LANGUAGE PRODUCTION IN A TYPOLOGICAL PERSPECTIVE: A CORPUS STUDY OF TURKISH SLIPS OF THE TONGUE

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ABSTRACT

LANGUAGE PRODUCTION IN A TYPOLOGICAL PERSPECTIVE:
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The main purpose of this study is to establish a Turkish slips of the tongue (SOT) corpus and make typological comparisons with English, French and German corpora. In the first part of the study, a slips of the tongue corpus has been created. 85 podcast recordings were analyzed and 53 SOT errors were found. SOT errors were extracted from the podcasts and these audio clips were combined with their spectrograms in a flash video. Classification of SOT errors were carried out with respect to linguistic units involved, type of error, and repair behavior. In this study it is hypothesized that Turkish will have more morphological errors due to agglutination, and Turkish will have less phonological errors as vowel harmony will function as an extra control mechanism. Classification of the SOT errors with respect to linguistic units that are involved shows that 54.27% of the errors are phonological, 16.98% of errors are morphological, 13.21% of errors are lexical and 7.55% errors are phrasal. The

classification with respect to error type shows that 26.42% of errors are anticipations, 30,19% of errors are perseverations, 18.87% errors are substitutions and 7.56% of errors are blends. There is a difference in the percentages of errors as compared to the other corpora. Turkish has more morphological and phonological errors. Also the data shows that there are more perseverations than anticipations, similar to German. Typological comparisons with other languages suggests that the difference in the ratio might be caused by the SOV sentence structure rather than agglutination. The first hypothesis was therefore confirmed partly. However, the second hypothesis was not supported. Vowel harmony did not function as a control mechanism on the phonological well-formedness of the utterance. Rather, it seems to be located at the level of morpho-phonology in the lexicon proper. Turkish having more phonological errors might also be related with a higher demand on working memory because of the head-final SOV sentence structure. In order to be able to draw more reliable conclusions the size of the Turkish SOT database needs to be increased.

Keywords: Turkish Slips of the Tongue Corpus, Speech Errors, Language Production, SOT Error Rates

ÖZ

TİPOLOJİK AÇIDAN DİL ÜRETİMİ:
TÜRKÇE DİL SÜRÇMELERİ DERLEMİ ÇALIŞMASI

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Bu çalışmanın iki öncelikli hedefi, Türkçe dil sürçmeleri derlemi oluşturmak ve bu derlem üzerinden diğer diller (İngilizce, Almanca ve Fransızca) için yapılmış dil sürçmesi çalışmaları ile oran karşılaştırmaları yapmaktır. Bu çalışmada 85 adet podcast kaydı incelenmiş, ve 53 adet dil sürçmesi bulunmuştur. Her bir dil sürçmesinin ses kaydı spektrogramı oluşturularak flaş video haline getirilmiştir. her bir dil sürçmesi, içerdiği dilbilimsel birimlere, sürçme tipine, ve düzeltme yapılıp yapılmamasına göre sınıflandırılmıştır. Bu çalışmada Türkçedeki sesli uyumunun fazladan bir denetim mekanizması olması nedeniyle, dil sürçmesi derleminde daha düşük oranda sesbilimsel hata olacağı ve eklemeli bir olması nedeniyle de daha yüksek oranda biçimbilimsel hata olacağı öne sürülmüştür. Dil sürçmelerinin dilbilimsel sınıflandırılmasında tümce hatalarının %7,55, kelime hatalarının %13,21, biçimbi-

limsel hataların %16,98, ve sesbilimsel hataların %54,27 oranında olduğu görülmüştür. Sürçme türüne göre sınıflandırılmada ise harmanlama (blend) hatalarının %7,56, yerine geçme (substitution) hatalarının %18,87, geriye dönük kalıcılık (perseveration) hatalarının %30,19, ve ileriye dönük kalıcılık (anticipation) hatalarının %26,42 oranında olduğu görülmüştür. Dilbilimsel değerlendirmede, özellikle biçimbilimsel ve sesbilimsel hata oranlarında diğer diller ile Türkçe arasında farklılıklar vardır. Ayrıca hata türlerinin oranları açısında da ileriye dönük ve geriye dönük kalıcılık hatalarının oranları için de diğer diller ile Türkçe arasında Almancanın oranlarına benzer farklılıklar bulunmuştur. Biçimbirimsel hata oranlarındaki artış ile ilgili olan ilk öngörümüz kısmen doğrulanmıştır. Diğer diller ile yapılan tipolojik karşılaştırma, Türkçedeki daha yüksek biçimbirimsel hata oranının, eklemeli yapıdan çok, nesne-özne-yüklem şeklindeki cümle yapısından kaynaklandığı düşünülmektedir. Fakat ikinci öngörümüz doğrulanamamıştır. Sesli uyumunun sesbilimsel bütünlük için fazladan bir denetim mekanizması olmadığı ortaya çıkmış, ve sesli uyum mekanizmasının sözlük içerisinde biçimbilim-sesbilimsel boyutta bulunduğu yönünde deliller bulunmuştur. Türkçenin diğer dillerden daha yüksek sesbilimsel hata oranına sahip olmasının, yüklemi sonda olan nesne-özne-yüklem cümle yapısının, daha fazla kısa süreli hafızaya ihtiyaç duymasından dolayı olabileceği düşünülmektedir. Daha net çıkarımlarda bulunulabilmesi için daha geniş bir dil sürçmeleri veritabanına ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Türkçe Dil sürçmeleri Derlemi, Konuşma Hataları, Dil Üretimi, Dil Sürçmesi Hatalarının Oranları

Bir tanem Gülçin ve inci tanem Damla'ya

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PREFACE

This study aims to create a database of Turkish slips of the tongue for further research in language production based on speech errors. Currently SOT databases mainly compiled from languages that are members of Germanic and Romance language families. In addition, some databases exist for Uralic, European and Semitic language families, namely Arabic and Finnish. Adding a highly agglutinative language like Turkish would be very beneficial since it may reveal previously unnoticed relations between language production modules. In this regard, the database presented in this thesis is prepared from bottom-up and will be compared to other databases that are available.

This thesis has sections that briefly present and discuss the slips of the tongue data in various languages namely, German, English, and French. Also tries to explain major SOT types with examples, gives brief introductions to the serial and interactive language production theories. These sections try to shed light on why and how slips of the tongue occur. Also there is a section that explains the details of the database and method that is used throughout these investigations.

The hardest part of the study was to collect and investigate the errors. By now, more than hundred errors have been selected, however, only 53 of them were considered as slips after detailed analysis[1]. For each slip, that are recorded on the database the negotiations of error type, validity and comments took an hour at average. Each of

1 To be more precise: 27 of them have been dropped to ensure the database does not represent a limited number of speakers' slips; another 18 of them have been marked as not slips but were kept in the database, 20 for them were considered as speech plan changes and variations in daily language, and the many dropped out for various different reasons, like being tongue twister, appropriateness repair etc.

the SOT error, that is recorded in the database, classified with respect to three different basis as linguistic units involved, slip type, and repair behavior.

It should be kept in mind that, this is a study that lays the ground for new studies on Turkish grammar (phonology, morphology, syntax) and lexicon, based on a slips of the tongue corpus. Also the study will continue after the completion of the thesis to incorporate more and more items as time goes by.

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1	1st person	loc	locative
2	2nd person	n	noun
3	3rd person	neutr	neutral
abl	ablative	nom	nominative
acc	accusative	noms	nominalizing suffix
act	active	obj	object, objective
adj	adjective	p.p.	past participle
adjs	adjectivizing suffix	pa.p	passive participle
adv	adverb	pa.t	past tense
aff	affix	part	partitive
ass	associative	pass	passive
caus	causative	pcont	present continuous tense
conj	conjunction	pl	plural
cpd, cpds	compound	poss	possessive
dat	dative	ppt	past perfect tense
EI	English interpretation	pr.p	present/active participle
fut	future tense	pr.t	present tense
gen	genitive	pref	prefix
ILT	interlinear translation	prep	preposition
IPA	International Phonetic Alphabet	prn	pronoun
imp	imperative	refl	reflexive
impers	impersonal	sg	singular
impf	imperfect	SOT	Slip Of the Tongue
inf	infinitive	sta	status
instr	instrumental	subj	subject/subjective/subjunctive
interj	interjection	suff	suffix
interr	interrogatie	TOT	Tip Of the Tongue
intr	intra	tr, trans	transitive
L1	1st language	v, vb	Verb
L2	2nd language	vbs	verbalizing suffix

CHAPTER 1

SLIPS OF THE TONGUE

Slips of the tongue (SOT) can be defined as "an unintended, non-habitual deviation from a speech plan" (Dell, 1986; see also Poulisse, 1999). "Unintended deviation" is the most distinctive feature, sometimes these deviations are used intentionally, like an erroneous word from a famous person, as in a spoonerism[2]. This definition implies that the immediate discourse and sentence context also need to be known, so that the deviation or slip that occurred within the whole speech plan can be observed and discerned. Also habitual (linguistic and physiological) deviations play an important role, e.g., if speakers have a habit of dropping consonants at the word end, or having a longer tongue that causes some consonants to be misplaced, that cannot be accepted as a SOT (Garnham *et al.*, 1981; Poulisse, 1999). The above definition emphasizes the importance of competence in a general sense. In order to explore the performance of competent speakers, any regular anomalies should be ruled out. Thus, studies with aphasic patients or other patients are only supportive and their utterances cannot be counted as SOT errors.

The definition of a SOT implies three important aspects. First, there must be a valid speech plan; second, the speaker must not have a habit of deviating from the language norm (impaired faculty/motor system/physiology); and third, the deviation must be unintentional. The errors that does not fit in these restrictions are studied

2 Utterances like "A blushing crow" instead of "A crushing blow" is an example of spoonerism.

under the broader category of “speech errors”. Speech errors are all unintentional errors of the speaker, including SOT errors, TOT errors, speech plan change or appropriateness repairs.

Non examples of SOT

Record : 2007/02/06 MS 00:18:38
Error : Not Error
Sentence : O il bi yeşil silgi-ler var-dı hatırla-r mı-sınız?
ILT : That <il bi> green rubber-pl exist-pat remember-adj-inter-2pl
EI : There were green rubbers, do you remember?

In this non-example, <il bi>, the problem is that there is no repairable error here so this speech error is considered as an invalid SOT.

Record : 2007/02/06 MS 00:16:26
Error : Not Error
Sentence : Fahir biz siz coşku-nuz-a stüdyo dış-ın-da
ILT : Fahir I you excitement-2pl-dat studio outside-acc-loc
EI : Not comprehensible

In this non-example, <biz siz coşkunuza stüdyo dışında>, although it could be interpreted with intuition, is a meaningless utterance.

Examples of SOT

Record : 2007/04/03 MS 00:40:25
Error : Anticipation of <u> from <uğraşıyorsunuz>
Sentence : Ne uş-le ne iş-le ne üş-le uğra-ş-ıyor-sun-uz Tuğba hanım
ILT : What job-with job-with job-with deal-with-pcont-2pl Tuğba mistress
EI : What are you working on

Record : 2008/11/17 MS 01:03:31
Error : exchange of root morphemes <araba> and <radyo>
Sentence : radyo-da-y-ım araba-yı dinl-iyor-um
ILT : radio-loc-1sg.poss car-acc listen-pcont-1sg.poss
EI : I am listening the car in the radio.

Example that highlights the contextual information:

Record	: 2007/04/03 MS 00:10:30,50
Error	: blend of two root morphemes <sarımsak> and <sepet>
Sentence	: ssserımsaa-(ı)n sap kıs-mı de-di-ği ne ya o sepet-te dur-ur-ken aksesuar ol-an şey mi?
ILT	: garlic-gen trunk part-acc say-pat-acc what oh basket-abl stay-adj-while accessory be-adj thing interr?
EI	: What is the trunk he is mentioning, is the accessory that is seen while garlics are presented in a basket.
Comments	:The repetition of <s> is an example of a stuttering, however, this repetition is caused by a repair process aimed at a repair of a previous perseveration/blend; If the repetition was not caused by a recovery attempt, it would be a good non-example.

In literature, some speech error corpora includes only SOT and TOT data, discarding other speech errors (Fromkin, 1973). Some of the corpora only include SOT errors (Berg, 1987; Garnham *et al.*, 1981; Poulisse, 1999), and some speech error corpora only include data from aphasic patients (Browman, 1978). Although all language production theories used speech errors as a main source of evidence, they discriminate the SOT errors from speech errors. Even if their corpus includes those errors, which are not SOT, researchers tend to consider these errors as supportive, rather than conclusive.

Although SOT errors are well defined, there are many SOT definitions. Basically, some claim that speech errors and SOT errors are synonymous (Cutler, 1981), some claims they are different (Dell, 1986; Fromkin, 1973). Speech errors include SOT errors, TOT errors, stuttering, repetition, and many errors that are caused by other cognitive processes. If the aim of these studies are to sketch the system of the language production, then collected errors must reflect the properly working system. This implies that, speech plan changes during ongoing speech, repetitions, and repairs of inappropriate utterances are excluded from slips, but are still counted as speech errors. The basic idea behind this definition is that there is a separate faculty of language underlying language processing, that is free from the influence of other cognitive mechanisms. If slips are “a window” to this faculty, then the errors must be collected from the system that have proper input and working without intrusions.

This does not mean that other speech errors are useless. These speech errors are valuable for better understanding of how speech is generated, but less useful for how the faculty of language is generating speech. Hence, there is a debate on whether a faculty of language exists or not, boundedness of SOT on faculty of language may cause SOT definition to be changed.

Berg (1998:303-304) has reviewed the debate between formalism and reductionism. Formalists claim that faculty of language, or competence cannot be explainable in terms of computations, or brain. While reductionists claim that there is no such thing that cannot be explainable in terms of processing. Reductionists also explains the regularities in language, or formalism, as a result of the processing. There is another stance in between the two edges and assumes that even the processing can explain the whole language phenomenon, it does not nullify the formalism, and formalism in this respect is only a guidance, or intermediate step. As Berg (1998:313) summarized, it is not possible to prove or disprove reductionist claims or formalist claims. However, there is a growing resistance against the concept of "the faculty of language" from both neurological and biological perspective. From the neurological perspective, previously language specific areas like Broca's and Wernicke's area have found to be related with other cognitive abilities, like attention, working memory, spatial processing etc. (Särkämö *et al.*, 2009). The uniqueness of language to humans is also under discussion. It has been shown that several human specific cognitive abilities proven be exists in primates, too (Margoliash & Nusbaum, 2009). Actually, these evidences are supporting the arguments of the reductionists, claiming non-existence of the competence, or formalism, over the performance. However all the SOT corpora studies also verifies the formalism in language and language production, by highlighting regularities even in the speech errors.

If the black-box of the "faculty of language" is broken, some of the linguistic processes will become related with other cognitive functions. Although some findings suggests that faculty of language is not a single black box but a collection of black boxes, as Wernicke and Broca aphasia highlight, and studies related to working memory hinders further divisions, these findings, does not cause a change in the formalisms, and it seems not so possible. There is still possibility that definition of

faculty of language can change and this might force to change the definition of the SOT. Currently, it is not the case and utterances that are "unintended, non-habitual deviation from speech plan" are accepted as SOT errors[3].

In summary, SOT errors are erroneous utterances that have been produced during speech production and aids researchers to explore a system that is otherwise impossible to investigate. Each SOT error pattern gives the clues of how the system of language production works and helps to identify language subsystems and their interactions.

