to maintain fixed bearings at all times" (*Space* 168). Boroditsky describes the difference between the spatial orientation ability of the speakers of Kuuk Thaayorre, another Australian aboriginal language, which only uses the absolute reference frame, and the speakers of English, which mainly uses the relative reference frame:

> One obvious consequence of speaking such a language [Kuuk Thaayorre] is that you have to stay oriented at all times, or else you cannot speak properly…speakers of languages like Kuuk Thaayorre are much better than English speakers at staying oriented and keeping track of where they are, even in unfamiliar landscapes or inside unfamiliar buildings. What enables them – in fact, forces them – to do this is their language. Having their attention trained in this way equips them to perform navigational feats once thought beyond human capabilities" ("How Does our Language Shape the Way we Think?" 2-3).

And this is exactly what the Peterson et al study found.

After the initial survey of the lexicalization of spatial orientation Pederson et al next asked whether these cross-linguistic differences "co-vary with differences in nonlinguistic spatial conceptualization and problem solving" (573). They excluded the purely instrinsic languages and mixed languages and devised a rotation experiment with

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[7] Even though the egocentric frame of reference is relatively easy to use not all speakers of languages which mainly use this frame remember which side is right and which is left.

two equally correct solutions: a relative solution and an absolute solution. Participants were shown, and asked to memorize, an array of toy animals which all faced in the same direction. Then the participants were turned around 180 and asked to reconstruct the array. If the toy animals turned with the participants, i.e. kept the array and thus changed direction, they were using a relative frame of reference whereas if the participants kept the direction which the toy animals were facing constant while they turned they were using an absolute frame of reference. The results indicated that the lexicalized frame of reference correlated well with the conceptual frame of reference used (580): participants whose language employs an absolute frame of reference were more likely to use an absolute frame when performing the task and vice versa. Pederson et al concluded: "The linguistic system is far more than just an AVAILABLE pattern for creating internal representations: to learn to speak a language successfully REQUIRES speakers to develop an appropriate mental representation which is then available for nonlinguistic purposes" (586).

5.2 Li and Gleitman: The Importance of Spatial-Contextual Conditions

Li and Gleitman argued that the spatial-contextual conditions of experimentation were an unrecognized variable in previous experiments and they set out to investigate whether the choice of a frame of reference would change if the spatial-contextual conditions were changed. Li and Gleitman reproduced the Pederson et al experiments using only monolingual English speakers. Crucially they altered the context in which the participants carried out the line-up-the-animals task by adding implicit landmark cues of various kinds. In the first experiment twenty subjects were tested in a featureless laboratory which had a floor-to-ceiling window at one side. Half were tested with the blinds pulled down while the other half were tested with the blinds raised revealing the familiar sight of the university library. No mention, however, was made of the blinds or landmarks to any of the participants. The participants who were tested with the blinds down showed a preference for the relative frame of reference. However, the participants tested with the blinds up chose both the relative and the absolute frames of reference.

In order to further reproduce the landmark cues available to speakers of Tzeltal the 10 subjects in the second experiment were tested in a large grassy area on Penn campus. Experiment 1 was repeated albeit with buildings and roads visible. This time the subjects showed a bias towards the absolute frame of reference, although not to quite the same degree as the speakers of Tzeltal. "Can landmark information", Li and

Gleitman asked, "if it is salient enough more completely determine the degree to which a single population solves spatial problems from an egocentric versus allocentric perspective?" (280). To find out, a third experiment was performed. Twenty subjects were tested in the original laboratory room of experiment one with the blinds up. Then the subjects were shown the three line-up animals. A little toy, a pair of kissing styrofoam ducks on a paper lake, stood on a table, the stimulus table, to the right/south side of the subject. When the subjects were rotated, a replica of the little toy stood on the recall table. For half the subjects the replica was placed to the right of the subject thus creating a relative bias whereas for the other half the replica stood on the south of the table thus creating an absolute bias. The subjects were found to use either the relative or absolute frame of reference "depending on the presence and strength of the landmark cues made available to them" (282).

These experiments then show that speakers of the same language vary in how they solve spatial tasks depending on environmental cues regardless of lexical resources. Li and Gleitman argue that people will use landmark cues, when they are available, regardless of the language which leads them to the following conclusion:

> Linguistic systems are merely the available formal and expressive medium that enables speakers to describe their mental representations of the linguistic world. Depending on the local circumstances in which human beings find themselves, they select accordingly from this linguistic available pool of resources for describing regions and directions in space"(290).

5.3 Levinson et al: Intrinsic vs Absolute Frames of Reference

Levinson et al claimed that the Li and Gleitman failed to make crucial distinctions between spatial frames of reference and consequently misrepresented the results of their own experiments. What the Li and Gleitman experiments distinguished was the relative frame of reference and the intrinsic frames of reference. They thus confounded the intrinsic and absolute frames of reference. According to Levinson et al "True absolute systems have nothing to do with landsmarks – the geometry of such systems does not consist of lines converging on a landmark, instead it has infinite parallel lines constituting an abstract 'slope' across an environment" (172). The experiments which Li and Gleitman attempted to replicate, such as Pederson et al, tested relative vs absolute frames of reference whereas Li and Gleitman tested relative vs intrinsic frames

of reference. Levinson et al argue that English employs both the relative and the intrinsic frames although the relative frame is predominant. They also maintain that landmark cues along with low memory demanding tasks (as opposed to higher memory load of absolute frames) can "induce a switch" (179) from the relative frame to the intrinsic frame. According to Levinson et al this switching between frames is compatible with their hypothesis that "language correlates with and influences cognition" (179) because both frames are lexicalized and both frames are used in non-linguistic spatial tasks.

Levinson et al also argue that Li and Gleitman simplified the rotation task which led to the participants being able to second-guess the intention of the experimenters and so doing what they thought they should be doing (163). Levinson also rejects the determining role of the culture and ecology in the choice of the absolute frame of reference. Three Mayan cultures in similar ecology lexicalize different frames: Mopan (intrinsic only), Tzeltal (absolute and intrinsic), and Yukatek (relative, absolute, and intrinsic) (161). The studies which Li and Gleitman attempted to replicate tested the absolute frame whereas the Li and Gleitman study did not. Levinson et al claim that English speakers cannot switch easily to the absolute frame because "they can't routinely compute it, anymore than they can instantly give you their telephone numbers in binary code" (181). However, English speakers may not be able to use absolute frames expertly, but what about the speakers of Tzeltal? Can they use relative frames of reference despite not having the lexical resources?

5.4 Li et al: Lexical Resources do not Limit Spatial Orientation

Li et al examined the spatial reasoning skills of the Tenejapan Mayans who speak Tzeltal. Although Tzeltal has terms for left (*xin*) and right (*wa'el*), these terms are used very narrowly i.e. only for body parts (Papafragou 13) and never for space outside the body. Instead the Tzeltal language uses geocentric terms downhill (alan), uphill (ajk'ol), and crosshill (ta jech) which have been extended to refer to the cardinal directions with downhill as north, uphill as south and crosshill as horizontal which then corresponds to the absolute frame of reference. Levinson comments "[O]ne cannot say in Tseltal 'The boy is to the left of the tree', or 'Take the first turning left'...We therefore believe that there is a systematic downgrading of left/right asymmetries in Tenejapan conception" (*Space* 149). Li et al asked whether the "left-right" lexical gap in Tzeltal translates to a conceptual gap in the conceptual architecture of its speakers (34). Previous cross-

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linguistic studies (Pederson et al and Majid et al) showed that when given the choice, as in a rotation task, English speakers prefered the egocentric frame of reference whereas Tzeltal speakers prefered the absolute frame. Li et al argue that these studies only show preference for certain frames and not the unavailability of other frames. Preference, they further mainain, could be explained as effects of "language on language" because the previous studies had used an ambiguous command when the participants were asked to make an array "the same" after being rotated: "To infer what is intended to be construed as the same orientation, people may implicitly consult the way their language community customarily speaks about or responds to inquiries about locations and directions." (35).