Although SOT errors are the main source for language production theories, there are criticisms on the reliability of SOT corpora (Cutler, 1981; Ferber, 1991; Ferber, 1995; Poulisse, 1999). The main cause of the criticisms is rooted in the basic idea that there is no clear cut definition of SOT errors and the detection and collection methods differs from corpus to corpus (Ferber, 1991; Poulisse, 1999). Those criticisms extend to include the laboratory induced SOT experiments. This criticism arises from the fact that, the experiments are designed for testing the theory assumptions. These experiments represent a "chicken and egg" problem. If those "language production models" make wrong assumptions, then those designed experiments will likely repeat them (Ferber, 1995). A recent trend in language production research is to include data from the aphasic patients to verify accounts of the language production process by utilizing computer simulation models (Dell *et al.*, 1997b; Roelofs, 2004) might address these criticisms.

1.1. DETECTION AND COLLECTION OF SOT ERRORS

As SOT definition suggests, listening a speaker for unintended, non-habitual deviations of her speech plan is the only and very subjective method for detection. The nature of the speech is on-line and most of the time (if it is not recorded) listener has only one chance to detect these deviations, so it requires skills in SOT detection.

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3 There is also more discussion on the topic of definition hence, child slips corpora are gaining more and more interest. It is not possible for children to have a fully grown faculty of language, so current definition of SOT is not valid for child corpora (Jaeger, 2005), or it is even impossible to talk about SOT errors for children.

Since the procedure of SOT collection limits how you detect errors, more focus is concentrated on the collection process. Basically, there are two primary methods for SOT collection. First method is to collect SOT errors by “paper and pen”, and the second method is to scrutinize recorded media for SOT errors. Also there are methods that combine both, as initiating base corpus by “pen and paper” and enriching this corpus with recordings by laboratory experiments.

If “paper and pen” method is utilized for SOT collection, then there is only one chance to listen speech and note down SOT error with the description. Every detail, as much as possible, should be noted down upon speaker makes a SOT error. This method is very dependent on listening and writing skills, and more importantly luck. Although, it is very prone to the error, it is possible to create a small sized corpus in a relatively short time by attending various events. This method is not so reliable, because it is very easy to mishear a word and incorrectly record the utterance or skip as if it is correct.

Collecting SOT errors from a recorded medium has two difficulties. First, it requires high quality recordings, that is clearly distinguishable speech in the recording with little environmental noise, scratches or white noise, but not the special equipments or high bit-rates. Second it requires a great deal of time to scrutinize the audio. Although slip detection is the same for each method and depends on the listeners skills, recorded medium has an advantage, researcher can listen the recording as many time as it is wished. Also it is possible that the medium can be shared with other experts for inter-rater verification to avoid the rater biases.

There is no discussion of which collection method is the most reliable for collecting SOT errors and researchers agree that scrutinizing recorded media is the most reliable (Ferber, 1991; Fromkin, 1973; Stemberger, 1982). Actually, what matters for the studies in general is not the reliability, but the available resources, mainly time (Dell, 1980; Fromkin, 1973; Stemberger, 1982). Studies with relatively restricted time prefers the pen and paper method for collection. These studies try to improve the reliability in two ways, either comparing their data with corpora collected from the recorded medium (Fromkin, 1973; Stemberger, 1982), or by taking necessary precautions (Meyer, 1992; Poulisse, 1999).

In the literature there are many concerns with respect to the reliability, that varies from the SOT rate in speech to differences in the distribution of SOT error types. SOT error rates differs very broadly, as one study revealed that there is an error per thousandth words (Garnham *et al.*, 1981). Another study revealed that there are 50 SOT errors for 45 minutes of talk (Ferber, 1991), if a speaker can utter two words at a second then this means that there are 50 SOT errors in 5400 word utterance, or one SOT error per 108 words. There is significant difference between 1/1000 and 1/108, which can be attributed to the familiarity of context and content (Kawachi, 2002). It is assumed that more familiarity with content and context will decrease the ratios of some SOT error types. But more research is needed in this topic. Also the distribution of error types across the different corpora is speculative. It is assumed that the percentage differences between corpora of same languages caused by researchers' perception, that is their thought about how language is produced, and their basis, or proofs of that theory (Ferber, 1995). Actually, these differences between the corpora raise these issues, or reliability concerns that might be related with collection methods and nonexistence of double – inter-rater – verification. These issues related with the SOT corpus research is summarized below:

1. Corpora seem not to be comparable and each corpus remain subjective, because no other researcher worked on the other corpus (Ferber, 1995; Meyer, 1992). Even recorded ones does not provide tapes for inter-raters (Garnham *et al.*, 1981).

2. Also the same error might be identified as a different type by other researchers (Meyer, 1992). For example one researcher might account for a phonetic error as a segmental error, while the other might account for it as a feature error. This also compromises the direct comparability of different corpora.

3. Even if a researcher wants to study on other corpora and access a corpus, there are difficulties. Most of the corpora are collected by paper and pen, so most of them lack the contextual information or context is limited to a sentence, as it could be seen in Fromkin's SOT corpus, error number 301:

"*chancellor's cabinet*". This information is not enough for clarifying immediate context and discourse context.

4. Another factor is the "slips of the ear" phenomenon, that is you can mishear words that are correctly uttered due to priming or other factors, like phonemic similarity (Cutler, 1981; Frisch & Wright, 2002; Vitevitch, 2002), or urgency of catching the slip, in particular, if it is a phonetic one (Vitevitch, 2007). Particularly, linguistic units smaller than words are most likely to be affected by "slips of the ear".

5. Also some slips may go unnoticed due to their complexity, like using *sende geliyorsun, değil mi (you are coming, aren't you - order)* instead of *sende geliyor musun (are you coming - invitation)*[4] could be result of grammatical similarity, attention shift, and context relatedness (Cutler, 1981; Ferber, 1991; Meyer, 1992; Poulisse, 1999). In order to decide whether it is a slip with an editing or not requires off-line listening.

The most criticized but most used method is the paper and pen method[5,6]. Nearly all researchers, including those that have created a corpus with the method, argue against this method (Fromkin, 1973), but they follow the tradition. It is indeed the best method if the study is limited in time (Stemberger, 1982), however, it requires the researcher to have necessary listening skills for detecting SOT errors. This is not a limitation hence experience can be gained during the research, also opportunistic and non-interactive nature of the method allows researchers to collect SOT errors even while traveling. Although analysis can take a great deal of time, it is very time

4 These examples are just created to show the effect of the speech plan change, it is very easy for the speaker to convert the first sentence to second sentence on-line, even after articulation of <sende>.

5 First paper and pen corpus is published by a German researcher, for separately children and adults, in the hope of shedding light for mental processes of language-production (Meringer & Mayer, 1895)

6 There is at least one resource about the slips of the tongue errors, but it is written for clearance of English use, and includes mainly corrections of misconceptions in English. The examples given in are habitual differentiations from regular English and misuses of words/phrases. (Long, 1888)

saver. This also has makes the data less reliable, hence no other researcher can listen the error, but only written excerpt from the corpus. Generally the following points need attention while collecting SOT errors (Cutler, 1981; Ferber, 1991; Ferber, 1995; Meyer, 1992):

1. Transcription of errors must preserve the immediate and general context, so that it can be analyzed correctly (Ferber, 1991).
2. Transcriptions must include tonal and phonetic signals correctly, (Meyer, 1992)
3. It must be heard in the same way by another listener to avoid perceptual bias (Fromkin, 1973).
4. The decision whether the utterance is a SOT or not must be left for analysis. (Ferber, 1991)
5. The transcription must include as much information as possible (Ferber, 1991; Meyer, 1992).

Other issues like personal background, knowledge of other languages, age and gender are usually not taken into consideration, since the collection of this information from the speakers, in most cases, is very hard, and awkward (Fromkin, 1973). Other than these precautions, further issues that might affect the analysis are:

1. Memory may fail to remember a SOT event, or it could be distorted (Ferber, 1991; Ferber, 1995)
2. Transcriptions might be erroneous (Ferber, 1995).

Also there are other problems like high rate of SOT, or not possible to take notes, that might cause the loss of SOT errors. Although researcher may take necessary precautions to avoid some of the highlighted issues, s/he may not guarantee the reliability of the SOT corpus. Issues like “the mood of the listener while capturing slips”, “a slip being unverifiable by other researchers”, and “perceptual biases of the researcher” are unavoidable.

Using media recordings for establishing a SOT collection is most respected method. It is accepted as free from errors (Fromkin, 1973) or less prone to error (Cutler, 1981; Ferber, 1995; Garnham *et al.*, 1981). In the literature, media recordingss are collected in two ways, by using an existing speech corpora, or by recording speeches. It's main

disadvantage is time, hence several iterations of listening is required to ensure nothing has been skipped, there can be perceptual biases, mood differences and other factors that can effect the detection. But it has great advantages, as SOT errors can be verified by inter-raters and recordings does not lose context information (Cutler, 1981; Ferber, 1995; Meyer, 1992).

Additionally, there are hybrid methods like a staged approach to the study of speech errors, in other words, conducting a broad corpus study then making experiments. Initially, a pen and paper corpus is created in order to build and empirical base, so that testable hypotheses can be derived, then in a second step, specific psycho-linguistic experiments to elicit certain classes of slips which are of particular interest are devised (Hohenberger & Waleschkowski, 2005).

1.2. CLASSIFICATION

There are several approaches to classify SOT errors, which emerged from different needs. Fromkin developed an approach that helped her to systematically organize her data (Fromkin, 1973). Stemberger (1982) used a similar classification approach, but added anew dimension to precisely describe errors that gave hints on internal structure of lexicon. Garnham *et al.* (1981) classified their data by using a different approach, a flat SOT classification, by introducing eight SOT types. These three example show that every researcher has something different in their mind, so that they created their ways of classification.

Fromkin (1973) used a two step approach for SOT classification. In the first step she identified the slip type as “process” among “substitution, addition, deletion, etc.” and in the second step she defined the direction of the slip as “substitution, addition, anticipation, etc.”, within eight linguistic units.

Stemberger (1982) has used a similar approach with Fromkin's two step approach and he added a third step. The Third step is added for identification of the source of the error and the location of error. This addition is very useful when finding extra information about lexical and typological organization.

Garnham *et al.* (1981) offered a straight forward approach for classification by using only SOT type and involved linguistic units. They used seven SOT types, as "substitution", "anticipation", "exchange", "omission", "addition", "perseveration", and "blend" with the addition of "other" error type for error classification. Also they used "phoneme", "segment", "word", "phrasal" and other for classifying the involved linguistic units.

If there are no drawbacks to any of the classification approach then there wold be all in one solution, however, every researcher has different needs, and tries to prove different ideas or tries to explore different topics in speech production. This creates the variety in classification approaches, also even in the same corpus some changes can be observable within minor details[7]. This makes it a bit harder to work on these corpora. Currently, only the corpora from the Max Planck Institute for Psycho-linguistics[8] can be reached on-line, and the researchers working in the institute, made efforts to standardize each speech errors corpus to make it more accessible to other researchers.

Slips of the tongue can occur in nearly all linguistic levels, from syntax to phonology, including several units within each level. SOT errors have common mechanisms, such as "Addition, Substitution, Deletion, Blend, Anticipation, Perseveration, Exchange, Metathesis and Fusion"[9]. At each linguistic level, affected units may change but these mechanisms persist.

German slips of the hand shows morphological errors, because phonological features carry morphological features (Leuninger, Hohenberger & Waleschkowski, 2007). Also some irregular forms have similar phonological forms that, tense changes easily can easily be represented by single phoneme as sing-song example. But these interactions between different levels of linguistic processing does not mean that there are slips between the linguistic levels, rather it means that each linguistic level

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7 Actually, if MaxPlanck's speech error corpora is explored, it is easy to find inconsistencies within the each corpora.

8 Currently their speech error corpora includes 8673 slips of the tongue data from English, French, German and Italian languages within 21 sub-corpus of 9 corpus.

9 Also there are more mechanisms but those are basics.

connected to other linguistic levels. In other words, there exist strict linguistic levels on which our brain/mind operates while producing language, which means that language processors does not make random errors, if there is an error in lexical selection, then randomly, non related phoneme can insert into somewhere in the sentence. However there are slips that are produced due to the interaction of several linguistic levels, especially levels between morphology and phonology (Nooteboom & Quené, 2008), due to the connection between processing levels.

Although definitions of SOT mechanisms and linguistic units involved do not deviate between studies, differences come from the SOT categories. What is confusing is the same processing mechanism on the same linguistic units could be identified differently, as phonological errors, sub-lexical-errors, word-errors and so on (Ferber, 1995; Poulisse, 1999).

SOT categories used in this thesis is based on the categorical definitions of Hohenberger & Waleschkowski (2005) with some additions. Addition of "metathesis" category and addition of "syllable template" in the involved linguistic units are examples of these minor additions. In this respect this classification will contribute to the confusion of SOT classification (Ferber, 1995), however, due to the slight modification of original design this should not matter much.

Although SOT categories will not be explained in much detail, simple explanation with a brief example will be given for each type of slip:

Addition: It is a mechanism that a linguistic unit has been added into bigger linguistic unit, like a segment can be added to a syllable or a syllable added to a word or morpheme. It could be caused by various reasons but similarity plays an important role.

Record	: 2006/11/01 MS 00:28:12
Error	: Addition of syllable <k>
Sentence	: iki pakket pamuk al-ıp saç yap-ıl-mış sakal yap-ıl-mış, karton-a yapış-tır-ıyo(r)-lar pamuk-lar-ı
ILT	: two package cotton take-conn hair make-pass-.ppt mustache make-pass-ppt card_board-dat glue-caus-pct-pl cotton-pl-acc

EI : They had crafted a mustache and hair from cotton by taking two package of cotton and gluing it to a cardboard.

Substitution: It is basically a replacement of a linguistic unit with another. Like a segment can substitute another, or a syllable morpheme or a word. It is hard to detect a substitution at lower linguistic levels, hence it could be an anticipation or perseveration, and if the SOT error could not be identified by anticipation or perseveration than it could be labeled as substitutions for the levels below semantics. Also substitutions can be further classified in to simple, semantic, formal and semantic/formal substitutions with respect formal and semantic similarities.

Record : 2006/11/01 MS 00:47:20
Error : Substitution, Semantic
Sentence : rica ed-er-im iyi a(kşamlar) iyi gün-ler akşam-lar değil
ILT : plea make-adj-1sg good a(evening) good day-pl evening-s not(verb)
EI : Not at all, good e.. good day, not evening

Deletion: It is removal of a linguistic unit. Although it is not observed in the SOT Turkish corpus, it can occur nearly all linguistic levels below syntax.

None detected yet

Blend: Blends are the amalgamation of two words into one word. It generally can occur between levels below syntax and sometimes it might be caused by semantic relatedness or syntactic position similarity.

Record : 2007/04/03 MS 00:10:30,50
Error : blend of two root morphemes <sarımsak> and <sepet>
Sentence : ssserımsaa-(ı)n sap kıs-mı de-di-ği ne ya o sepet-te dur-ur-ken aksesuar ol-an şey mi?
ILT : garlic-gen trunk part-acc say-pat-acc what oh basket-abl stay-adj-while accessory be-adj thing interr?
EI : What is the trunk he is mentioning, is it the accessory that is seen while garlics are presented in a basket.

Anticipation: Anticipations are common SOT types, that are observed in all linguistic levels below semantics including syntax. A linguistic unit can be

anticipated earlier in production than it should appear, replacing the correct linguistic unit.

Record	: 2006/11/01 MS 00:24:28,50
Error	: Antipation of a segment <h> from <hortum>
Sentence	: bir saniye fil haaz-ı-nın içine hortum sok-a-ma-z yaa
ILT	: one second elephant mouth-acc-gen inside trunk put-dat-neg-prt inter
EI	: One moment, an elephant cannot put his trunk into his mouth.
Comments	: Although it is an anticipation, anticipation filled an empty onset position so it is an additive anticipation, but not both addition and anticipation. It is not considered an addition because of the filled empty segement is sharing same syllabic position from the hortun, that is word onset.

Perseveration: Perseveration is the opposite of anticipation and it is another common SOT error. A linguistic unit can be replaced in the speech with a previously uttered linguistic unit.

Record	:2007/04/03 MS 00:01:13,40
Error	: Perseveration of <o> in <kuralım>
Sentence	: mikser-i orta-ya kour-a-lım
ILT	: mixer-acc inbetween-dat setup-dat-1pl
EI	: Lets place the mixer inbetween
Comments	: There is also a slight chance to be a blend of "kuralım" and koyalım" from different speech plans, but perseveration is more likely. Hence there is no evidence of different speech plans.

Anticipation/Perseveration: It is an error that could be both addressed as an anticipation or perseveration hence the source can be identified as a future unit or past unit. It is also named as harmony errors (Leuninger *et al.*, 2004).

Record	: 2007/06/01 MS 00:09:00
Error	: There are lots of <a> around the error, so it is both anticipation and perseveration
Sentence	: Bu şey yani estetik kaygı-ya bağ-lı bişey ama hani ma mutlaka görün-üyo ol-ma-sı gerek-iyor....
ILT	: This thing namely aesthetics concern-dat depend-assoc something but well ma certainly be-ns-acc need-pcont

EI : It depends on the aesthetic concerns of the wearer but certainly it needs to be visible.

Exchange: These are swaps of units within the same linguistic level, like a morpheme with a morpheme, segment with a segment etc.

Record : 2008/11/17 MS 01:03:31
Error : exchange of root morphemes <araba> and <radyo>
Sentence : radyo-da-yım araba-yı dinl-iyor-um
ILT : radio-loc-1sg.poss car-acc listen-pcont-1sg.poss
EI : I am listening the car in the radio.

Fusion: It is a blend of two neighboring elements. It must not be confused with blends. Fusion only occurs in neighboring elements.

Record : 2006/11/02 MS 00:30:20,90
Error : Fusion/Telescoping of <mesele> and <nefes>
Sentence : meses değil ya mesele kan ama eğer kan-ı su-la-n-dır-ır-sa-k
ILT : issue(me-se-le)/breath(ne-fes) not yah issue blood but whether blood-assoc water-vs-pass-caus-pt-subjn-3pl
EI : Breath is not an issue yah issue is blood but, if dilute water...

Metathesis: It is basically two exchanging segments, although it can be observed in the words, it is very hard to detect hence it can easily be identified as exchanges. Metathesis does not respect the syllable position and, onset and coda positions swap for the linguistic units, like <kibrit> → <kirbit>, <toprak> → <torpak> etc. In Turkish, this type of swaps are common in local dialects, and this make it harder to detect as a SOT. It is better to identify this metathesis as a process of localization, or adaptation of words.

None detected yet

1.3. REPAIRS AND EDITS

In the SOT research "repairs" and "edits" are hints for the errors, but not necessarily shows the SOT error. These mechanisms with the help of the monitoring tries to ensure what is intended to say is said as intended. There is no discussion about the

significance of “repairs” and “edits”. Edits are the markers of the errors and show that language production is halted or paused. Repairs can occur in every stage at the language production. The literature on the repairs and edits differs in how errors are monitored, whether they are monitored by a separate system, or within the processors by feed back or both (Postma, 2000).

Three is a great literature about mechanisms of monitoring, repairing and editing summarized by Postma (2000). Basically there are two different approaches as “perception based monitoring” and “production based monitoring”. The difference in these theories, or approaches, arise from how they apply monitoring in the language processing, and the degree of interactivity in the language processing.

In the perception based theories, there is a monitoring that employs inner speech and/or outer speech as an input and if it detects an error, immediately (depending on the severity) terminates speech processing, then may employ editing terms while correcting the speech plan and finally resumes the operation with the correction. Both inner and overt speech is monitored. The monitor can force editions and repairs even though the error may not be uttered. If the erroneous utterance is already in the phonetic plan buffer, then an audible SOT may be observable in overt speech (Levelt, 1983; Levelt, 1989). Monitoring is not only responsible for controlling speech errors of the speaker but also verifies whether the speaker's intention is fulfilled, whether the utterance expresses what was meant to be said, whether in the way it was intended to be said, and whether the utterances is pragmatically correct (Levelt, 1989).

In order to monitor all of this information, there is a need for more than one module, or a module with several inputs. A proposed solution to this problem is to include two channels to the speech-perception module. The first channel of the speech perception model take input from the phonetic plan and the other channel is provided through auditory input, or the speaker's listening to his/her own speech. The monitor can detect erroneous utterances or inappropriate selection of words, etc. through the speech perception. Also the monitor could be primed by discourse to prioritize which type of errors are more important (Levelt, 1983; Levelt, 1989; Postma, 2000). More

recent iteration of the theories change the monitor's position to prosodification or syllabic form from gestural scores or pre-articulation message(Levelt *et al.*, 1999).

Production based theories approach monitoring as an integral part of the production system and most notably spreading activation theory (Dell, 1986). These theories assume processing is hierarchically carried out and each process also feedbacks the superordinate by positive feedback. Positive feedback to the superordinate helps the node to be activated longer, or reach higher activation states. This higher activation, or lengthened decay, helps to self correct errors, while they are occurring, and decreases number of non-lexical slips. These models specifically explains why there are more lexical SOT errors than non-lexical SOT errors. In order to repair the error there is no need for an external monitor but, the positive feedback, autonomously fixes the error or forces error to be lexical without intervention from external processes. These theories do not deny that there can be an intrusion from speech perception and only deals with the production processes and some requires that there is a need for a specific monitor that checks for thresholds of the positive feedback (Dell, 1986; Postma, 2000). .

It is summarized that neither of the models propose necessary mechanism to cover all repairs and theories the includes both perception and production based monitors are more plausible (Postma, 2000). Recent exploration of this theory have found that some of the monitoring functions (biases) could not be primed while some of them could be primed. The difference in priming the monitoring functions shows that monitor functions can indeed work independently. Clearly there should be more than one monitoring system. Also a study showed that the monitoring system is composed of several subcomponents that work somehow independently and effects of monitoring are observable for both speech production and speech perception (Hartsuiker, 2006).

Another study showed that the monitor does not work the same for perception and production. Since it captures more errors in perceptions than in production, it should be a part of comprehension system (Özdemir, Roelofs & Levelt, 2007). Inner speech SLIP tests show that there is not only a comprehension based monitoring system but also a feedback mechanism (Nooteboom & Quené, 2008). This research favors

“interactive language production models” as they support both internal feed-back type monitoring and interruptions from the “language-comprehension system” (Nozari & Dell, 2009).

There are also many studies that try to explain slips of the tongue errors in terms of other cognitive modules, such as memory. It is known that there is a strong relation between certain types of slips with working memory. As an example, phonological store errors most likely occur in the production phase but not in the perception phase of phonological processing (Saito & Baddeley, 2004).

CHAPTER 2

LANGUAGE PRODUCTION

Language production theories in general try to define how language is produced starting from the ideas in our mind – the "non-verbal message". They describe the process in our mind that forms speech, uttered by our speech organs or in the case of sign language, by hands. It starts with conceptualizing our ideas, selecting words pragmatically with respect to discourse, then encoding it grammatically, then phonetically, and finally sending the message to the motor system of speech. This is an unconscious system that runs very fast, automatically, and nearly unobservable. How can a system like this, from start to end, be observed, and its underlying mechanisms be learned? The quest for answering these questions is continuing for nearly two hundred years now.

These questions initially tried to be answered form a neurological perspective by Jacques Lordat (1773-1870), a medical doctor. He tried to explain why some patients with brain injuries had language deficiencies. His investigation on patients with brain injuries paved the way to the conception of a language-production system, so that he could explain the causes of loss of the speech. Although his studies with regard to this system were completely lost, his ideas were unearthed and became somehow re-linked by several other researchers. Broca's definition of aphasia and the first localization of a language-specific area (Broca's area) may be grounded in this initial work.(Lecours, Nespoulous & Pioger, 1987).

Lordat's 1843 model of speech production is a good example of exploring the production system with methods other than SOT data, namely a biological exploration. Jacques Lordat, a medical pioneer lived between 1773 and 1870, started his career as military surgeon. Later he became a professor of physiology. He mainly focused on aphasia and identified many types of aphasia, and he had also suffered from aphasia starting from 1825. He prepared a system of speech production so that, his students would clearly understand the consequences or effects of the certain aphasia types as shown in figure 2 (Lecours *et al.*, 1987).

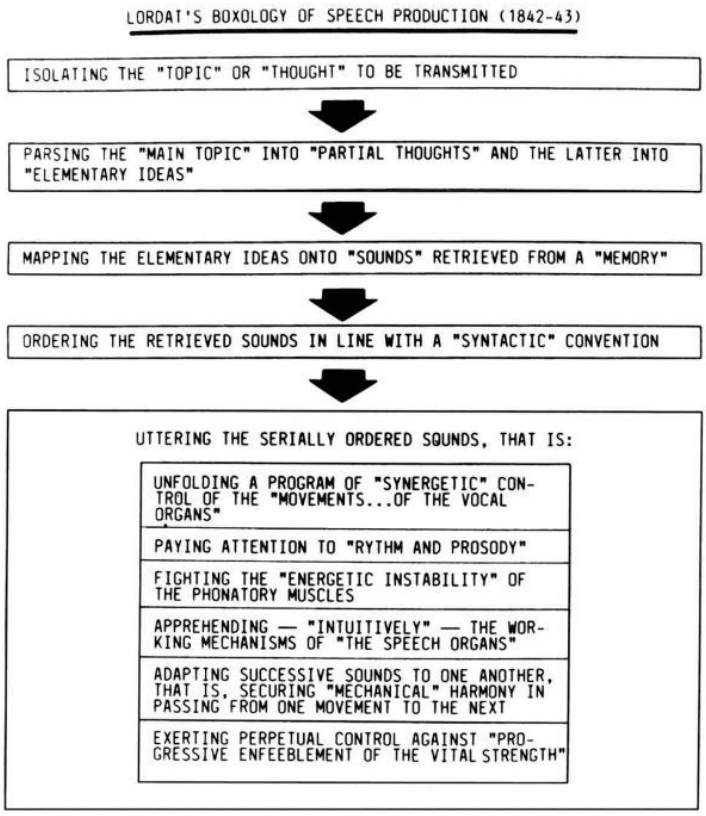

Figure 1: Lordat's boxology model of speech production (Lecours *et al.*, 1987:8).

Lordat's model is a pure production model and was created only for the purpose of explaining aphasia. The model includes the discourse context, a conceptualizer with a message generator (as "thoughts to be generated"), a formulator that has access to the lexicon (as "mapping ideas onto sounds") and applies syntax rules, then a phonetic plan (as "ordering sounds with syntax"), and, lastly, an articulator (as "uttering serially ordered sounds"). Although many individual components of speech production seem yet to be merged, as in "mapping ideas onto sounds", and many

processes are oversimplified, such as “ordering sounds with syntax”, actually, modern psycholinguists achieved a model like this not earlier than 1971.

Nearly fifty years later, a different perspective on language-production was developed by Meringer and Mayer in 1895[10]. They tried to answer those questions with the recurrence of speech errors. They collected SOT errors, analyzed them and pointed out regularities between errors. Also Meringer had foresight that children's SOT errors might have been valuable for exploring language (Fromkin, 1973).

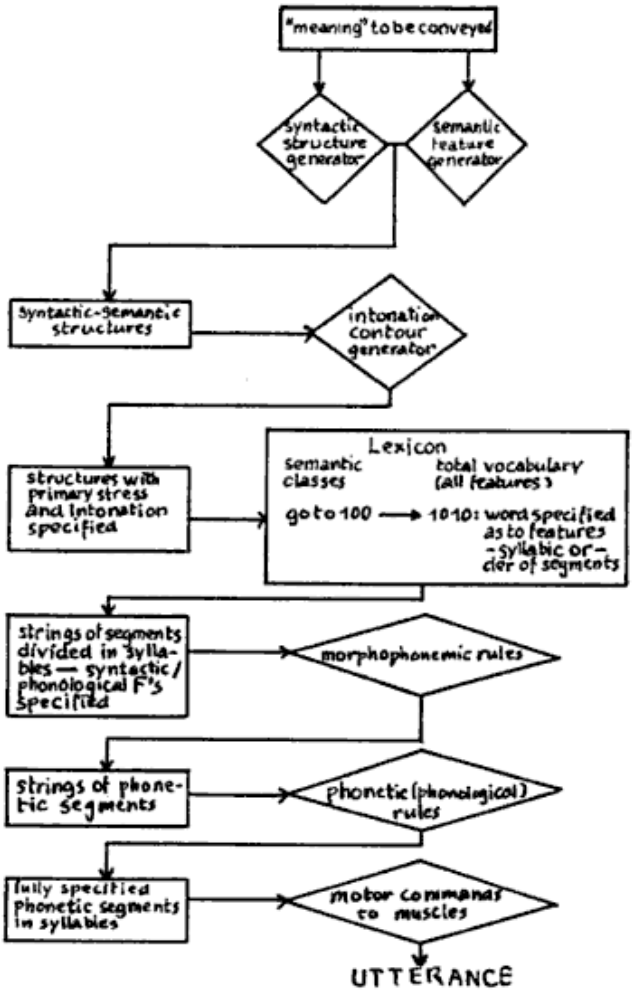

Figure 2: Fromkin's Model of Language Production (Fromkin, 1973:240)

10 Actually, these are available from a dedicated site that tries to preserve historic books:
Meringer & Mayer (1895): http://www.archive.org/details/versprechenundv00mayegoog
Meringer (1908): http://www.archive.org/details/ausdemlebenders00univgoog

Seventy years later, proving Meringer and Mayer's early insights, the most influential study came from Fromkin (1973). She systematically analyzed SOT data. Her analyses and those of others confirmed the existence of the structures like phonemes, segments and features with the external evidence. The main achievement of the analyses was the recognition of the patterns that SOT showed. She concluded eight rules from those patterns, and suggested a five-staged production system as shown in figure 2. Her model was describing only production without speech monitoring, that means, she did not account for repairs in daily speech (Fromkin, 1973). This work was very influential and several other theories of production were instigated that also mainly relied on the analysis of SOT errors (Dell, 1980; Dell, 1986; Garnham *et al.*, 1981; Levelt, 1989; Levelt *et al.*, 1999; Stemberger, 1982 among many others).

Those theories based on SOT data tried to describe language production from two different perspectives. The first perspective assumes that production is modular and the process continues unidirectional (serially), thus each module takes input from the preceding module and gives an output to the succeeding module without controlling the succeeding module's output (Fromkin, 1973). Monitoring and error correction is completed by a different system (see also Levelt, 1983; Levelt, 1989; Levelt *et al.*, 1999; Postma, 2000).