In three tests they compared the ability of Tzeltal speakers to solve spatial tasks requiring an egocentric frame of reference to ones requiring an absolute frame of reference. To rule out the "language on language" effect the tasks were designed to be unambiguous, with a single correct solution. They found find that the Tzeltal speakers "did at least as well – usually better – in solving the spatial problems in the egocentric conditions where the linguistic categories of Tseltal mismatched (at least on the surface) the implied organization of the task itself compared to geocentric conditions" (51) Li et al therefore concluded that "these results strongly support the view that spatial reasoning is flexible and largely independent of the implied dictates of linguistic encoding" (51).

These results were similar to those of Papafragou who also tested Tzeltal speakers and found that they not only used the egocentric frame without problems but also that, on certain tasks, they performed better with the egocentric frame than with the absolute frame. Papafragou proposed the following interpretation:

> We take this as another demonstration of the independence of spatial reasoning from linguistic encoding preferences: the linguistic and non-linguistic representations of space, even though correlated, are distinct and dissociable. If anything, the linguistic representation of space underrepresents the cognitive representation systems that underlie spatial thought (286).

5.5 Discussion

This review of the lively debate on the relationship between lexical resources and spatial orientation has been rather lengthy because the work of Levinson and colleagues has been the flagship of Neo-Whorfianism. The debate has essentially revolved around the question whether the lexical resources are simply available patterns for communication or whether language forces speakers to develop certain cognitive representations and exclude others.

The findings which have emerged from this research on spatial orientation seem to have brought the issue in a full circle. As Levinson described all spatial thinking was thought, from Kant onwards, to be essentially and universally egocentric. The cross-linguistic study of Pederson et al, however, showed that there is variation in how languages lexicalize spatial frames of reference and that not all languages lexicalize the "universal" egocentric frame at all. These studies have, moreover, shown that all the spatial frames of reference are conceptually available even though they are not lexically available. Nevertheless, the spatial frames are not all conceptually available to an equal extent, suggesting a moderate element of linguistic relativity. These studies have revealed that it is relatively difficult to switch from thinking in a predominantly egocentric frame to thinking in an absolute frame while switching from thinking in an absolute frame to thinking in an egocentric frame does not seem to be as problematic. English speakers thus find it difficult to recognize the cardinal directions, while speakers of the Australian aboriginal language Guugu Yimithirr which lexicalize only the absolute frame of reference have an uncanny sense of direction. On the other hand, speakers of Tzeltal do not find solving problems which require thinking egocentrically despite lacking lexical resources.

This suggests that the egocentric frame is indeed easier to use and therefore more natural. It certainly is easier to use, as Deutscher (163) argues, because this frame is based on the viewer's body and visual field and therefore the viewer always knows were left, right, front, and back are. However, the use of the absolute frame is more demanding because it requires the viewer to take notice of the environment in order to stay oriented. Lexical resources then do not determine the availability of these spatial frames of reference. All the frames are available conceptually but their availability is rather determined by training, by habitual use.

6.0 Neo-Whorfian Studies III: Return to Color Terms

A third line of lexical research after the birth of Neo-Whorfianism is not a new line of research but a continuation of a previous line of research, namely research on color terminologies and color cognition.

6.1 Davies and Corbett: Modest Evidence for Weak Linguistic Relativity

Davies and Corbett examined the blue-green region of the color spectrum. They compared speakers of English (which has two terms: *blue* and *green*), Russian (which has three: *zelenyj* (green), *sinij* (dark blue), and *goluboj* (light blue) and Setswana (which has a single term: *botula* (blue-green). The speakers were compared on a color sorting task, where they were asked to sort a set of 65 colors into groups according to similarity. The result showed a striking similarity in the patterns of color sorting which supported "perceptual universalism" (513). On the other hand, there were also small but reliable differences as well. The speakers of Setswana were more likely to group blue and green together than the speakers of English and Russian. However, the speakers of Russian were no more likely than the English speakers to group light and dark blue separately. Davies and Corbett concluded: "To a first approximation colour perception is universal, but there may be scope for small-scale modifications by language and other cultural influences" (513).

6.2 Davidoff, Davies and Roberson: Linguistic Influence on Color Categorization

Davidoff et al further studied the blue-green region, comparing English speakers with the Berinmo, a tribe of Papua New Guinea. The Berinmo language does not distinguish between blue and green, as English does, but between the colors *nol* and *wor,* which have no equivalence in English. The subjects were shown a color which they were then asked to remember for 30 seconds and then select again the same color from a pair of similar alternatives. The English speakers showed "an advantage for cross-category blue-green decisions" (203) but they showed no such advantage for nol-wor decisions. The Berinmo speakers showed exactly the opposite result. According to Davidoff et al these results "indicate that categorical perception occurs, but only for speakers of the

language that marks the categorical distinction, which is consistent with the linguistic relativity hypothesis" (203-204). They also taught English speakers the nol-wor distinction and the Berinmo the blue-green distinction, as well as the yellow-green distinction, to test the universalist position that categories always form around "natural fault lines in perceptual color space" (204). If this was the case it should be relatively easy to learn the color categories of another language. The subjects were also taught to distinguish between two kinds of green, which was not lexically marked in either language. The Berinmo found it equally difficult to learn the new green distinction as the blue-green distinction. The English speaking subjects found the yellow-green distinction easier to learn than the nol-wor distinction. Both groups of subjects found it easiest to divide colors into the categories lexicalized in their languages. Davidoff et al concluded that their results were "consistent with there being a considerable degree of linguistic influence on color categorization, and place constraints on the type of neuron likely to underpin it" (204).

6.3 Roberson, Davies and Davidoff: Color Categories not Universal

Roberson et al also used Berinmo speakers in a series of experiments replicating the classic Heider research on the Dani. They argued that Heider's study, which was hailed as evidence for universal color categories, could be interpreted in some of its result as supporting linguistic relativity of color categories instead. Roberson et al compared native English speaking subjects to monolingual Berinmo speakers, whose language only contains five basic color terms, equivalent to *white*, *black*, *red*, *yellow*, and *green/blue* (372). They failed to replicate Rosch's study, with all their data demonstrating linguistic relativity:

> Our data show that the possession of color terms affects the way colors are organized into categories. Hence, we argue against an account of color categorization that is based on an innately determined neurophysiology. Instead, we propose that color categories are formed from boundary demarcation based predominantly on language. Thus, in a substantial way we present evidence in favor of linguistic relativity (394).

Roberson et al do acknowledge that there are some constraints on color categorization, the most important being grouping by similarity. No language would thus include yellow and blue and exclude the area between them i.e. green (395). Nevertheless, they conclude that "there is an extensive influence of language on color categorization. The

influence is deep rather than superficial applying both to perceptual and memorial processes" (396).

6.4 Kay and Regier: Strong Universal Tendencies in Color Naming

Kay and Regier returned to the issue of cross-linguistic universals in color naming. They conducted statistical tests on the color naming data of the Word Color Survey (WCS), which was undertaken in response to the criticism of the original Berlin and Kay data. The WCS:

> has collected color naming data *in situ* from 110 unwritten languages spoken in small-scale, nonindustrialized societies, from an average of 24 native speakers per language..., insofar as possible monolinguals. Speakers were asked to name each of 330 color chips produced by the Munsell Color Company (New Windsor, NY), representing 40 gradations of hue at eight levels of value (lightness) and maximal available chroma (saturation), plus 10 neutral (black-gray-white) chips at 10 levels of value. Chips were presented in a fixed random order for naming....In addition, each speaker was asked to indicate the best example(s) of each of his or her basic color terms. The original BK study used a color array that was nearly identical to this, except that it lacked the lightest neutral chip (9085)

In their statistical tests, Kay and Regier asked two questions. They firstly asked whether color terms from different languages in the WCS cluster together in color space to a degree greater than chance. Secondly, they asked whether WCS color terms, all from unwritten languages of nonindustrialized societies, fall near color terms of written languages from industrialized societies, as represented by the Berlin and Kay sample. According to the WCS data the answer to both questions is 'yes'. The data show signicantly more clustering than expected by chance and the data are signicantly closer to the Berlin and Kay data than expected by chance (9088). According to Kay and Regier (9089) the statistical tests on the color naming data of the WCS established three points :

(i) There are clear cross-linguistic statistical tendencies for named color categories to cluster at certain priviliged points in perceptual color space

(ii) These priviliged points are similar for the unwritten languages of nonindustrialized societies

(iii)   The priviliged points tend to lie near, although not always at, those colors named red, yellow, green, blue, purple, brown, orange, pink, black, white, and gray in English

6.5 Regier, Kay & Cook: Focal Colors are Universal

Regier et al set out to address the possible role of universal foci in color naming. They did so partly in response to the Roberson et al study which suggested that color categories were not organized around universal foci but were instead determined by varying color vocabularies. They also wanted to elaborate on the Regier and Kay study which only addressed universal tendencies in color naming but not the existence of universal foci. Regier et al made two predictions. Firstly, that "if best examples are reflections of the proposed foci, then best examples of color terms from languages of nonindustrialized societies should cluster near those locations in color space corresponding to the best examples of English *white*, *black*, *red*, *green*, *yellow*, and *blue*" (8386). Secondly, they predicted that "if best examples are reflections of universal foci, then best examples should cluster more tightly across languages than do the centers of category extensions, because category extension is known to vary accross languages" (8386).