The second perspective assumes that language is production through spreading of activation, based on lexical access. Schönefeld (2001:20) offered “interactive” rather than “spreading activation” to describe the models in this connectionist tradition. As Dell (1980:287) explains, theories based on this perspective assume that a planned utterance is processed on all stages of speech processing simultaneously. Dell tries to explain only syntactic, morphological and phonological processes. These theories, as shown in figure 3, use a frame and slot approach that assumes that at each level of processing the whole utterance somehow exists, and all processes co-exist up to some extent. The basic mechanism for this approach is a frame and slot filling approach. At each stage of the activation a slot is filled with a frame with many slots. This is an iterative process that will end when each slot is filled with some fillers. The process operates in parallel and interactively, that is, neither activation waits for completion of all processes at a given stage but waits until a slot is filled. Then

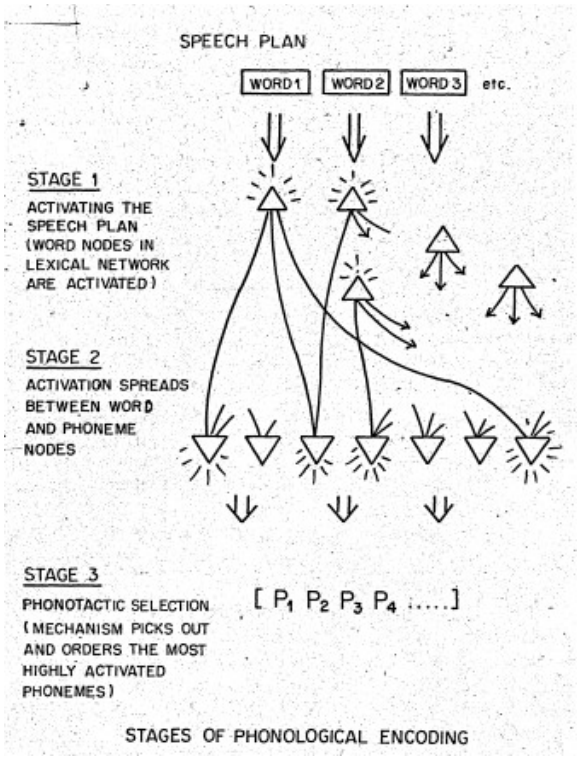

Figure 3: Dell's Phonological encoding (Dell, 1980:113-115)

activation spreads to the next stage. An activated node also feeds its own activation back to the activating node or slot, that is each activation has a two-way communication, or interactive (Dell, 1980; Dell, 1986; Levelt, 1989; Meyer, 1992).

2.1. LEVELT'S 1989 THEORY OF LANGUAGE PRODUCTION

The first model that anyone interested in speech production will face is probably Levelt's 1989 "blueprint of speaker"[11], since this theory is the most complete theory of language production. The theory tries to create a blueprint of how speech is produced in the speaker's mind, integrating discourse and speech perception, as shown in figure 4. Although Levelt proposes a serial model, he gives great importance to the spreading of activation. His perception of "activation spreading" does not go so far that he accepts it as a formal language, and he claims that what makes his model serial, or modular, is the interaction between modules, not how specific modules, or parts work (Levelt, 1989:19-20).

11 Levelt et.al.'s 1999 article have more explanatory power than 1989 model. Also it is somehow more complete due to the inclusion of Roelof's activation spreading for lexical access.

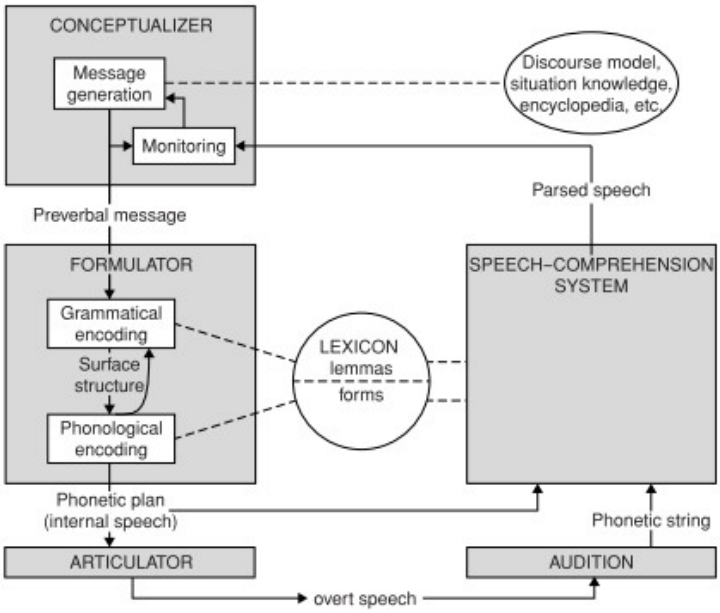

Figure 4: Levelt's 1989 blueprint of speaker (Levelt, 1989:9)

The speech production system consists of a conceptualizer, which is responsible for generating and monitoring messages, a formulator, that is responsible for producing a phonetic plan, an articulator that is in charge of motor execution of the phonetic plan, and a self-monitoring system that includes the audition and speech-comprehension system. As knowledge bases, Levelt assumes a discourse module (with encyclopedic and 'world' knowledge) and a mental lexicon (Levelt, 1989).

2.1.1. THE CONCEPTUALIZER

The conceptualizer turns the intention of communication into a conceptual pattern, the “preverbal message”. Levelt divides the activities of the conceptualizer into two planning stages within message generation, which he defines as follows: “elaboration of a communicative intention by selecting the information whose expression may realize the communicative goals will be called *macroplanning*...” (Levelt, 1989:5), and “... planning an informational perspective of an utterance – will be called *microplanning*” (Levelt, 1989:5). Basically, macroplanning changes the speaker's attitude to fit the context of speech, i.e., being informational, more explanatory or using slang, and in the micro planning stage, the topics to be discussed are planned while considering which information is new and which information is already given. Basically, the conceptualizer starts from a communicative intention and uses a

discourse model with the situation and encyclopedic knowledge and creates the preverbal message. By using the monitor it ensures that, the preverbal message fits the situation within the discourse and that errors are repaired if something goes wrong with the utterance.

2.1.2. THE FORMULATOR

This component takes the preverbal message from the conceptualizer, activates items from the lexicon, and builds up grammatical and phonological structures from this message and finally generates the phonological and the phonetic plan. An important aspect of formulator is its strong dependence on lexical access, that even determines the syntactic features and syntactic constructions. A detailed account of lexical access is found in Levelt *et al.* (1999) and Roelofs (2002).

2.1.3. LEXICAL ACCESS

A chunk of preverbal message from the conceptualizer, that is, some lexical concepts, activate a set of lemmas in the lemma lexicon. Lemmas contain the (semantic and) syntactic information of a lexical item. Those lemmas which have the highest activation are selected as they match the semantic information of the lexical concepts. As an example, if the sentence “Some swimmers sink” is to be produced the lemmas “some” “swim”, and “sink” will be selected out of the 30000-50000 words that a normal speaker knows. Figure 6 shows this activation procedure (Levelt, 1989).

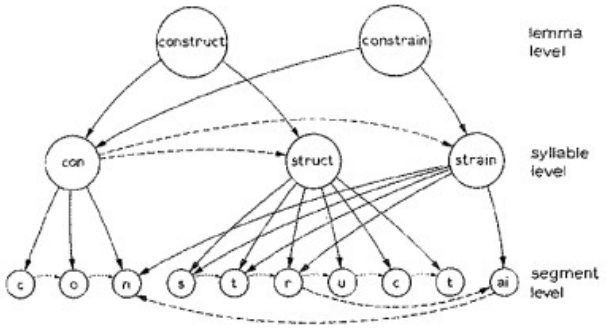

Figure 5: An example of activation spreading network (Levelt, 1989:19)

A lexical entry points to a lemma (which comprises semantics and syntax) and its morpho-phonological form. Upon retrieval of a lemma, its syntactic properties are retrieved and these syntactic properties trigger grammatical processing, i.e., structure building. As an example, during the activation of the lemma “swim”, its syntactic properties such as grammatical class (verb), grammatical function (predicate), and verbal complements (none in this case, otherwise direct and indirect objects) become available. In addition, diacritic parameters like tense, mood, aspect, etc. become available and a lexical pointer points to the lemma's specific form. Lemma information, which is stored in a buffer called 'syntactic buffer', activates the morpho-phonological form of the word (Levelt, 1989).

After activation of the correct syntactic form, phonological encoding start, and produces the correct morphological and phonological forms, or 'internal speech'. In phonological encoding, correct word forms are normally more strongly activated than incorrect forms. Also stress and intonation patterns are activated in this component. This information, the phonetic plan, is then sent to the articulator(Levelt, 1989).

2.1.4. THE ARTICULATOR

The articulator executes the phonetic plan and sends motor signals to the speech organs to produce overt speech. The articulator stores articulatory representations in the articulatory buffer. This buffer, which stores chunks of the phonetic plan, is necessary since speech is a serial process and planning may be ahead of articulation. Articulation requires synchronous movements of the respiratory, laryngeal and post-laryngeal musculature. Also, this component is responsible for compensating the hampered movements of muscles to some degree, like talking with a gum in our mouth.(Levelt, 1989).

2.1.5. SELF MONITORING

This model does not employ a direct feedback mechanism between the components of the language-production systems, however, feedback is provided through covert and overt speech, by self monitoring. Levelt proposed two self-monitoring paths, as explained above, one internal and one external. A direct connection between the

covert speech/phonetic-plan and the language-comprehension system is called internal path. The second path proceeds via hearing one's own speech, so that the language-comprehension system feeds information back to the monitor. If an error is detected, a repair takes place according to certain schemata as such pauses, editions, re-articulation, or rebuilding the whole sentence.

2.2. LEVELT'S 1999 BLUEPRINT

The theory evolved in several ways, first subcomponents has changed and interactions among the underlying processors have been reviewed, especially the lexical access and monitoring. Second, grammatical and phonological encoding have been separated as grammatical encoding placed in rhetorical/semantic/syntactic system. Third, Articulation is integrated in phonological/phonetic system (Levelt, 1999; Levelt *et al.*, 1999). This theory is indeed the same theory of 1989's theory with some changes as represented in figure 6.

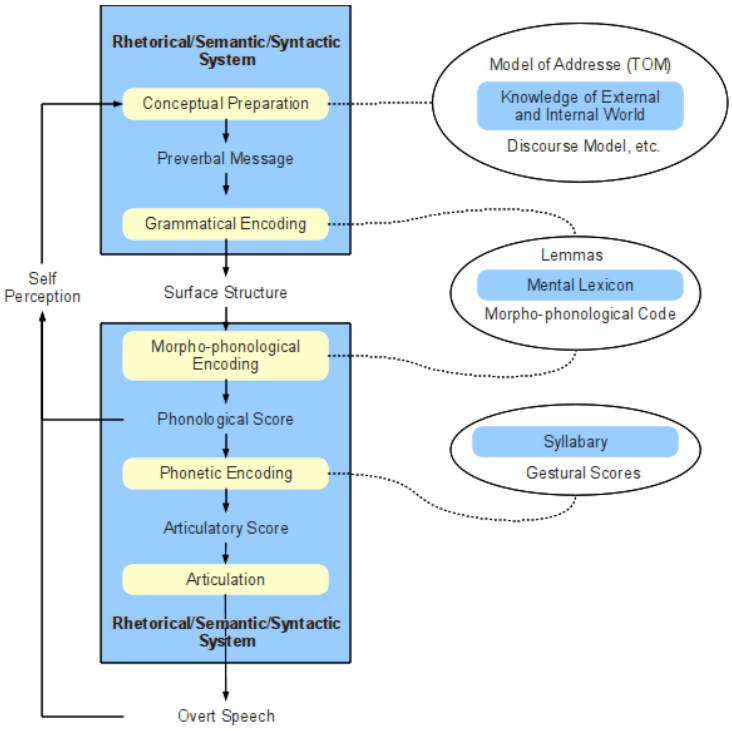

Figure 6: Levelt's 1999 a blueprint of the speaker

Process groupings have changed to better represent the abstractness of the processes, or with respect to their relations with the lexicon. Lemma and lexeme differentiation is observable in groupings as pure semantic components, conceptual preparations and

grammatical encoding is represented as one group. Morpho-phonological encoding, phonetic encoding and articulation, which have access to lexeme and syllabary are grouped together (Levelt, 1989; Levelt, 1999; Levelt *et al.*, 1999).

Findings of Wheeldon & Levelt (1995), suggested that phonological encoding needed to be divided as morpho-phonological encoding and phonetic encoding. As the findings suggests words are first morpho-syllabified than converted to the phonemic score, research further suggests that, inner speech is based on initial phonological, or syllabified word.

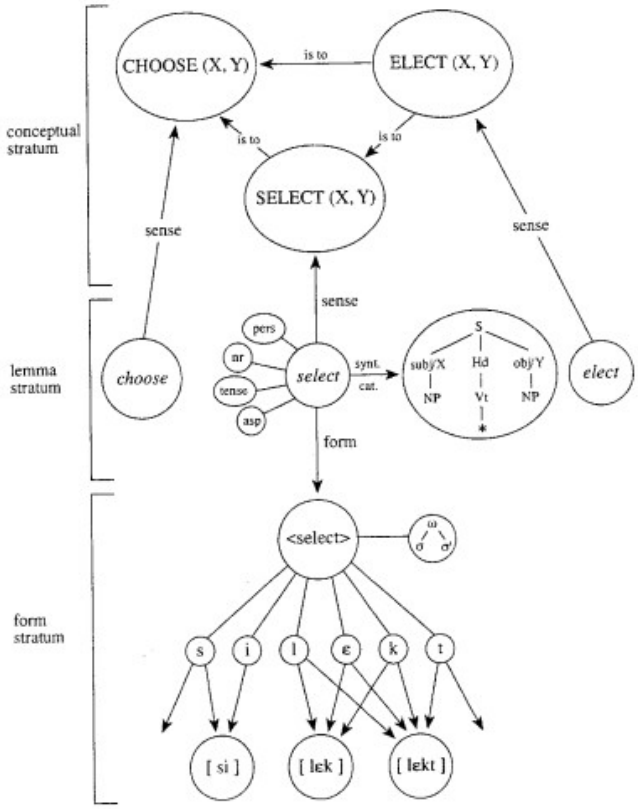

Figure 7: Fragment of lexical network (Levelt, 1999:97)

How lexical access is achieved have been clarified and Roelof's (1992) model has been chosen. A fragment of this lexical network can be seen in figure 7. This model uses spreading activation network, without utilizing a feedback mechanism and having distinct nodes for lexical items and word forms (lemma – lexeme distinction). In this manner it differs greatly from Dell's 1986 model. Lemma – lexeme distinction without decomposition also allows this theory to simplify the hypernymy problem.

Basically the theory does not assume concepts are decompositional (Levelt *et al.*, 1999; Roelofs, 1992; Roelofs, 1997b).

Having a lexicon without decompositional concepts does not mean nonexistence of a race between concepts for highest activation. This simply means that, when a concept reached highest activation, it does not trigger activation of decomposed concepts. Also the race between concepts include a dominant link connection, or a sense connection, to ensure intended lexical item is selected while limiting the lexical errors to the related concepts. This sense connection is a feature of the proposed network model.