Regier et al tested these predictions in two studies against the data of the World Color Survey. The tests confirmed the first prediction. The best examples of named color categories appeared to cluster near or at the best examples of English *white*, *black*, *red*, *green*, *yellow*, and *blue* (8387), which suggested that these six regions in color space may reasonably be considered to universal foci. The second prediction was also confirmed. The best examples of color categories clustered more tightly across languages of industrialized and nonindustrialized societies than did the centers of the centers of these of those categories' extensions (8389). They concluded: "we view these results as supporting a universal tendency for named color categories of languages based on favored percepts selected from restricted regions of color space in languages of both industrialized and nonindustrialized societies" (8389). However, Regier et al added that their findings were compatible with the Whorfian results demonstrated by Robertson et al "provided one allows that the variations of category boundaries itself is constrained by universal forces" (8389).

6.6 Kay and Regier: Color Naming Universals: The Case of Berinmo

Kay and Regier maintained that those who argue for linguistic relativity in the color domain as opposed to linguistic universals often confound two distinct questions (290):

(1) Do the languages of the world lexically carve up the color space largely arbitrarily?

(2) Where color-naming differences among languages occur, do they correlate with corresponding differences in memory, learning and discrimination of colors?

Kay and Regier explain that relativists would answer both questions with Yes whereas universalists would answer both questions with No. They, however, maintain that current evidence points to a No and Yes because there are "non-trivial universal tendencies in cross-language color naming ... but at the same time color-naming differences occur and do correlate with color memory, learning and discrimination" (290). The Roberson et al study of the Berinmo speakers answered question (2) in the positive and a positive answer to question (1) was argued as well on the grounds that color categorization is determined by language and not universal focality.

Kay and Regier analysed the color naming system of the Berinmo language and compared Berinmo color categories with the 110 languages of the World Color Survey and found that "Berinmo color naming appears to be quite similar to that other five-term languages from a range of genetically and geographically separated language families, all of which show clear similarities to each other" (297). This led them to conclude that "there is no evidence in Berinmo color naming to challenge the findings of universal constraints on color naming" which demonstrated that "[c]urrent evidence supports both the existence of universal constraints on color naming and the influence of color-naming difference on color memory and discrimination" (297).

6.7 Winawer et al: Russian Blues and Color Discrimination

Winawer et al also proposed a new approach to the "Whorfian question". English and Russian differ in how they lexicalize 'blue' because Russian has distinct terms for light blue (*goluboy*) and dark blue (*sinly*). They tested speakers of English and Russian on a

discrimination task which spanned the *goluboy-sinly* border. They found that Russian speakers were showed a category advantage across the *goluboy-sinly* border because they were faster in discriminating two colors which fell into the *goluboy* and *sinly* categories than if both color were from the same category. The English-speakers did not show any such category advantage. However, the category advantage of the Russian-speakers was eliminated by a verbal interference task (7783). According to Winawer et al, three main point emerge from the results:

(1)   Categories in language can affect performance of basic perceptual color discrimination tasks.

(2)   The effect of language is online, because it is disrupted by verbal interference.

(3)   Color discrimination performance differs accross language groups as a function of what perceptual distinctions are habitually made in a particular language.

Because the results show that language-specific distinctions occur in a non-linguistic perceptual task Winawer et al suggest a new framing of the Whorfian question. The traditional framing, which asks whether language influences non-linguistic processes, presupposes, they argue, a clear distinction between linguistic and non-linguistic processes. Winawer et al propose a different question:

A different approach to the Whorfian question would be to ask the extent to which linguistic processes are normally involved when people engage in all kinds of seemingly nonlinguistic tasks (e.g., simple perceptual discriminations that can be accomplished in the absence of language). Our results suggest that linguistic representations normally meddle in even surprisingly simple objective perceptual decisions (7784).

6.8 Agrillo and Roberson: Brown and Lenneberg Revisited

Agrillo and Roberson compared communication accuracy and recognition memory in two experiments. By using both an ordered a randomized test array, they wanted to investigate whether focal colors are easier to communicate accurately and to remember than other colors, regardless of context. They found that focal colors were easier to communicate but that they were not more recognizable regardless of context. For focal

colors to be more inherently salient than non-focal colors, they must be more recognizable, both in a ordered array, where the focal colors can be compared to less typical examples of the same color, and a randomized array, with no such comparison advantage. They concluded that focal colors are not inherently more memorable or recognizable

> The advantage found for coding and recognition of (focal) best examples of English color categories result from the tight links between linguistic and cognitive organization of categories, not from any inherent natural 'goodness' of these colors over others ... the Focal points of basic categories are *no* easier to recognize than other colors (429, italics original).

6.9 Discussion

What these studies reveal is that color terminology may not be a good choice for the testing of the linguistic relativity hypothesis. First of all, it is not always clear what is being tested (Harley 18). Is it perception of color or memory for color? Also, according to Pinker, all that the studies involving memory show is that color is remembered in two forms: "a nonverbal visual image and a verbal label, presumably because two kinds of memory, each one fallible, are better than one" (*Language* 65). Color perception may similarly depend on more than one factor. It may be the case that the biological factor and the linguistic factor are complementary and that both are at work in color perception. As Wardhaugh (230-231) points out, it is easier for speakers of any language to perceive and identify focal colors than to mark precise boundaries between neighboring colors. Perception of focal colors, or typical examples of basic colors, may then depend on a universal biological factor whereas categorization across fuzzy boundaries may be influenced by lexical factors.

7.0 Interpreting the Empirical Research

The three lines of research on color, number and spatial orientation terminologies have shown evidence for three hypotheses: the Requirement hypothesis, the Salience hypothesis and the Availability hypothesis, each of which will be reviewed below. The Requirement hypothesis and the Salience hypothesis are reformulations of the Sapir-Whorf Hypothesis while the Availability hypothesis is a purely universalist statement. It would, moreover, be accurate to describe the Requirement hypothesis as a reformulation of strong linguistic determinism while the Salience hypothesis is a reformulation of the weaker and weakest versions of linguistic determinism.

7.1 The Availability hypothesis

According to the Availability hypothesis language is merely the available medium of expression of thinking. Describing the Availability hypothesis, Li and Gleitman state: "Linguistic systems are merely the available formal and expressive medium that enables speakers to describe their mental representations of the nonlinguistic world" (290). The work of Li and Gleitman, Li et al and Papafragou on spatial orientation revealed that spatial frames of reference are very much available to speakers even though their languages do not lexicalized them. Their work was taken as "demonstration of the independence of spatial reasoning from linguistic encoding preferences; the linguistic and non-linguistic representations of space, even though correlated, are distinct and dissociable" (Papafragou 286).

The research on the Piraha (Everett; Frank et al) and the Munduruku (Pica et al) numerical reasoning also shows support for the Availability hypothesis. This research suggested that the absence of lexical resources, the absence of exact number terms, was not the determining factor in the poor mathematical performance of these tribes but rather that the lack of cultural necessity determined their performance. Early work on colour terminologies also showed that colour terminologies follow a particular hierarchy (Berlin and Kay) and that saliency is the determining factor in colour perception and memory (Heider) which suggested that physiological factors and not linguistic ones determine colour cognition. Or as Pinker aptly puts it: "No matter how influential language might be, it would seem preposterous to a physiologist that it could reach down into the retina and rewire the ganglion cells" (*Language* 62).

The Availability hypothesis assumes then that lexical resources are determined by such factors as human physiology and cultural interest and that there is no causality from language to cognition. The Availability then dismisses linguistic determinism, both the strong and the weak versions. It can, however, acknowledge linguistic relativism in the form of parallelism or correlations between linguistic resources and thinking if they are kept free of causation from language to thinking. But it is of course questionable whether such pure parallelism is interesting because it only shows that some of the available mental non-linguistic representations are lexicalized and some are not.

7.2 The Requirement Hypothesis

The Requirement hypothesis states that to learn "to speak a language successfully **requires** speakers to develop an appropriate mental representation which is then available for nonlinguistic purposes" where language thus "actually forces the speaker to make computations he or she might otherwise not make" (Pederson et al 586). This hypothesis is based on Slobin's Thinking-for-Speaking hypothesis which replaces "**thought** and **language** with a related but rather different pair of terms: **thinking** and **speaking**" (Slobin, "Thought" 71). Slobin explains this shift in emphasis: "[t]here is a special kind of thinking that is intimately tied to language – namely, the thinking that is carried out, on-line, in the process of speaking" (75). In this special kind of thinking the speaker's thought are then adjusted to the language being used. Slobing further explains: "Thinking for speaking involves picking those characteristics of objects and events that (a) fit some conceptualization of the event, and (b) are readily encodable in the language (76). Given that languages vary in grammatical and lexical distinctions speakers of different languages must pay different kinds of attention to objects and events when talking about them.

Slobin's Thinking-for-Speaking hypothesis is based on the work of Boas and Jakobson. Boas observed that grammar "determines those aspects of each experience that must be expressed" (Boas 132). Drawing on the work of Boas, Jacobson stated: "[T]he true difference between languages is not in what may or may not be expressed but what must or must not be conveyed by the speakers" (quoted in Slobin, "Thought" 70). As an example he gave the English sentence "I spent yesterday evening with a neighbour" (quoted in Deutscher 151). Curious types might wonder whether this neighbour was male or female, but that is not information which must be conveyed in

English. Speakers of other languages such as French and German, however, must, specify whether this neighbour was male or female: *voisin* or *voisine* in French and *Nachbar* or *Nachbarin* in German (151). Deutscher has proposed the term "the Boas-Jakobson principle" for these observations (150).

Slobin's initial Thinking for Speaking Hypothesis is uncontroversial. Pinker, for example, while dismissing Whorf's views allows for the thinking for speaking effect: [O]ne way in which language *has* to affect thought is that speakers attend to different things as they select words and assemble them into a sentence" (*Stuff* 132). He provides several examples. In English, for example, the relevant tense must be selected when speaking about an event and in Turkish speakers must indicate whether an event was experienced directly or indirectly from reporting. Pinker asks "whether a lifelong habit of attending to certain distinctions and ignoring others spills over into thinking for thinking – that is, reasoning about objects and events for purposes other than just describing them". His answer is that "the effects of thinking-for-speaking on thinking itself are small at best" (132).

Gumbertz and Levinson, on the contrary, maintain that thinking for speaking has far reaching consequences. They argue that "such thinking-for-speaking may itself require the coding of situations in specific forms at the time that they are experienced" (27). This "experiencing-for-speaking", as Levinson terms it (*Space* 304), is necessary, they argue, because: „we must mentally encode experiences in such a way that we can describe them later, in the terms required by our language" (Gumbertz and Levison 27). Slobin later agreed that there were such "ripple effects" of habitual attention for linguistic encoding because he expanded his theory to include not only "thinking for **present** speaking" but also "thinking for **potential** speaking" ("Language" 178).

The Research of Levinson and colleges on spatial vocabularies and spatial orientation found evidence for the Requirement hypothesis. The correlation between the lexicalization patterns of spatial terms and performance on spatial orientation tests was taken as evidence for linguistic requirement on thinking because the lexicalized frames of reference "place a bottleneck on the entire system of representations – if we are to talk about what we see and feel and remember, we must make sure that those representations are consistent with the available linguistic ones, or can be converted into them" (Levinson, *Space* 60-61). Thus:

the linguistic system is far more than just an **available** pattern for creating internal representations: to learn to speak a language successfully **requires** speakers to develop an appropriate mental representation which is then available for nonlinguistic purposes (Pederson et al 586; emphases original).

Winawer et al make the same claim with regards to colour terms and colour categorization:

The critical difference in this case is not that English speakers cannot distinguish between light and dark blues, but rather that Russian speakers cannot avoid distinguishing them: they must do so to speak Russian in a conventional manner. This communicative requirement appears to cause Russian speakers to habitually make use of this distinction even when performing a perceptual task that does not require language (7783-7784).

7.3 The Salience Hypothesis

According to the Salience hypothesis linguistic distinctions influence the relative accessibility of corresponding cognitive categories. In other words, lexicalized concepts become more salient than non-lexicalized concepts by habitual use of language. Papafragou explains:

Language, by virtue of being continuously used throughout one's life, would thus come to affect an individual's "habitual patterns of thought" (Whorf, 1956) by channelling the individual's attention towards certain distinctions and away from others …. Even though linguistic effects may not be permanent, and can potentially be overridden by other cognitive factors, language is considered to act as a lens on non-linguistic cognition (273).

In an influential paper, Hunt and Agnoli approach salience in terms of computational cost. On this view "a thought is natural if the necessary propositions can be constructed with a minimum of computation" (378). They argue that the "most obvious way to avoid computational burdens is to have a predetermined symbol structure identifying the thought to be transmitted…[O]ne language may have a single term for a concept that has to be described in another language" (378). Computational cost is then in direct relation to codability. Codability, however, is only psychologically interesting, according to Hunt and Agnoli, in relation to the differences in the computational burdens which languages place on their speakers. They describe how computational burden affects memory:

Coding considerations determine the demands that a language places on its users' psychological capacities. Recognizing and selecting lexical items places demands on long-term memory. Analyzing the structure of an utterance taxes short-term memory. The historical record suggests that languages evolved to move the burden from short-term to the long-term memory system (378).

Hunt and Agnoli describe how Californian surfers of the late 1980s invented a vocabulary for describing waves which moved the computational burden onto the long-time memory. Surfers of earlier decades could describe the same types of waves by using sentences, but with increased burden on short-term memory, where sentences are processed. And because space in cheaper in long-term memory the surfers of the 80s enjoyed lower computational cost than their counterparts of earlier decades. Hunt and Agnoli conclude: "This means that at any point in time the language user thinks most efficiently about those topics for which his or her lexicon has proved an efficient code" (378).

The Salience hypothesis combines the weaker and the weakest versions of linguistic determinism because it includes linguistic influence on perception, categorization, memory and reasoning. Some of the research on colour vocabularies and colour cognition found that lexicalized colour categories were privileged in corresponding cognitive categories and memory (Brown and Roberts; Davidoff et al; Roberson et al; Kay and Regier; Winawer et al; Robertson et al). Similarly work on number systems revealed considerable salience effects. Codability, or word length, was found to influence memory because faster pronunciation resulted in better performance on digit-span tests (Ellis and Hennelly; Hoosain and Salini; Chan and Elliott). The complexity of the number system was also found to influence the relative ease of learning the number system and well as influencing mathematical performance (Miura et al "Effects"; Miura & Okamoto; Miura et al "Comparisons") although other factors such as cultural experience and enducational experience (Stevenson et al, Towse and Saxton) were also recognized. The great ability of the speakers of Guugu Yimithirr, Tseltal (Levinson, *Space*) and Kuuk Thaayorre (Boroditsky "How Does our Language Shape the Way We Think?") to maintain fixed bearings at all time can also be interpreted as an salience effect because a certain type of cognition, which requires considerable experience and expertise, develops to a greater degree in the speakers of

those languages which only lexicalize the absolute frame of reference as opposed to those that lexicalize all three.