Theory's assumption of non-decompositional lexicon arises from several unresolved issues of the decomposition for serial models. First of all, decomposition is closely related with the categorization, that is each category of the knowledge, or concept, is included in wider categories, like “dog” is a hypernymy of “beagle”, “dalmatian”, and “collie”. Also each category may have subcategories, that creates the category, like “beagle”, “dalmatian”, and “collie” is a hyponymy of “dog”. From this perspective it can be assumed that each concept is decompositional in a way similar to categorization. However these decompositions raise issues in the language production theories, especially for lexical access. Other than this issue there are several other issues like dissection and word to phrase synonymy (Roelofs, 1997a).

Dissecting message and gathering the necessary word forms for syntactic production is described as dissection. In the decompositional lexicon mental concepts does not map directly to the word forms because of the bigger number of mental concepts than vocabulary items. This bigger number of mental concepts causes problems in word form selection during the lexical access. There could be issues like phrase and word synonymy, like “filly” and “female foal” or “mare” and “female horse”. Other than synonymy, there could be issues in dissection for labeling each vocabulary item or group of vocabulary items that constitutes a concept, as “filly”. If this labeling is not carried out, the mental concept becomes untranslatable in to the verbal message. Also the words selection, or preferring one vocabulary item over the another also becomes problematic, as in the case of “filly” and “female foal”. Another problem raises from the word selection as hypernymy of “filly” is “foal” and “foal” is a

hypernymy of “horse”. When selecting the “filly” from the lexicon, also both “foal” and “horse” are equally selected or activated as well. It proposes a problem in lexical selection on which of the activated lexical concepts will be put in the sentence. It is also same for the hyponymy. If the intended concept is “horse”, then also all hyponyms will be accessed like “stallion”, “mare”, “foal”, and “filly”. Then there should be a decision on which item is more appropriate, as each means different concepts in the same category. In order to select “horse” which criteria will be used comes in to question, and each criteria is represented by different concepts in the category. Actually, accessing a category name without accessing the hyponyms is defined as hyponymy problem (Levelt *et al.*, 1999; Roelofs, 1997a; Roelofs, 2002).

These issues that are highlighted for the decompositional lexicon does not valid for the non-decompositional lexical. Each lexical concept in the decompositional lexicon is stored with the word form, and with the features. The features can be defined as the linked concepts but, hence they are features, activating the lexical concept does not trigger activation of the feature linked concepts, eliminating hypernymy, hyponymy, and synonymy.(Roelofs, 1997a; Roelofs, 2002)

The theory is still using a version of incremental grammar (IG) (Levelt, 1999). It is a kind of transformational grammar, that uses two step approach to generate a sentence. Initially syntax has been generated hierarchically, then sentence is serialized by deeper first, left to right algorithm (Kempen, 1987). The syntactic encoding part reflects some changes and uses performance grammar (PG). Performance grammar relies solely on the lexicon and does not need any non-lexical rule to define a sentence structure. The theory uses triplets of lexical entries, concept frame, lexical frame, and typology frame for each concept as shown in figure 7. Typology frame carries syntactic information, such as syntactic role. Lexical frames carries information on word's class and it's sub-categorization information (like if it is a verb than it needs to be placed between subject and agent etc.). Concept frame is the conceptual information of the lexical item (Kempen, 1987; Kempen & Harbusch, 2002; Levelt, 1999; Roelofs, 2002).

2.3. DELL'S 1986 THEORY OF LANGUAGE PRODUCTION

Dell's 1986 model, or spreading-activation theory of retrieval in sentence production [12], is a connectionist attempt to answer how speech, or more specifically sentence is produced. The theory only deals with speech processing from syntactic to phonetic encoding, and does not explain speech perception with overt monitoring. It does not need a monitor due to the interactive nature -two way communication- of its spreading activation implementation.

Before discussing the theory some preliminary issues should be clarified. First, this is a connectionist network, so it uses terms of neural networks. The following terms that are used in this definition must be clarified, namely, neural network, node, input nodes, output nodes, later, activation, spreading, frame, slot, and slot filling (Dell, 1980; Dell, 1986):

- A *Neural network* is a group of neurons that are connected to each other through synapses and dendrites. The size of a neural network is described by its number of nodes.
- A *node* is like a nerve cell (neuron), a computing unit of the neural network. It manipulates output(s) activation with respect to input(s) activation.
- *Input nodes* are the front nodes of the network that receive input from the outside of the network.
- *Output nodes* are the end nodes that produce signals for external use.
- *A layer* can be defined as both the sequence of the activations, such that the first activation triggers the second, the second activation triggers the third, etc., and different networks.
- *Activation* is measured by the strength of the signal that ranges from 0 to 1. (Actually, neurons transmits signals through positive and negative ion exchanges, and it is natural that, depending on the number of ions, the signal

12 Dell *et al.* (1997b) model has more explanatory power than this one, hence it is able to explain aphasic patients' errors. Moreover, it splits semantic meaning from word forms. Although this theory has a similar structure it does not fully explain the interaction between the two parts of lexical item, lemma and form.

will scale linearly.)

- *Spreading* can be defined as an interaction triggered among two neural networks or nodes, by transferring node activity to the slot fillers. This process starts the decay of activation.
- A *frame* is the number and sequence of active outputs that needs to be satisfied between two layers of networks or nodes.
- Each *active output* considered as a slot.
- The node with the highest activation value for a particular slot is the *slot-filler*.

Theory makes assumptions about two linguistic distinction by accepting semantic, syntactic, morphological, and phonological levels as separate and distinguishing lexicon from generative rules, or simply separating process from data as shown in figure 8. Process is defined as the set of generative rules that defines how linguistic units are combined at which categorical positions for each representation level. This process indeed generates the frames to be filled with slots.

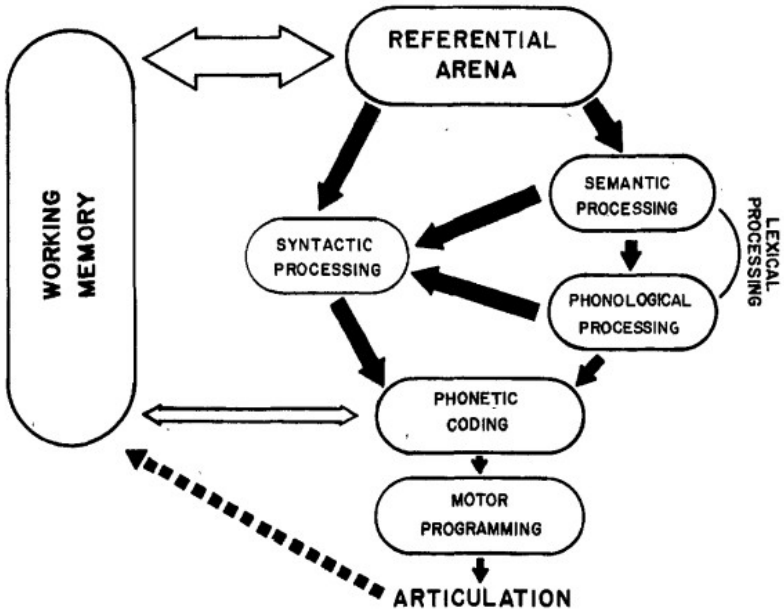

Figure 8: Bock's model of formulation(Bock, 1982:24)

Lexicon is described as network of information as concepts maps the words, words maps to morphemes, morphemes maps to phonemes, phonemes maps to features etc.

This implies that a concept's all hypernymies, synonymiesi and hyponymies and all forms of these words are stored in the lexicon, and the selection among the lexicon is carried by node activations (Bock, 1982; Dell, 1986).

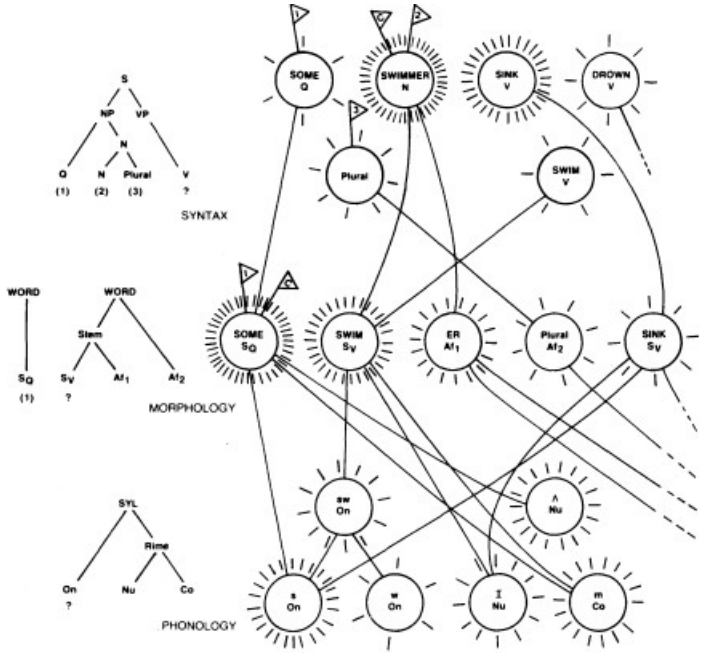

Figure 9: An example that shows a moment of spreading-activation with frame and slot filler mechanism creating "some swimmers sink" sentence (Dell, 1986:290)

Sentence production, in the light of the previous assumptions, carried by syntactic rules, in which they create empty slots with categorical definition and driven by the semantic concepts. It is a top down process, as can bee seen in a processing moment of creating “some swimmers sink” utterance in figure 9. First the syntactic representation frame becomes ready with empty slots, as “Adverb Noun-plural Verb”. The second word in the sentence, “swimmers”, is selected as a result of race between nodes represents “swum, swam, swimming, swimmer, etc.” and swimmer wins the race. Then the generative rules creates the morphological frame “Verb Agentive Plural”. Then “swim-er-s” win the race. For the each morpheme a phonological frame is created as “onset-nucleus-coda”. Production levels below the phonological level is also carried in a similar fashion (Dell, 1986).

The theory offers three activations in a sequence simultaneously. Although sequential parallel execution seems a bit confusing, actually, it is a lot simpler. Sentences are serial in nature and output should be prepared sequentially.

Assumption is simple, each representation is indeed a frame with many empty slots. Processing of lower representation starts upon filling of the first slot. Thus all processes become parallel. In other words, each activation sequence fills a slot and creates a new frame[13]. Subordinate nodes race for the filling of the slots of the frame, and winning node fills the slot and creates own frame with empty slots as can be seen in figure 9.

This spreading activation can lead to some confusion in the ordering. Hence, a network or cell required to be filled many slots in a phonological frame, and the process is parallel. Thus limiting an active node to be present in a different slot. It is suggested that, an active node can also be selected for the different slots, if it's activation state is significantly higher than the nodes which it is competing for empty slot.

The distinction of theory comes from the interaction between nodes. Theory allows subordinate levels to inform the superordinate levels about activation (Dell, 1986). Thus, if a node is activated, it also send activation signal to the superordinate. This type of feedback helps to eliminate errors without consciousness (Dell, 1986). It provides an automatic on-line recovery for building processes. When a node become active and selected as a slot filler, connects to other nodes. Establishing a connection means also sending some portion of activation to the connected nodes, increasing connected node's activation level. If decaying activation potential accepted as a time based function, then this shared potential among the connected nodes helps the nodes to stay active longer, or select correct nodes.

In summary, the theory approaches the lexicon as an information store of both concepts and word forms. It allows two-way interactive communication between nodes. Separates syntactic encoding at each level from lexicon and attributes to a different non-lexical, generative rules. This approach enables speaker to modify it's utterance on-line, or allows speaker to evolve his/her speech plan. Whole process of lexical access is carried in two steps as first step is to map semantics to the word

13 Actually, it does not generate the slots, but the generative grammar creates the slots to assemble the construction.

forms and second step is mapping words to phonemes. Although there is another step specific for morphological process that further decomposes word forms to morphemes, it is considered as a part of word to morpheme mapping. Actually, it takes two and a half step that whole lexical access is completed.

2.4. TWO STEP THEORY OF LEXICAL ACCESS

Two step theory is a derivation of Dell's (1986) model. It is still considered as an incomplete theory because, it does not express how lemmas are selected, how the syntactic frames are created, and where the generative rules are stored (Schönefeld, 2001). Several researches have been carried over the model's fitness to the aphasic patients utterances. This ability of the simulating aphasic errors is indeed an important sign that model can explain the real language processing.

Impairing the model with respect to aphasic patient's brain damage has been tried in several ways. Decay rate and activation weight are accepted as global and these are considered as primary factors for the erroneous aphasic utterances (Dell *et al.*, 1997b). Changing decay rate, weight are successfully explained the more aphasic picture naming tasks both in group and per case basis. Thus it turned out to be a simple alternation can explain both aphasic patient's utterances and normal speakers. Although, the study lacked the cases of pure semantic and pure phonetic aphasics errors, later study revealed that it could also be explainable by the theory (Dell, Martin & Schwartz, 2007; Foygel & Dell, 2000; Hanley, Dell, Kay & Baron, 2004; Schwartz *et al.*, 2006).

Although model successfully predicts the aphasic patient's utterances, it lacked neurological support, that is neurological findings suggests that there are two different highly active regions for phonological encoding and lexical selection (Foygel & Dell, 2000). The model has tuned to comply these facts. Also separating regions for the semantic encoding and phonological encoding makes it impossible to keep the globality assumption, hence the impairment can only effect a region of the brain. Also the node's activation weight and decay rate kept intact, hence if damage occurs in one part it will limit the connection, so that the activation weight and decay will become less important (Foygel & Dell, 2000; Schwartz *et al.*, 2006). The revised model more successfully predicted the aphasic patient's utterances including pure

semantic and pure phonetic errors, but performed not as good as weight-decay model in mixed errors. Also another problem that some patients, although they have good picture naming scores, their auditory repetition error rates were under-predicted by both versions of the models.

Difference in the error rates between picture naming and auditory repetition have been explored. And a non-lexical route has been added to the model to check the effect on the models prediction power (Hanley *et al.*, 2004). It is assumed that auditory repetition performance of aphasic patients on meaningful words are improved due to the effect of the non-lexical route, auditory buffer (Hanley *et al.*,

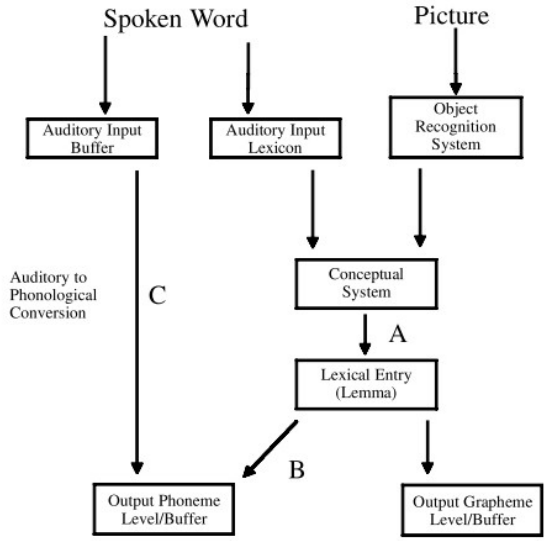

Figure 10: Dual route model of (Hanley, Kay & Edwards, 2002:195)

2002) can be seen in figure 10. This presumption has origins in dual route theory which claims that different modalities of the comprehension and production system uses two different mechanisms, orthographic systems and speech perception and production systems (Hillis & Caramazza, 1991) Also it is known that there is a link between the speech perception and production within the phonological working memory (Saito & Baddeley, 2004). Semantic-phonologic model with non-lexical route based have been successfully predicted the aphasic patients utterances that are previously under-predicted. However the model did not test the different modalities of the language production and phonological working memory but only tested the effect of the auditory input and object recognition.