There is a large body of literature on the effects or non-effects of language on the cognitive domains of colour, number and space. The research reviewed here has found evidence for all of the three hypotheses. However, there seems to be more substantial amount of evidence for the Salience hypothesis, than for the Requirement hypothesis and the Availability hypothesis. The Salience hypothesis excludes the extreme positions of both relativist (language determines thought) and universalists (language only expresses thought) and claims a moderate middle ground which recognizes both the general independence of thought from language as well as linguistic influence on thought which results in relative differences of conceptual ease. The Salience hypothesis is therefore in keeping with the weak (language affects perception) and the weakest versions (language affects memory and reasoning) of linguistic determinism. Pinker finds the weak versions to be boring or "banal" unlike the "sexy" strong versions of linguistic determinism: "Most of the experiments have tested banal 'weak' versions of the Whorfian hypothesis, namely that words can have effect on memory or categorization. Some of these experiments have actually worked, but that is hardly surprising" (*Language* 65). However, some of his colleges in the universalist camp disagree and consider moderate influence to be interesting as an aid to thinking.

7.3.1 Language as an Aid to Thinking

It is possible to maintain that thinking is essentially independent from language and yet at the same time recognize that language can play a role in thinking. Some of the more famous universalists have recognized that language aids thinking. Chomsky himself argues that "communication is not *the* function of language" (76; italics original) in any useful sense of the term but rather that "language use is largely to oneself: 'inner speech' for adults, monologue for children" (77). Jackendoff similarly maintains that language aids thinking (*Architecture* 179-208). He regards thought as a mental function which is both completely separate from language and unconscious and therefore inaccessible to the thinker. However, he argues that language aids thought in three ways.

According to Jackendoff the first way in which language aids thought is that, because language enables the communication of thought, it allows the accumulation of

knowledge: "language permits a major enhancement in the *range* of things the thought processes can pertain to – the conceptual structures that can be accumulated in long-term memory" (194; italics original). The second way in which language aids thought is by making conceptual structure, which is otherwise inaccessible, available for attention:

> Language is the only modality of consciousness that makes perceptible the relational (or predicational) form of thought and the abstract elements of thought. Because these elements are present as isolable entities in consciousness, they can serve as the focus of attention, which permits higher-power processing, anchoring, and, perhaps most important, retrievable storage of these otherwise nonperceptible elements (205)

The third way in which language aids thought, according to Jackendoff, is that is allows metareasoning: "having language makes it possible to construct thoughts about thought, otherwise unframable" (205)

Clark argues that language is a cognitive tool which extends thought and cognition by enhancing the computational power of the brain: "I would like to depict language as an external artifact which complements, but does not profoundly transform, our basic computational profile" ("Linguistic" 101). He lists (*Magic* 7-10) 6 ways in which language thus complements thought:

(i)   Memory Augmentation

(ii)   Environmental Simplification

(iii)   Coordination and the Reduction of On-Line Deliberation

(iv)   Taming Path-Dependent Learning

(v)   Attention and Resource Allocation

(vi)   Data Manipulation and Representation

Summing up these 6 ways augmentation, Clark states:

> The role of public language and text in human cognition is not limited to the preservation and communication of ideas. Instead, these external resources make available concepts, strategies and learning trajectories which are simply not available to individual, un-augmented brains. Much of the true power of language lies in its underappreciated capacity to re-shape the computational spaces which confront intelligent agents (*Magic* 10).

There are then different accounts of how language aids thinking. What they have in common is the idea of the relative ease of thinking…..

8.0 The Real Lexical Whorf

In the early formulations of Whorf's ideas as the Whorf thesis and Sapir and Whorf's ideas as the Sapir-Whorf hypothesis there is no distinction made between lexical and grammatical structure. These formulations reduce Sapir and Whorf's writings into two key propositions, namely linguistic relativism and linguistic determinism. In fact, when Whorf's writings are read it becomes apparent that the effects of the grammar and the lexicon on thought are different so in an important sense there should be a separation of linguistic relativism into grammatical relativism and lexical relativism as well as a separation into grammatical determinism and lexical determinism. Or we could talk about grammatical Whorf, which combines grammatical relativism and grammar determinism, and Lexical Whorf, which combines lexical relativism and lexical determinism. Lexical Whorf falls into the weak and the weakest versions of linguistic determinism and the Salience hypothesis while Grammatical Whorf belongs in the strong linguistic determinism, where some human thinking is determined by language, and the Requirement hypothesis.

8.1 The Central Role of Grammar in the Principle of Linguistic Relativity

Whorf's first definition of the principle of linguistic relativity does not make a distinction between grammatical and lexical structure:

> [A]ll observers are not led by the same physical evidence to the same picture of the universe, unless their *linguistic* backgrounds are similar, or can in some way be calibrated" (214; italics mine).

However, in his second, less formal, definition of the linguistic relativity principle Whorf attributes the worldview shaping power of language to the grammar:

> [U]sers of markedly different *grammars* are pointed by their *grammars* toward different types of observations and different evaluations of externally similar acts of observation, and hence are not equivalent as observers but must arrive at somewhat different views of the world (221; italics added).

In Whorf's most famous passage he explains in more detail how the different grammars leads to different worldviews:

We dissect nature along lines laid down by our native languages. The categories and types we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary, the world is presented in a kaleidoscopic flux of impressions which has to be organized by our minds – and this means largely by the linguistic systems in our minds. We cut nature up, organize it into concepts, and ascribe significances as we do, largely because we are parties to an agreement to organize it in this way – an agreement that holds throughout our speech community and is codefied in the *patterns* of our language (213; italics added).

It is clear elsewhere in Whorf's writings that by "the patterns of our language" (259) he means grammatical patterns. This interpretation is confirmed by other statements:

It is the grammatical background of our mother tongue, which includes not only our way of constructing propositions but the way we dissect nature and break up the flux of experience to construct propositions about (239)

8.2 Grammar as the Real Essence of Linguistic Thinking

It is the grammar then which determines the worldview and it is also the grammar which determines linguistic thinking, to be more specific. Cassasanto argues that Pinker confuses two proposals: "We think in language" and "Language shapes thought" ("Who" 65) when the latter discusses and dismisses Whorf and his theories (Pinker, *Language* 55-82). According to Cassasanto the first question is an "Orwellian" question whereas the the second question is a Whorfian question. However, Cassasanto and Pinker are both wrong to a certain extent. Cassasanto is wrong because Whorf clearly states that some thinking is linguistic. On his view the idea that language is only the communication of thought, which is independent and universally the same for all, is an illusion. On the contrary, language is concerned with the "formulation of ideas" (207) and thinking is "a matter of different tongues" (239). Ours is a "linguistically determined thought world" (212) because "thinking itself is in a language – in English, in Sanskrit, in Chinese" (252). The result surely must be the relativity of our conceptual systems and their dependence upon language (214-215).

However, Linguistic thinking, according to Whorf, is ultimately not a matter of words "but rapport between words, which enables them to work together at all to any semantic result. It is this rapport that constitutes the real essence of thought" (67). This real essence of thought is a linguistic background (221) of which speakers and thinkers

unaware: "Natural man ... knows no more of the linguistic forces that bear upon him than the savage knows of gravitational forces" (251). The following passage summarizes well Whorf's view on the relationship between thinking and grammar:

> [T]he background linguistic system (in other words, the grammar) of each language is not merely a reproducing instrument for voicing ideas but rather is itself the shaper of ideas, the program and guide for the individual's mental activity, for his analysis of impressions, for his synthesis of mental stock in trade. Formulation of ideas in not an independent process, strictly rational in the old sense, but is part of a particular grammar, and differs, from slightly to greatly between different grammars (212-213).