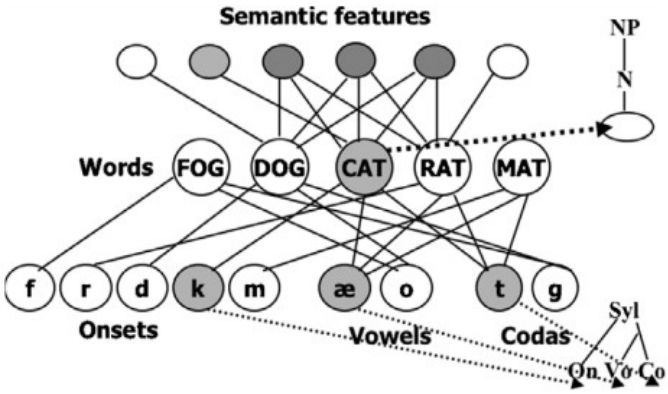

Figure 11: Two step lexical access, taken form (Dell *et al.*, 2007:493)

In summary theory defines lexical access within the boundaries of semantics and phonology, and defines the first step as semantic to word form selection, second step as word form to phoneme selection as can be seen in figure 11. Theory separates lexical selection process from phonological selection as two distinct systems that connects each other through output/input nodes. Also recognizes other language components both orthographic and auditory as interacting with the lexicon. Another assumption is, the interactive nature or feedback to superior nodes only last to closest neighbor, thus, it is not fully interactive. In other words phonemic selection can only feedback to the word selection but it does not effect the semantic selection (Dell *et al.*, 2007; Schwartz *et al.*, 2006).

Basically two step theory of lexical access is based on Dell's 1986 model of lexical access with the omission of the middle step, that is morphological encoding. Also the theory does not deny the existence of the morphological processing, just avoids. Actually, two step model is more specific theory in terms of interactions between network layers, and it has more details with respect to network interactions. Although it is more defining in terms of sentence production, it has less coverage for the phonological encoding, and offers 1986 theory for morpho-phonological encoding (Dell *et al.*, 2007; Schwartz *et al.*, 2006).

CHAPTER 3

METHODOLOGY AND DESIGN

3.1. METHODOLOGY

The paper-and-pen method has incurred several criticisms about its reliability (Cutler, 1981; Ferber, 1995). Since the listener has his or her own perceptual bias, not every slip will be recognized and written down correctly. As a listener processes both the content and the form of speech, her or his attention must be divided, which may lead to detection problems.

The detection of phonological slips of the tongue depends on the number of distinctive features changed in the error: while only 30% of errors with one different distinctive feature could be detected, 60% and 75% of errors with two or four different distinctive features would be detected. Also, slips of the ear cause some (more) problems for reliability as half of the noticed errors were indeed erroneous. Another issue is that, the detection rate of slips depends on the context, slip unit and type. Slips in stressed syllables have a detection rate of (44%) but in unstressed syllables only of (29%); lexical errors of (%85) and phonological errors of (%40), consonants of (32%) and vowels of (47%); perseverations of (%35) and anticipations of (%44) (Ferber, 1995).

Although Fromkin's comparative study of her corpus with a corpus of tape recorded slip resulted in no meaningful difference, this was probably due to her careful collection methods as it is mentioned in her 1971 article (Fromkin, 1973). It is argued that this non-meaningful difference was due to the integration of recorded

slips, however, the recorded slips only take a small percentage of her data. She accounted that the theory was based around over 600 hundred personally collected slips (Fromkin, 1973). Although there is no mention of inclusion of other slips data, even it is the case, the included data would not make significant contribution to ratio of slip types, as the aforementioned SOT errors only sums 124.

Initial study of Turkish SOT corpus with paper and pen method revealed that the problems of reliability cannot be avoided, so the initial corpus had been completely dropped. The current corpus is based on freely available speech segments from radio shows, or any other recorded public sources. Hohenberger & Waleschkowski (2005) argued for a staged approach to the study of speech errors. They offered first to conduct a broad corpus study in order to obtain an overall empirical frame of reference and derive testable hypotheses from it. Then, in a second step, devise specific psycho-linguistic experiments to elicit certain classes of slips which are of particular interest. In this case, the two stage approach could also be employed after the number of SOT data in corpus reaches a state where statistical distribution of errors are valid.

As mentioned earlier, podcasts of different programs have been collected for investigations. There are currently more than 1500 recordings from 27 different programs ranging from radio shows, to TV programs. From those recordings only 90 of them analyzed from one program.

In order to provide homogeneity of errors, that is distribution of error numbers with respect to speakers, after the initial five recordings, anchormen's SOT errors are neglected, only to phone attendees of programs are considered. So an additional step of locating phone sessions for each recording has been started, which causes an hour to listen and locate phone call sessions per recordings.

A three step approach have been used in the SOT detection's procedure. In the first step recording is listened to detect SOT errors. These detected SOT errors are analyzed and uploaded to server with some editing. Finally these uploaded and analyzed SOT errors are discussed with an expert to ensure it's type and features are correctly identified.

Detection of the SOT errors is a long and redundant task. There are three concerns with regards to detection, as hardware, mood, and perception. In order to avoid the effect which might be caused by hardware, two different speaker system is used with different sensitivity, a stereo speaker with an amplifier and a stereo headphone. Each recording has listened twice at different days to avoid the possible mood differences. Time of the each listening session is tried to be randomized, as morning or afternoon to avoid the perceptual biases. Also each listening session is limited by two hours to minimize the effect of tiredness. Each recording is listened at least four times. For each of the SOT candidate that is identified during listening sessions, are noted down with starting position in seconds with recording name.

All the collected SOT candidates are evaluated with respect to several criteria like phonemic differences, pauses, edits, habitual or cultural effects, speech defects etc. If the utterance can be verified as SOT, then the part of the speech with spectrogram had been copied from the recording to create a FLV file for web playing. Also a separate file for immediate context had been copied from the recording for additional information. A transcription of immediate context and SOT error had been prepared. A new SOT error defined in the server and, files have been uploaded to server. Interpretation of the SOT error completed by entering information on context and slip transcriptions. Initial analysis information has been entered to the server with a "Need Revision" mark.

Typically, 30-60 minutes required for the analysis of a SOT error. Other than initial five recordings, only detection of phone calls took 66 hours. At an average there is 10 minutes of phone calls for each recordings and at each detection step at most 6 of them could be analyzed, and most of them seemed to be caused from several biases, or different errors then SOT. It is a very time consuming process, but it seems reliable.

Within the domain of the statistics there are two types of the error that can be made while collecting the data. First there is an alpha error, that is accepting an utterance as SOT while it is not. Second, beta error, rejecting an utterance as SOT while it is. There is a trade-off between alpha errors and beta errors, if percentage of alpha errors

is tried to be minimized than percentage of beta errors will increase, or vice versa. In this corpus study, percentage of the alpha errors is tried to be minimized.

During the initial collection of SOT errors, beta errors tried to be minimized by several iterations of listening. This collected data later discussed with the SOT expert, Annette Hohenberger, to decrease the number of alpha errors. In the lengthy discussion sessions various possibilities had been discussed like speech plan changes, repetitions, stuttering, inappropriateness repairs, politeness etc. After these discussions, the alternative that has less speculation and more evidence has been selected. This procedure decreased the number of errors in the corpus by 18, but these errors kept in the database. This approach has been selected for decreasing the number of alpha errors or false positives, but clearly this increased the beta errors, or false negatives.

Inter-raters reliability could not be established due to lack of experts on both Turkish and Slips of the tongue. Although it would have been desired it was not feasible, unfortunately.

3.2. TYPES OF SOT

Initial categorization of SOT errors taken from (Hohenberger & Waleschkowski, 2005) as:

Type of slip: anticipation, perseveration, substitution(semantic, formal), blend, fusion, exchange, and deletion

Affected unit: phonological feature, syllable segment, morpheme, word, and phrase

Locus of repair: before word, within word, after word, and delayed

The SOT schema used in the corpus has been shown in the appendix B.

3.3. DATA STORAGE DECISIONS AND DESIGN

There are mainly two approaches for storing slip information. Both approaches use a database, either within a database integrated application or from a separate server. The first approach prefers client-side storage of slips in a database such as “File

Maker Pro" and "Access" databases. The second approach uses a database with a web interface like the one at the Max Planck Institute. The second approach is more beneficial as it allows multiple access and access from anywhere through the Internet with any platform (Windows, Linux, Mac, etc) and from any client (Internet Explorer, Firefox, Safari, etc.).

The database preference also reflects the software preference. If client-only approach is preferred then there is no need to make a selection for a user interface. However, if the client-server approach is chosen then it is required to choose a client software and interface. There are two options for the client-server setups, a platform-dependent and platform-independent approach.

The platform-dependent approach uses an application that is specifically written for that platform, connects to the database server and provides a GUI, like Glom for PostgreSQL backend. If the platform-independent approach is chosen then web services are taken into account. There are several choices for building such an interface, implementing a web server and database server. As an example, the Max Planck Institute prefers Perl scripting language with the Apache web server with an Oracle database backend. This approach also requires more-than-average knowledge of SQL scripting and database design. An advantage of this system is being highly customizable.

Existing softwares that provide web application frameworks are not reviewed, due to the time that needed to learn that framework. However, Content Management Systems (CMS) that provides ready-to-use interface and database support are reviewed. The main failure of the CMS is that they were designed to keep a site organized with a certain type of content, e.g., articles. Some CMS offer extensibility for other types of documents and even allows custom document types. But CMS is not adequate for the goals, that is, CMS generally does not allow relational data storage. Although some CMS allow this type of interactions, they lack certain functions, as database embedded media. Due to these problems, a new framework for this specific task is needed.

The most important factor on the data storage platform decision is the human factor, that is, familiarity with the software. In this respect, I prefer a web based client-server model. This platform choice will provide a longer life-time for the corpus software, with increased accessibility from broader range of individuals.

3.3.1. ANALYSIS

A closer inspection of the Max Planck's slips database revealed that slip of the tongue errors contain the following fields for slips, interpretations and analyses:

Slips

- Target Language
- Speaker
- Reporter
- Date
- Channel
- Situation
- Completeness
- Correction
- Trials

Interpretations

- Utterance
- Intention
- Issues
- Ambiguity
- Phonetics
- Other Information

Analyses

- Error Type
- Comments
- Target Unit
- Error Unit
- Source Location
- Wellformedness syntax
- Wellformedness lexical
- Wellformedness phonology
- Process Direction
- Process Procedure
- Item Syllable n
- Item Segment n
- Item Lexical Word n
- Item Morpheme n
- Item Feature Class n
- Item Feature n

Domain Properties

- Syntactic Target
- Prosodic Target
- Prosodic Error
- Stress Target
- Stress Source
- Stress Error
- Word Error

From those fields, the database seemed to be organized into four tables. However throughout the database there were inconsistencies about database field values, like

presenting substitution errors under a different field than process direction or process procedure. Also the domain properties are related with the analysis and there is no need for domain properties to be a separate table.

3.4. DESIGN

3.4.1. Database

In order to reach the goal database must have four tables to keep track of slips of the tongue, as records, slips, interpretations and analyses, further two tables to store articles and news, and one more table for storing authorization information as it is shown in table 1:

Table 1: Table of Database Tables

Part	Table Name	Description
Slips of the Tongue	records	Whole audio record of the radio show
	slips	Audio record and information on slip
	interpretations	Interpretation of the slip record (what is said)
	analyses	Analyses based on interpretation and slip audio
Content	content	Content material, like help parts
	news	News on the site changes
Authentication	users	User information like user name and passwords

As can be seen in figure 12 an audio file can be linked with many slips. Each Slip can have links with more than one interpretation. Each Interpretation also can have links with more than one analysis. Basically, a slip can be validly interpreted and analyzed as many times as it necessitates.

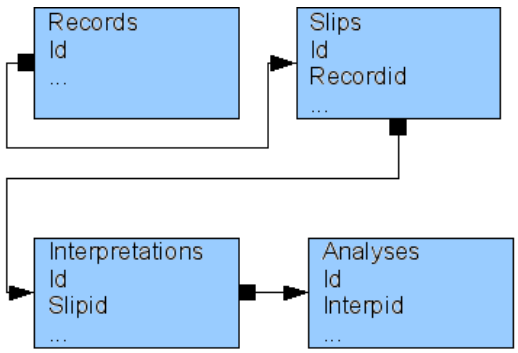

Figure 12: SOT Database Relationship Map

3.5. STRUCTURE

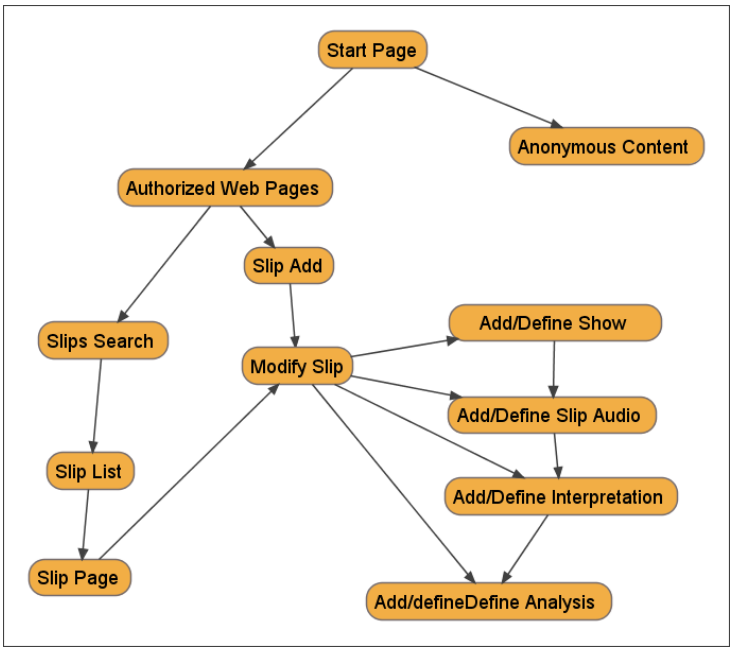

Figure 13: Site Map of Slips Page

Basic structure of SOT web page is shown by figure 13. However this figure must be clarified. First, the site does not allow any slip record to have more than one “show record” and more than one “slip audio”, but it may include many interpretations for a single slip. An interpretation also may have more than one analyses. There is a SOT error sample page from the web site in appendix C.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1. HYPOTHESES

Most of the studies on the slips of the tongue are using corpus from many languages that belongs to three different language families, namely Germanic, Romance and Semitic. Typological differences of Turkic[14] language family with these language families may provide further evidence for language production processes. It is therefore of particular interest to compile a corpus of Turkish speech errors as a basis for a typological comparison. This study has two aims, as to create a Turkish SOT corpus and to make typological comparisons with Germanic and Romance languages. In the first stage of the study, focus is on the creation of Turkish SOT corpus, and in the second stage focus is on the typological variation. Although both stages of the study is completed, Turkish SOT corpus will include more SOT errors as time goes by.