Pinker's real error, on the other hand, lies in equating the linguistic determinism of Whorf and the linguistic determinism of Orwell at the lexical level. In Orwell's view a lexical gap results in a conceptual gap. Whorf, however, does not subscribe to such a view. Discussing the lack of "ownership" in the Hopi language, for example, he states:

> [A]n expression formally equivalent to English 'my room' DOES NOT EXIST, or have even a formulaic meaning; there is a gap here in the language as compared to ours. If the Hopi should borrow from us the custom of having individual "own" rooms, or should rent individual rooms when they visited other Hopi villages, they would STILL be unable to say 'my room.' What they would probably do would be to coin a new expression for this need (201, small caps original).

According to Whorf then when the need arises a new expression is coined. A lexical gap does not leave the Hopi unable to grasp the concept of 'my room'.

8.3 Lexical Meaning and Misleading Words

The power of language over thinking at the lexical level is comparatively weak because the lexical level is dependent on the level of patternment according to Whorf. He maintains that words do not have an exact meaning because reference, the meaning of words, is only relatively fixed: "The reference of words is at the mercy of the sentences and the grammatical patterns in which they occur" (259). Whorf gives several examples. In the sentence "I went all the way down there just in order to see Jack", the proper noun *Jack* is the only word with fixed concrete reference. However, a specific thing like a dog can be refered to by its name, *Fido*, and then the reference is specific because the word is used by "a certain person at a certain time", but also by the word *dog* which refers to "a class with elastic limits" (259). The reference of the English word *few* has,

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furthermore, elastic boundaries: "A 'few' kings, battleships, or diamonds might be only three or four, a 'few' peas, raindrops, or tea leaves might be thirty or fourty" (259). Similarly, words like 'hand', 'bar', 'electrical', and 'group' all can have different references in different contexts (260). Whorf also points out that there are even archaic words with no reference of their own such as *kith* and *throe* which must have the pattern *kith and kin* and *in throes of* to have any meaning (261). According to Whorf then "reference is the lesser part of meaning, patternment the greater" (261). However, he did not underestimate power of language at the lexical level because that was the level which sparked his interest in the linguistic influence on thought.

It was constantly demonstrated to Whorf in his work as a fire-insurance investigator how words can mislead. Whorf famously found that the word *empty* led a worker to mistakenly believe that a gasoline container which contained no liquid gasonoline was also without any gasoline in gasous form (135). Whorf lists other words which led people also to accidentally cause fire: *limestone*, *varnish*, *light on*, *pool of water*, *blow*, *scrap lead* (135-137). He maintains that language "confuses two different situations, has one pattern for both" (139) and because people "act about situations in ways which are like the ways they talk about them" (148) they make fire-causing errors. Pinker (*Language* 60) rightly points out that visual perception, and not linguistic categorisation, must be the primary factor in the case of the empty gasoline container: "A drum with nothing but vapor in it looks just like a drum with nothing in it at all".

In Whorf's view words have the power to mislead because the lexicon has a role to play in the segmentation of nature: "Languages differ not only in how they build their sentences but also in how they break down nature to secure the elements to put in those sentences. This breakdown gives the units of the lexicon" (240). Whorf's most famous example of such lexical "break down of nature" is undoubtedly Eskimo terms for *snow*. That particular example is part of a passage where Whorf shows how noun classes differ in inclusiveness or domain differentiation in different languages. He first gives an example from Hopi:

> Hopi has one noun that covers every thing or being that flies, with the exception of birds, which class is denoted by another noun. The former noun may be said to denote the class (FC-B) – flying class minus bird. The Hopi actually call insect, airplane, and aviator all by the same word, and feel no difficulty about it. The situation, of course, decides any possible confusion among very disparate members of a broad linguistic class, such as (FC-B) (216).

Whorf then points out the relativity of differentiation or inclusiveness in noun classes by comparing English and Eskimo:

> This class seems to us too large and inclusive, but so would our class 'snow' to an Eskimo. We have the same word for falling snow, snow on the ground, snow packed hard like ice, slushy snow, wind-driven flying snow – whatever the situation may be. To an Eskimo, this all inclusive word would be almost unthinkable; he would say that falling snow, slushy snow, and so on, are sensiously and operationally different, different things to contend with; he uses different words for them and for other kinds of snow (216).

He points to a language which is even lexically poorer than English in the domain of snow:

> The Aztecs go even father than we in the opposite direction, with 'cold,' 'ice,' and 'snow' all represented by the same basic word with different terminations; 'ice' is the noun form; 'cold,' the adjectival form; and for 'snow,' "ice mist" (216).

Whorf's discussion of nouns and domain differentiation shows that language is not a prison house at the lexical level. Although Hopis have a single word for everything that flies, apart from birds, they do not confuse insects, airplanes, and aviators, although all are called by the same word, because the situation decides "any possible confusion among these very disparate members of a broad linguistic class"(216). Whorf's discussion of *snow* should be understood in the same way. Even if English had only a single word for snow, which turns out not to be the case, English speakers would still be able to see differences in the different kinds of snow. However, although lexical differences do not have serious cognitive consequences Whorf is very aware that the lexical segmentation of nature can be misleading. By the use of words, he argues, "we ascribe a semifictitious isolation to parts of experience. English terms, like 'sky, hill, swamp,' persuade us to regard some elusive aspect of nature's endless variety as a distinct THING, almost like a table or chair" (240; caps original). However, the grammatical segmentation, on the other hand, is not just semifictitious, like lexical segmentation, but can be completely fictitious:

> We are constantly reading into nature fictional acting entities, simply because our verbs must have substantives in front of them. We have to say 'It flashed' or 'A light flashed,'. Setting up an actor, 'it' or 'light' to perform what we call an action, "to flash." Yet the flashing and the light are one and the same! (243)

8.4 Idealism in Whorf's Worldview Relativism

The claim that the segmentation of nature by language leads to a worldview which includes fictious and semi-fictious things has philosophical implications. To begin with, the claim is anti-realist. Realism is the philosophical view that the external world is real, composed of real or true things, and that it is knowable. Whorf's philosophical position is, on the contrary, idealistic and idealism, contrary to realism, is the philosophical view that reality only exists in ideals and ideas. In other words, reality does not exist independently of the workings of the human mind. Kant used a cookie-cutter-metaphor to explain the idealist view (Devitt and Sterelny 247-248): The cook imposes cookie-cutters (concepts) on the dough to create cookies (appearances). In other words, the mind creates reality because reality can only be grasped through the minds conceptual filters.

Whorf's view clearly includes idealistic cookie-cutting:

> The categories and types that we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary, the world is presented in a kaleidoscopic flux of impressions which has to be organized by our minds – and this means largely by the linguistic systems in our minds" (213).

Language thus provides the mind with concepts and categories which it, in turn, imposes on reality. Whereas Kant emphasized that universality of the concepts imposed upon reality, Whorf argued for the relativity of those concepts because they are provided by language.

Whorf's view is closely related to the Humboldtian Weltanschauung hypothesis. Like Kant, Humboldt assigned an active role to the human individual in his perception of the external world. Humboldt, however, assigned this active role particularly to language: "man lives in the world about him principally , indeed exclusively, as language presents it to him" (quoted in Penn 22). Humboldt placed language firmly between the external world and the individual: "The sum of all words – language – is a universe which lies midway between the external, phernomenal one and our own inward actives ones" (quoted in R.L. Brown 94). Any organized knowledge of external reality was then dependent on language: "languages are not really means for representing already known truths, but are rather instruments for discovering previously unrecognized ones" (quoted in R.L. Brown 94). According to Humboldt then language plays a central role in perception; it is the sole means of objectifying the external world.

The Idealist view thus does not deny the existence of an objective reality per se, it simply claims that it is only knowable through the mind which imposes its concepts on reality (Devitt & Sterelny 235).

Devitt and Sterelny argue that Sapir and Whorf vacillate between idealism and radical constructivism. Constructivism is the philosophical view that the mind creates reality and that the only reality is mind-constructed reality[8] . They maintain that sometimes Sapir and Whorf are talking about a theory of the world, claiming that languages organizes our *experience* of the world, but that at other times Sapir and Whorf also talk as if language organizes the real world, not just our experience of it, and thus constructs it for us. Sapir states: "The fact of the matter is that the 'real world' is to a large extent built up on the language habits of the group...The worlds in which different societies live are distinct worlds worlds, not merely the same world with different labels attached" (162) The latter claim would therefore be defined as linguistic constructivism. If language is imbued with such world-making power and that there are diverse world-views to be found within the various languages of the world, the reality that each community lives in must be relative to its language (Devitt & Sterelny 250).