We make the following broad hypotheses:

1. Turkish speakers will make more morphological errors, as Turkish is an agglutinative language with a particularly rich morphology.

14 Structure and members of language family seems to be changed. Theory of Altaic language family seems abandoned. (Georg, Michalove, Ramer & Sidwell, 1999)

2. Turkish Speakers will make less (phonological) vowel errors as Turkish employs vowel harmony, which may serve as an additional control mechanism. It will be particularly interesting to determine the syllable structure of Turkish by means of phonological speech errors.

4.2. RESULTS AND DISCUSSION

Currently Turkish SOT corpus has 12 paradigmatic (4 blends, 1 exchange, and 7 formal substitutions), 39 syntagmatic (2 additions, 13 anticipations, 1 anticipation and addition, 4 anticipation and perseverations, 1 fusion/telescoping, 15 perseverations, 1 perseveration and addition, 2 formal substitutions), and 2 paradigmatic and syntagmatic errors (1 blend and fusion/telescoping, and 1 semantic and formal substitution). The details of the corpus can be seen in table 2.

While qualitative analysis will reveal the processing details of language production, quantitative analysis will reveal the relationships between processes. I will report the qualitative findings on vowel harmony, complex segments, parallel processing, and agglutination. The quantitative findings part will explore the higher rate of perseveration over anticipations, higher rate of morphological and phonological errors, and syllable position constraint.

4.2.1. QUALITATIVE ANALYSIS RESULTS OF SELECTED SOT

Vowel Harmony

Record	: 2007/04/03 MS 00:10:30,50
Error	: blend of two root morphemes <sarımsak> and <sepet>
Sentence	: ssserımsaa-(ı)n sap kıs-mı de-di-ği ne ya o sepet-te dur-ur-ken aksesuar ol-an şey mi?
ILT	: garlic-gen trunk part-acc say-pat-acc what oh basket-abl stay-adj-while accessory be-adj thing interr?
EI	: :Is it the accessory that stays with the garlics in the basket?

Throughout the analysis, first issue is the long <s> at the word onset. This raises the possibility of utterance to be a stuttering or hesitation. Other than this instance, the speech is fluent and without hesitation. It is certain that the utterance clearly

represents an error in language production. It is thought that, <sepetin içinde gördüğümüz sarımsakları tutan ....> and <sarımsağın sap kısmı dediğin ne ya, sepetin...> were two competing speech plans that caused a delay in sentence production and this delay is a raised by the competing speech plans. Although winning plan starts with <sarımsağın>, or literally <sarımsaaan>, the uttered word is <serımsaan> This utterance can be explained as two competing plans have the same word syllable <se> and <sa>. These vowels <a> and <e> are allophone with respect to vowel harmony.

This implies that during syllabification, <sa> and <se> perceived as same syllable and both syllables are initial syllable of word root, this syllable is not forced for harmonization, that caused the blend. Although this error supports the view "vowel harmony is not applied to the root words or morphemes", it does not contribute to the debate. Because the speaker can also speak English, which does not have the vowel harmony.

This error is a slight deviation from Poulisse's (1999) 10th claim, "a non-possible sequence" is created with respect to vowel harmony.

Record	: 2007/04/03 MS 00:40:25
Error	: Anticipation of <u> from <uğraşıyorsunuz>
Sentence	: Ne uş-le ne iş-le ne üş-le uğra-ş-ıyor-sun-uz Tuğba hanım
ILT	: What *job*-with job-with *job*-with deal-with-pcont-2pl Tuğba mistress
EI	: Dear Tuğba, what is your profession?

First, the speaker tried to produce <işle>, but he produced <uşle> as a result of the anticipation which can be seen in figure 14. His monitor detected the error and repaired by repeating the whole word <işle>. Most likely the error <uşle> seemed interesting to the speaker and he consciously tried to utter the word <uşle>, but his production system did not allow him to produce vowel dis-harmonic utterance <uşle>, and he produced <üşle>. This error is again showing a deviation from the Poulisse's 10th claim. .

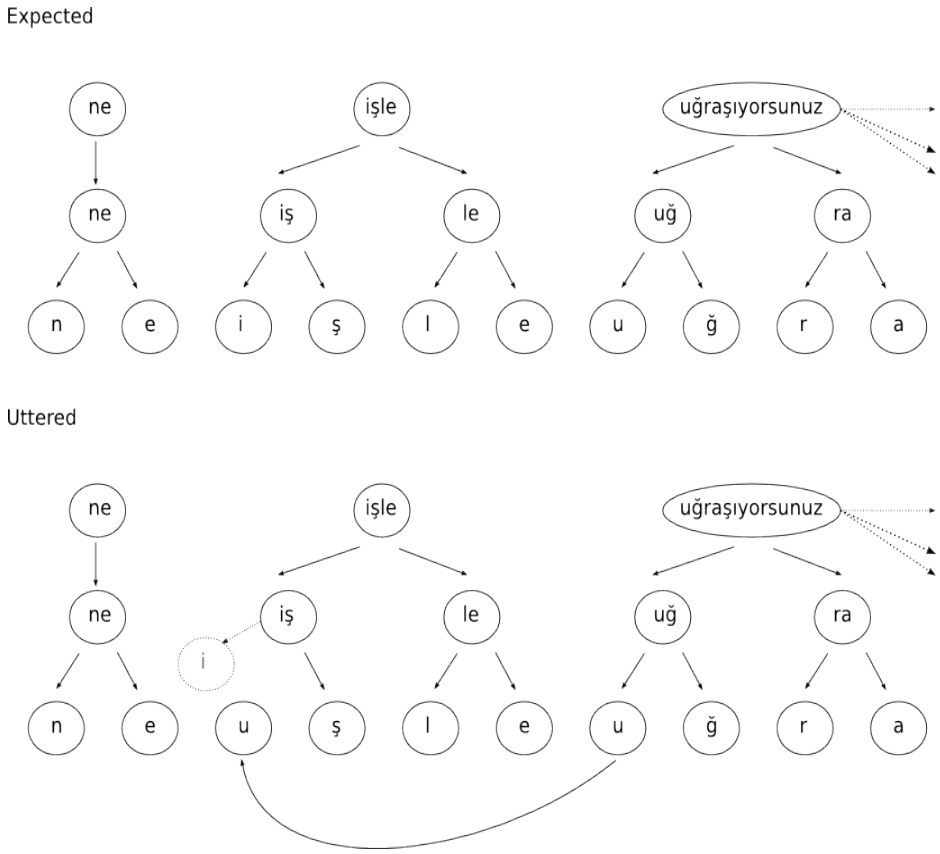

Figure 14: Expected and uttered segments of <ne işle uğraşıyorsunuz>

Overall, these two instances imply that serialization does not care for vowel harmony. That is if an error is occurred due to anticipation, or any other error type, the phoneme is not checked against the vowel harmony, as the checks or selection with respect to vowel harmony is carried before serialization.

In the literature there are two main theories with respect to the vowel harmony as summarized by (Levi, 2001). Both theories explain the vowel harmony by approaching phone alternations as a feature change of segments like backness and frontness. The difference between theories come from the way the feature change is applied to the vowels. The syllable head approach claims that vowel of word initial syllable spreads it's features to the remaining syllables serially during the syllabification or articulatory score generation. The theory of feature geometry claims that word initial vowel's features spreads serially through each segment, by the assimilation with respect to geometry constraints shown in figure 15. Basically

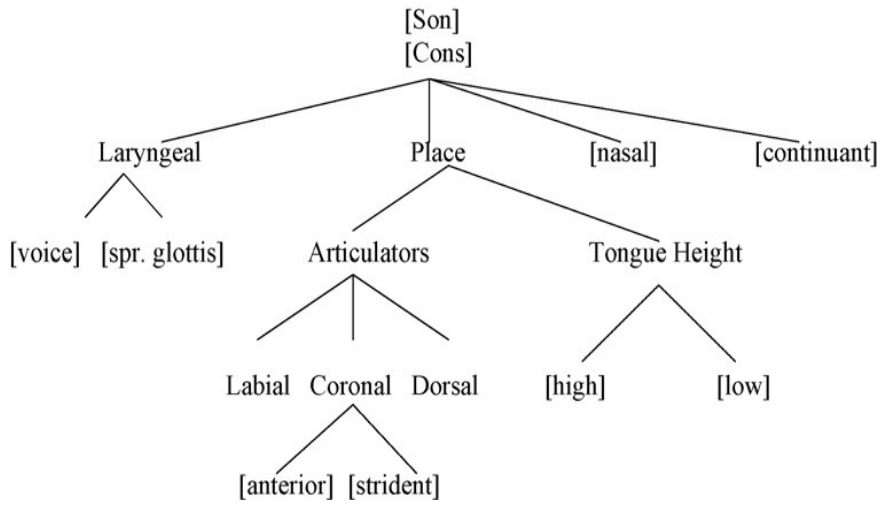

Figure 15: Feature Geometry taken from Kabak (Kabak, 2007:1393)

both of the theories explain the Turkish vowel harmony, but syllable head approach fails with some semi-irregular forms like <petrol-den> (Kabak, 2007; Levi, 2001).

These two examples can be accounted by feature geometry theory, if the generated articulatory score of <u> stored in the memory before articulation. In this case a problem in the serialization of the articulatory score of the segments in the buffer can cause the out-of-order callback of the specific articulatory code <u>. Also the repair in the second example hints that there is an immediate editing after the error. This editing highlights that the error source is in the serialization of articulatory codes. Although second error can easily be explained by the articulatory score buffer, the problem still remains problematic for the first example, a higher level error, blend, causes a dis-harmonic word <serımsağın>. It must be noted that, Kabak (2007) highlights an ongoing debate over whether Turkish has the vowel harmony on word roots. If the vowel harmony does not operate on the word roots and second error is due to the memory error, then these errors fits into to the feature geometry approach. However, if these errors does not reflect memory error, then only interactive theories can account for the errors, as they provide an immediate feedback mechanism that may help to re-instantiate the features of the head syllable's vowel. Also there is another possibility that harmonization can be carried before phonemization, but this possibility needs an experimental verification.

Complex Segment **Fragmentation**

Record	: 2007/04/03 MS 00:10:58,10
Error	: Not Error/Tongue Twister/Deletion
Sentence	: doğru gerçi siçek çiçek de-n-iyo(r) o-na ama
ILT	: right albeit flower flower say-pass-pcont it-dat but
EI	: Right, although it is called flower

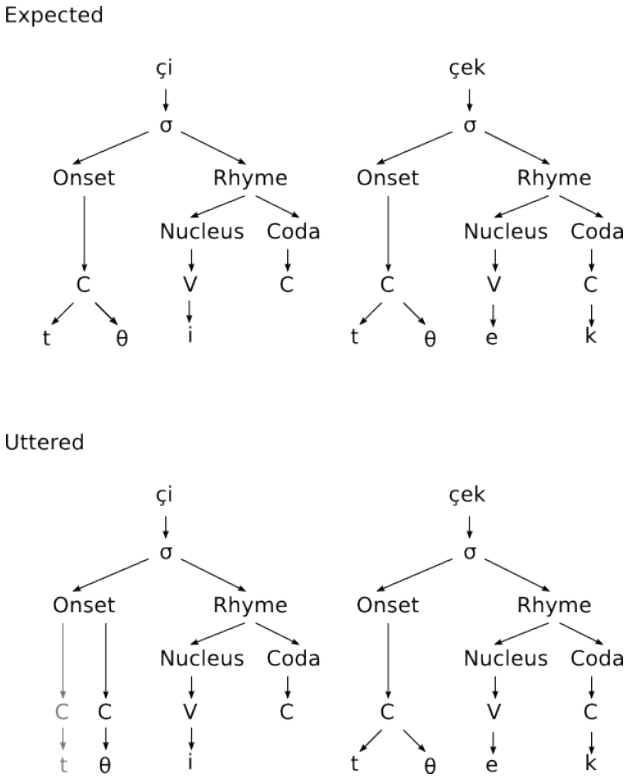

Figure 16: Syllable structure of <çiçek>

This utterance is not accepted as a proper SOT error, because <gerçi çiçek> sequence includes many <ç>:[t͡ʃ] segments that create a stress on the phonological processor. This stress is more observable in the phrase <kuş uçtu>. If you repeat saying this example several times, phrase may morph into <kuç uçtu> or <kuş uştu> depending on the speaker. Although the utterance in the example considered as a tongue twister, it shows how the phonological processor deals with the affricates as shown in figure 16.

There is a difference between <ç>:[t͡θ] in <çiçek> is and <ç>:[t͡ʃ] in <çabuk>, so <ç> is represented as [t͡θ] to reflect the difference. Initially the existence of the <ç>:[t͡θ] as a syllable onset has been searched within the sentence context, and possibility of

anticipation and perseveration has been eliminated. Three consequent <ç> segments in the syllable onset might cause the phonological processors to fragment complex segment [t͡θ] into [t] and [θ]. Turkish syllabic templates do not allow two consonants as onset, so the processor most likely delete [t] and preserve [θ]. Hence Turkish does not have [θ] as a phoneme, processor or articulator most likely chosen [s] instead.

Record	: 2007/02/06 MS 00:16:04,95
Error	: Anticipation
Sentence	: Margaret gene ne piçir-di ne pişir-di falan diye
ILT	: Margaret again what cook-pt what cook-past like as
EI	: (neighbors will ask questions) like, What is Margaret cooking this time?

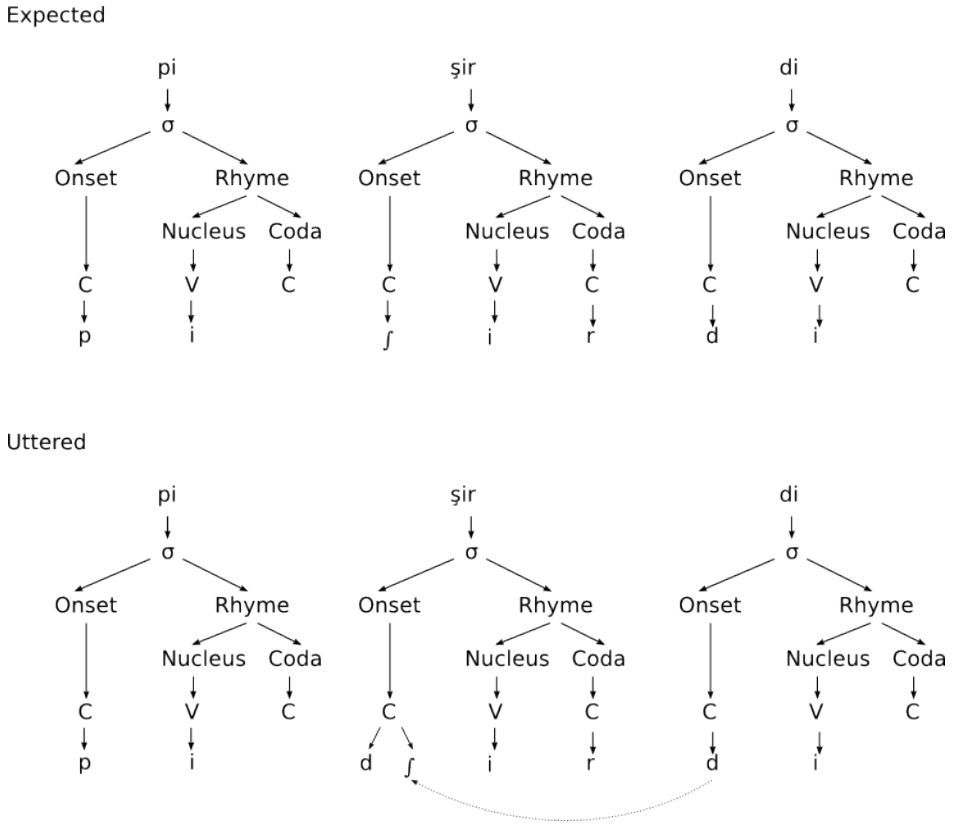

Figure 17: Syllable structure of the word <pişirdi>

Non-existence of <ç> in the sentence context eliminates the possibility of being either blend, exchange, or substitution error for the <piçirdi>:[pɪt͡ʃɪrdɪ] utterance. The best explanation of this error is being an anticipation of [d] from the third syllable of

<pi-çir-di>:[pɪ-t͡ʃɪr-dɪ], however, instead of simple anticipation, phonological processor creastes a complex segment [t͡ʃ]. Word final devoicing and voicing assimilation of syllable onsets might helped this error to occur. In Turkish if a word final syllable ends with a voiced stop or affricate and a syllable starting with a voiced stop attached, then voiced stops becomes voiceless. This rule is seemed to be applied to [d], and it becomes [t].