8.5 Radical Saussurean Idealism

Devitt and Sterelny also argue that there are important parallels between Saussure's structuralism, which includes radical idealism, and the idealism of Sapir and Whorf. At the heart of Saussure's structuralism lies the *sign*, the basic linguistic unit, which is composed of a *signified* (a concept) and a *signifier* (a sound-image). Language is then a system of signs. Saussure distinguishes between *parole* (actual speech of individual speakers) and *langue* (the system of shared associations underlying speech) and he regards *langue* as being primarily social: "language never exists apart from the social fact ... its social nature is one of its inner charatceristics" (quoted in Chapman 147). In Saussure's view the signs function "not through their intrinsic value, but through their relative position" (118). Meaning, on this view, is then not dependent on anything external to the language system, but on the signs' place in the structure, how it relates to and differs from other signs in the language (149).

Saussure's approach to language study was to study the *strucutural* relationship between the signs and the term *structuralism* came therefore to be used for his

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[8] This view is also called mental constructivism (see Saeed 1997: 45)

approach, although he himself used the term *semiology* as he was more interested in the study of the human use of signs in general. Saussure describes two types of relations between signs: *syntagmatic* and *paradigmatic*. A sign is in a syntagmatic relationship with other signs when they can be combined to form a *syntagm*, or a well-formed combination of words, for example the sentence "Tripoli explodes today". A sign holds a paradigmatic relation with other signs which could be substituted for it. *Keflavik* could be a possible alternative to *Tripoli* and their relation is then paradigmatic. Together these two types of relations, in Saussure's view, constitute, and exhaust, meaning (Devitt & Stevelny 262). A sign is thus defined by its place in the entire structure, not just by its relation to a few other words. Make the least changes in that structure and the sign's meaning changes (263). That makes the system of signs extremely holistic.

By thus confining meaning to structural relations within a mental system of signs Saussure essentially regards language as a closed system. He rejects reference, by denying the signified any language-independent referent, but defining it rather as a concept "the nature of which is entirely determined by relations internal to the language" (265). Language is then a self-contained, autononmous system, without any reference to anything outside its structure just like chess: "In chess, what is external can be separated relatively easily from what is internal ... everything having to do with its system and rules is internal" (quoted in Devitt and Serelny 264). Also "the game of chess is entirely in the combination of the different chesspieces, language is characterized as a system based entirely on the opposition of its concrete units" (264).

Two other features contribute to the autonomy of Saussure's system of signs. Firstly, according to Saussure the study of language should be *synchronic*, at one point in time, and not *diachronic,* that is, over a certain period of time. By thus ignoring the historical development of the system of signs it becomes ahistorical: how a closed, self-contained system originated is here beside the point. Secondly, Saussure regarded the relationship between the two parts within the sign, the signifier and the signified, as being arbitrary. There is, for example, no rational or natural connection between the word *pen* and the concept it signifies. Neither the vocal form, nor the written one, shows any resemblence to the concept. Apart from a few cases of *onomatopea*, where properties of the signifier imitate the signified as in *tic-tac* or *cuckoo*, their relationship is arbitrary and therefore conventional. In Saussure's view language is then an autonomous, holistic, arbitrary and ahistorical system.

8.6 Saussure vs. Whorf

Devitt and Sterelny are wrong, however, in equating Saussure's view of language and thought with Whorf's views although there are important parallels. Saussure's theories do indeed include linguistic relativism and linguistic determinism. He affirms the central place of language in cognition: "without language, thought is a vague, uncharted nebula. There are no pre-existing ideas, and nothing is distinct before the appearance of language" (quoted in Devitt and Sterelny 265). Ideas, or concepts, here cannot pre-exist because they are entirely defined by relations internal to the language. Thought is therefore entirely dependent on language. And given that Saussure describes languages "as not sharing any particular characterisitics, other than their level complexity" (quoted in Chapman, *Philosophy* 148) the mental world of speakers must be relative to the signs available to them through their language. Saussure's view of language thus clearly includes linguistic relativism and linguistic determinism. By denying reference, Saussure severs any connection to objective reality and thus assumes a radical idealist stance. Signifieds are not concepts of some objective reality and language therefore creates its own reality (see Elffers 79-93 and Wiley 319-341 for arguments against Saussure being a relativist).

However, a radical idealist or even constructivist interpretation of Whorf's views is mistaken. The very terms "semi-fictitious" and "fictitious" (240) imply that there must be a true or correct way of classifying experience or that there is experience which is the same for all but can be misrepresented by language. Indeed, Whorf borrows the term "isolates of experience" from Gestalt psychology (164). The isolates which he refers to are primarily essentials of experience universally available to all observers (Lee, "When" 53). The problem is that language users are unaware of how distorted their worldviews can be and how much they are at the mercy of their grammars: "No individual is free to describe nature with absolute impartiality but is constrained to certain modes of interpretation even while he thinks himself most free" (214) and "The individual is utterly unaware of this organization and is constrained completely within its unbreakable bonds" (256).

Whorf's main concern is to show that the various worldviews produced by different grammars are all provisional analyses of reality and that the Western worldview is just as provisional as the worldviews found in tribal languages. As Lee ("When" 54) points

out, Whorf sees one of the central problems of linguistics as being the search for a neutral frame of reference:

> Our problem is to discern how different languages segregate different essentials out of the same situation....to compare ways in which different languages differently 'segment' the same situation or experience, it is desirable to be able to analyze or 'segment' the experience first in a way independent of any one language or linguistic stock, a way which will be the same for all obervers (162)

8.7 Conclusions: The Standard Whorf vs. the Real Whorf

The Whorf who emerges from textbooks, the standard Whorf, is in significant ways not faithful to the real Whorf. A picture of Whorf which is based on the Sapir-Whorf hypothesis coupled with his famous quotation about "ABSOLUTELY OBLIGATORY" terms and the 'empty', 'snow' and 'time' examples fails to represent many of the finer points of his views because it is too general and therefore open to different kinds of interpretations and misrepresentations. Many scholars and students do not read his actual writings, basing their evaluations of Whorf and his views on the standard picture instead. Lee argues that there is: "a widespread phenomenon of secondary elaboration upon ...[Whorf's]... ideas" ("When" 46). The standard Whorf has also become a very handy strawman when Whorf's theories are criticized.

The second key idea of the SWH, linguistic determinism, has been the source of more misunderstanding than the first key idea, linguistic relativism. The definition of linguistic determinism in the SWH is which is "The structure of anyone's native language strongly influences or fully determines the worldview he will acquire as he learns the language" (R. Brown 128). This general statement does not explain what this structure of language is. Is it lexical structure or is it grammatical structure? One interpretation is then that there is such as thing a strong linguistic determinism at the lexical level. This is why Pinker equates Whorf with Orwell. And this is why the Eskimo *snow* example can be misunderstood to be an example of terminology determining perception of different kinds of snow or even colour perception. This is also why Gordon believes that the failure to conceptualize exact number is due to a lexical gap and that this is "the strongest version of Benjamin Lee Whorf's hypothesis" (496).

However, "the strongest version", the most radical claims in Whorf writings, does not involve the lexical level. This becomes apparent when Whorf's theories are compared to the three versions of strong linguistic determinism. To begin with Whorf does not agree with the strongest version of linguistic determinism according to which all thinking is determined by language because he recognizes that animals are capable of thinking: "Beasts may think but they do not talk" (220). Whorf also does not hold that all human language is determined by language because he writes about thought "insofar as it is linguistic" (67-68), which excludes the second strongest version of linguistic determinism. Whorf agrees with the weakest of the strong versions of linguistic determinism, that language determines some kinds of human thinking, but this occurs at the grammatical level, as the linguistic background of which speakers are unaware. This background character of the grammatical influence is a key issue. Speakers are aware of lexical distinctions or categorizations to a much greater degree than the grammatical ones. According to Whorf, speakers may be aware of overt grammatical categories, or "phenotypes", but they are unaware of covert grammatical categories, or "cryptotypes" (87-88). The interplay of these two types of grammatical categories, he maintains, results in the meaning of grammatical forms (105). However, it is the cryptotypes which are the key to the psychological aspect of Whorf's theory because they form the structure which speakers are unaware of but exerts subtle and yet strong influence on the speakers' thinking.

The real lexical Whorf, the lexical influence on thought and perception, on the other hand, belongs in Miller and McNeill's weak and weakest versions of linguistic determinism. According to the weak version language influences perception and according to the weakest version language influences affect only processing on certain tasks where linguistic encoding is important such as memory and reasoning. Whorf's fire-causing errors did indeed involve people whose perception and reasoning were influenced, or misled in this case, by their language. Nowhere in his writings does Whorf provide examples of people whose thinking or perception were fully determined by language at the lexical level. Not even the Hopi or the Eskimos. This places the lexical aspect of Whorf's theories squarely within the Salience hypothesis, which irronically, is supported by considerable empirical evidence. The standard Whorf, especially the standard lexical Whorf, fails therefore to represent the theories of Benjamin Lee Whorf faithfully.

Why is it so important to distinguish between lexical Whorf and grammatical Whorf? Isn't this just a case of a set of radical theories taking on a life of their own independent of their originator or polulizer? It is certainly true that the name of Whorf has become synonoumus with strong linguistic relativism and determinism but unfortunately this means that he has come to represent, as an easy target or strawman, all the different kinds of strong linguistic relativism and determinism although Whorf's kinds are very specific. With all the easy dismissals, marginalization and ridicule associated with the name of Whorf it is now important to study and criticize Whorf fairly, in the terms of his own writings and not according to a standard image which crumbles under scrutiny.

9.0 Whorf and the Future

9.1 Growing Interest in the Real Whorf

Fortunately, the birth of Neo-Whorfianism in the early 90s sparked an interest in Whorf's actual writings. There had certainly been earlier revisits to Whorf's writings (Kay and Kempton; Lucy, "Historical") but the more detailed analyses were yet to come. Two attempts, in particular, to provide a faithful account of Whorf's theories, are noteworthy. Lucy (*Language*) gives a very useful overview of Whorf's theories but his main aim is to provide a more adequate framework for future research with special focus on grammatical structure and habitual thought in order to investigate Whorf's theories more fruitfully. Lee (*Whorf*), on the other hand, offers a very thorough analysis of the "Whorf theory complex" with detailed accounts of Whorf's ideas on linguistic thinking and the linguistic relativity hypothesis, for example. Also noteworthy is Alfrod who maintains that considerable knowledge of physics is indespensible in order to understand Whorf's writings. This paper, where the lexical aspect of Whorf's theories has been elaborated upon, in order to reject the standard view of him as false, is also seen as a part, a very modest one, of the endevour to present the real Whorf. Three areas of reseach are of particular interest for future research in this endevour.

9.2 Future Research I: Lateralized Whorf

The first area is the "lateralized Whorf" hypothesis proposed by Regier et al. According to this hypothesis the left hemisphere is involved in most language tasks, and because perceptual input from one side of the body is processed in the opposite side of the brain, the contralateral hemisphere, language affects perception primarily in the right half of the visual field, and much less if at all in the left half. Regier et al argue that the two opposing stances of universalism and relativism have outlived their usefulness and present an obstacle to understanding because this traditional framing is too simple and "coarse-grained" (165). The traditional stances, for example, conflate two separate questions: the question whether semantic distinctions in languages are determined largely by linguistic convention and the question whether semantic differences cause corresponding cognitive or perceptual differences in speakers of different languages (165). According to Regier et al the "traditional framing implicitly assumes that the two questions will receive the same answer: either both 'yes' (relativist), or both 'no' (universalist). Regier et al reject such simple yes-and-no answers. Data from their

research "support a picture that is more interestingly differentiated than either of these traditionally opposed positions" (165). They offer a "hedged" universalist answer to the first question:

> [E]mpirical support has been established for the 'universalist' tenet that there are constraints on color naming across the world's languages that go well beyond 'grouping by similarity' – but at the same time, our findings leave open the possibility that linguistic convention may play some role in selecting from among the class of well-formed color naming systems. This leaves us with an interestingly complex view of color naming: ultimately universalist, but with a relativist tinge (173)

On the other hand, Regier et al offer a "hedged" relativist answer to the second question:

> This conclusion flows from a finding unanticipated by the framing of the debate: language may affect perception in the right half of the visual field, and much less if at all in the left half. On this view, language simultaneously affects perception, and affects it much less if at all, in the same individual, depending on which part of the visual world is considered (174)

9.3 Future Research II: Grammatical Requirements on Attention

The second area of research is the grammatical requirement on attention. The Requirement hypothesis predicts that grammatical distinctions make demands on attention. For example, Gumbertz and Levinson argue that because English marks number as singular or plural English-speakers must notice the number of all possible referents. Another example is honorifics. Speakers of Japanese must notice whether a referent is their junior or senior if he or she is to be described later. Slobin (2001) provides one more example from grammar: "When you report an encounter with a friend in a language with gender pronouns, you must have remembered the sex of the friend" (2001: 22).

Grammar lends itself more naturally to the Requirement hypothesis the lexicon because grammatical distinctions must be made when speaking whereas lexical distinctions are more optional. The grammatical requirements on attention are a neo-Whorfian formulation of Whorf's strong linguistic determinism, where grammar determines a speaker's worldview. It is therefore a research area which perhaps truly enables the investigation of strong linguistic determinism.

9.4 Future Reasearch III: Mystical Whorf

The third area of research, Whorf and Mysticism, is of special interest. Lucy (*Language*) and Lee (*Whorf*) included Whorf and mysticism in their analysis of Whorf and his writings but a more thorough analysis needs to be done because the mystical element is an important, and unfortunately neglected, part of Whorf's work. Whorf acknowledges the French grammarian and mystic Antione Fabre d'Olivet as an important influence. A comparison needs to be made between the views of Fabre d'Olivet and the views of Whorf in order to determine if Whorf inherited any mystical elements from the frenchman.

However, Whorf's connection to Indian Mysticism, particularly yoga and vedanta, are perhaps clearer than the french connection. One of Whorf's most interestings papers, "Language, Mind and Reality" (246-270), was presented to a group of theosophists and in this paper he explains his views in light of yoga. This mystical side of Whorf has sometimes been seen as a source of obscuration. Pinker, for example exclaims: "No one is really sure how Whorf came up with his outlandish claims, but his limited, badly analyzed sample of Hopi speech and his long-time leanings toward mysticism must have contributed" (*Language* 63). Ironically, the juxtaposition of Whorf's principle of relativity and yoga brings a greater clarity to Whorf's ideas. Whorf even recognizes that there are only two kinds of men who can be free of the provisional analyses reality inherent in languages, namely linguists and yogis. It would be interesting to explore whether yoga is a system of thought which simply happens to be similar to Whorf's theories or whether yoga is actually an influence on Whorf's thought.

9.5 Dramatic Banality?

When Whorf started writing for publication in the late 1930s he would have been astounded by the extreme reactions his writings would later have on the academic community. Initially his ideas were widely accepted but subsequently they were firmly rejected in a new intellectual climate. Whorf was then revisited and reformulated and a lively debate between relativists and universalists ensued which is still going on. Sadly, Whorf witnessed none of this because he died in 1941, but perhaps it is fitting that writings which are dramatic and extreme in many ways should have such a dramatic and extreme destiny. However, Whorf must no longer be only associated with the extreme

or strong aspects of his theories because the weaker aspects are just as important. Although Whorf's writings first appeared more than 80 years ago it is only relatively recently that the real Whorf started to emerge, both the weak lexical Whorf and the strong grammatical Whorf. Weak Whorf may well be "banal" and strong Whorf "sexy" (Pinker *Language*, *Stuff*) but that is just a matter of personal taste, as Deutscher (156) observes.

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