These two cases have affricates involved in the error, and show Turkish has segmental templates for complex consonants and it seems easy for the phonological processor to compose and decompose affricates. In relevant literature, complex segments are accepted as single segment, but in phonology, they remain as two separate phonemes (Kehrein, 2006).

Parallel Processing

Record	: 2008/11/03 MS 01:02:09
Error	: Semantic Substitution
Sentence	: Sivrihisar kavşa(k)-a(ğı)-na kadar gayet güzel eee nizami bi(r) oto ora araba-yla otomobil-le git-ti-k biz
ILT	: Sivrihisar junction-acc-dat until quite pleasant umm regular one oto(automobile) ora(blend of car and automobile) automobile-with go-pat-2pl us
EI	: We traveled with a quite pleasant umm regular car by the Sivrihisar junction.

Error initially seems as bubbling, however, sentence is a complete one, and bubbling does not go beyond the word selection. This <oto ora arabayla otomobille> sequence is predictable, hence there is an inappropriateness repair before the utterance, <gayet güzel> replaced with <nizami> by an editing. Hence the final word preference is <otomobil> it is better to assume the error as a semantic substitution. Actually, <araba> and <otomobil> pair is an example of equally strong synonyms, or quasi-synonyms. Peterson & Savoy (1998) conducted a series of experiments, indicating that, in the case of quasi-synonyms like “couch/sofa”, etc., both lemmas encode their respective word forms before one of the lemmas has become selected.

This parallel processing can be explained by both interactive and serial models. Although earlier account of serial processing (Levelt's 1989 model) does not explain this type of parallel processing at lemma selection, later model accounts for this specific parallel processing at lemma selection as a blend[15], or equally activated word forms. It is a bit problematic for serial model to explain the utterance of two separate words, rather than causing a word blend. This error favors for interactive models, although it is accountable for both theories.

Morphemization or Agglutination After Word Selection

Record	: 2008/11/17 MS 01:03:31
Error	: exchange of root morphemes <araba> and <radyo>
Sentence	: radyo-da-yım araba-yı dinl-iyor-um
ILT	: radio-loc-1sg.poss car-acc listen-pcont-1sg.poss
EI	: I am listening the car in the radio.

This error is a morpheme exchange[16] of the "stranding" type, that is inflectional units stays behind (strands) and only roots swap.

4.2.2. QUANTITATIVE ANALYSIS RESULTS

Percentages of SOT error types versus slip units are shown in table 2. We have two hypotheses about the quantitative results as, more morphological errors and less phonological errors including vowels. In the relevant literature, each study collected it's own corpus from different context (Meyer, 1992), so that the ratio of the morphological/phonological errors are not same across the SOT corpora. Poulisse's (1999) provides a good overview of the quantitative results of several SOT corpora, and highlights these differences.

Comparative analyses is carried out between the Turkish, German, English and French corpora. English and French corpora gathered from the Max Planck Institute of Psycholinguistics' on-line speech corpora. Corpus data is downloaded from the

15 It is explained in Levelt, Roelofs & Meyer, (1999) at the page 17, and also in Roelofs (1992) at blend section.

16 There are many of these errors in the Fromkin's database like #3105. Dell's sample could be seen at the page 200 of his dissertation.

web site and with the help of a parser, it was imported into spreadsheet application. All the data from the corpus summarized by using pivot tables. These on-line corpora have a different classification for SOT types, so their classification is wrapped to fit Turkish SOT corpus.

Table 2: Turkish SOT Error Ratios for “Error Type” versus “Slip Units”

		Feature	Morpheme	Phrase	Segment	Segment Cluster	Segment Feature	Stress	Syllable	Syntax	Syntax Morpheme	Word	Word Intonation
Addition				1,89					1,89				
Anticipation			3,77		13,21	1,89			1,89	1,89	1,89		
Anticipation Addition					1,89								
Anticipation Perseveration		1,89			5,66								
Blend			1,89	1,89								1,89	1,89
Blend Fusion/ Telescoping						1,89							
Exchange			1,89										
Fusion/ Telescoping												1,89	
Perseveration	1,89	9,43	5,66		7,55		1,89	1,89					
Perseveration Addition					1,89								
Substitution, Formal				1,89	1,89								
Substitution, Semantic			3,77									9,43	
Substitution Semantic and Formal				1,89									
Total	1,89	11,32	16,98	7,55	32,08	3,77	1,89	1,89	3,77	1,89	1,89	13,21	1,89

English and French corpora defined the SOT with both process procedure and process direction. In Turkish SOT corpus, errors are only classified by their types. Process direction maps to Turkish SOT corpus's slip type, however, there are many errors in these corpora that lacks definition of “process direction”. In the wrapping process, slip type is considered as “process direction”, if the process direction is not defined in the error, “process procedure” is checked, and used as slip type. Even if the “process procedure” lacks the information, then the error is discarded.

After completing the classification with pivot tables 427 errors were eliminated from the Fromkin's English corpus, as these data did not have “process procedure” and “process direction” information. Another 25 errors were removed from the database as they are examples of the tip of the tongue phenomenon. The remaining 3402 errors were classified with respect to slip type as seen in table 3 by the ratios of errors.

Table 3: Fromkin's “English Speech Error Corpus”

Process direction		Lexical	Morphological	Morpho-syntactic	Phonological	Phonological Lexical	Phonological Morphological	Phrasal	Syntactic	Total
Addition	0,12	0,29	0,47	0,41	0,79	0,24	0,09	0,12	0,29	2,82
Anticipation		1,32	0,38	0,09	14,93	1,79	0,03	0,09	0,03	18,67
Anticip. & Persev.		0,12			1,29	0,09			0,03	1,53
Blend	0,21	0,76	0,06	0,03	0,65	0,18		0,65	0,06	2,59
Deletion	0,18	0,26	0,26	0,24	1,62	0,21	0,03	0,35	0,15	3,29
Exchange	1,56	3,88	1,65	0,03	17,14	2,03	0,12	0,24	0,15	26,78
Haplology	0,09	0,29	0,03		0,65	0,03			0,03	1,12
Perseveration		1,23	0,24	0,06	10,79	1,44		0,12	0,12	13,99
Shift	0,29	1,65	1,21	0,21	2,12	0,38	0,06	0,24	0,21	6,35
Substitution	0,79	10,93	2,76	0,56	4,35	1,85	0,15	0,59	0,88	22,87
Total	3,23	20,75	7,05	1,62	54,32	8,23	0,47	2,38	1,94	100,00

French corpus[17] is a bit different hence, it also SOV language with agglutinative nature, or more correctly it is fusional without vowel harmony. Comparisons with respect to French corpus can only be made on the second hypothesis, hence there is no agglutination difference between Turkish and French. Analysis with pivot tables revealed that 629 errors lacked slip type information and were removed from the corpus. 2 more were errors removed from corpus for being examples of TOT phenomena. Remaining 1316 errors were classified with respect to slip type, as shown in table 4.

17 Max-Planck Speech Errors site states that French SOT corpus is collected by Pierre J. L. Arnaud.

Table 4: French SOT Corpus

Process direction		Lexical	Morphological	Morpho-syntactic	Phonological	Phonological lexical	Phonological morphological	Phrasal	Syntactic	Total
Addition		0,23	0,08		0,38		1,14		0,08	1,90
Anticipation	0,08	2,81			13,30	0,38	0,08		0,08	16,72
Anticip. & Persev.					0,08					0,08
Blend		0,15			2,13	0,53	0,30			3,12
Deletion		2,13	0,15		0,30	0,46		0,08	0,08	3,19
Exchange		1,14	0,08	0,08	4,86	0,08	0,38		1,52	8,13
Haplology		0,15			3,42	0,30	1,52			5,40
Perseveration		2,20	0,15		16,79	0,46	0,08		0,30	19,98
Shift		0,08			0,15				0,08	0,30
Substitution		22,72	0,99		16,72	0,38		0,38		41,19
Total	0,08	31,61	1,44	0,08	58,13	2,58	3,50	0,46	2,13	100,00

German SOT data wer taken from the Hohenberger & Waleschkowski's German Speech Errors Corpus (Hohenberger & Waleschkowski, 2005), and summarized in table 5. Hence Turkish SOT corpus is based on this study, it is directly comparable with respect to the slip types.

Table 5: Hohenberger & Waleschkowski's German Speech Errors Corpus

	Other	Phrase	Morpheme	Phoneme	Word	Sum	%
Anticipation	3		44	95	42	184	19,49
Perseveration		1	44	113	56	214	22,67
Anticip. & Persev.			1	44	3	48	5,08
Substitution			25	6	25	56	5,93
Semantic			35		121	156	16,53
Formal			7	8	16	31	3,28
Semantic + Formal					3	3	0,32
Blend		150			38	188	19,92
Fusion					1	1	0,11
Exchange			4	5	2	11	1,17
Deletion	2		13	9	19	43	4,56
Addition	1		1	6	1	9	0,95
Spreading						0	0,00
Sum	6	151	174	286	327	944	100,00
Sum %	0,64	16,00	18,43	30,30	34,64	100,00	

Turkish, German, English and French corpora are not comparable with respect to linguistic units that are involved in errors. In order to make a comparative analysis, Each corpus' linguistic units must be converted into the most basic corpus' definition, and the corresponding units for each corpora is listed in table 6. Smallest linguistic unit was selected for errors which has two or more different linguistic units.

Table 6: Mapping of Linguistic Units Between Corpora

German SOT	French & English SOT	Turkish SOT
Phrase	Syntactic	Phrase
	Phrasal	Syntax
Word	Lexical	Word
Morpheme	Morphological	Morpheme
	Morpho-syntactic	Syntax & Morpheme
Phoneme	Phonological morphological	Feature
	Phonological	Word & Intonation
	Phonological lexical	Stress
		Segment & Feature
		Segment
		Segment Cluster
		Syllable

After standardization of linguistic units with German corpus, slip types ratios with respect to Turkish, German, English and French are calculated as shown in table 7. Both corpora have errors that are not assigned to any linguistic units, so the “total” column does not sum to 100%.

Table 7: Percentages of errors with respect to linguistic units

	Phrase	Word	Morpheme	Phoneme	Total
Turkish	9,43	13,21	18,87	56,60	98,11
German	16,00	34,64	18,43	30,30	99,36
English	4,32	20,75	8,67	63,02	96,77
French	2,58	31,61	1,52	64,21	99,92

In the first hypothesis, it was predicted that Turkish would have more morphological errors than other corpora due to the effect of rich morphology with agglutination. In the corpus 18.87% of errors are labeled as morphological. This number is 8.67% for Fromkin, 34,64% for German, and 1.52% for French. There is a big difference in percentages with respect to English and French corpora. German, as a generatively (not typologically) agglutinative language has nearly the same error percentage.

Error percentages, as presented in table 7, shows that first hypothesis was partially correct. Furthermore, effect of agglutination is not observable from the other languages' data, and from the corpus. Thus, first hypothesis was correctly predicted the increased percentage of morphological errors, but failed for explaining the underlying reason.

The effect of the rich morphology is considered as an explanation to morphological error percentage, however there is not enough data for further investigation of the underlying reason. Currently there are 10 morphological errors of those 3 are anticipation, 3 are perseveration, 2 are semantic substitution, 1 is exchange and 1 is blend.

It is thought that having more morphological errors is a sign for the decompositional lexicon. In a decompositional lexicon each concepts is composed of several prime concept, and even a single concept “horse” activates many prime concepts, like animal. For this reason it is thought that having a decompositional lexicon also explains why Turkish has more perseveration errors than anticipation errors. As in the literature having more perseveration errors is an issue of serial ordering, and it is thought to be related with either fast decay of information, or by degraded lexical connections (Dell, Burger & Svec, 1997a). Faster decay of information can be result of the memory overload as highlighted by several studies on the phonological loop (Acheson & MacDonald, 2009; Saito & Baddeley, 2004). These memory experiments used tongue twisters to increase demand on the information, so information is decayed faster in memory. Although outcomes of these studies did not explain “more perseveration” issue directly, these studies gave emphasis on memory overloading. Therefore decompositional lexicon of Turkish may easily create a working memory overload, causing production system to make more perseveration errors. Although this explanation is a bit problematic for serial theories, as they claim that decompositional lexicon is a bit problematic (Roelofs, 1997a), interactive theories do not have issues with decomposition.

The second hypothesis was related with phonological vowel errors and predicted that Turkish would have less phonological vowel errors. However, it is better to look percentage of phonological errors at first then look the percentages of vowel errors

within the phonological errors. Turkish SOT corpus has less phonological errors (56,60%) than English (63.02%) and French (64,21) copora, but it has nearly doubled the German (30,30%) phonological errors' percentage. Even if we take an average of the three corpora (53.96%), Turkish corpus seems to have more phonological errors. The percentage of vowel errors in phonological errors for Turkish is 22.64%. This is 6.98% for English and 6.85% for French. It is thought that Turkish language processor would reject inappropriate utterances more easily because of the harmony, especially for the SOTs involving vowels. The findings with respect to vowel harmony suggests that vowel harmony is not operating within the phonemization process. This differences in the percentages of vowel errors clearly shows that our second hypothesis was not correct.

Table 8: Percentages of errors with respect to SOT types.

	Turkish	**German**	**English**	**French**
Anticipation	26,42	19,49	18,67	16,72
Perseveration	30,19	22,67	13,99	19,98
Anticip. & Persev.	7,55	5,08	1,53	0,08
Substitution		5,93	22,87	41,19
Semantic	13,21	16,53		
Formal	3,77	3,28		
Semantic + Formal	1,89	0,32		
Blend	7,55	19,92	2,59	3,12
Fusion	1,89	0,11		
Exchange	1,89	1,17	26,78	8,13
Deletion		4,56	3,29	3,19
Addition	3,77	0,95	2,82	1,9
Spreading				
Other	1,89		7,47	5,7
Total	100	100	100	100

Each corpus have been adjusted to make them comparable in terms of slip type as can be seen in table 8. Definition of slip types differs in each corpora, like Turkish and German corpora further categorize “substitutions” as “semantic”, “formal”, and “semantic and formal”. English and French corpora just defines “substitutions”, and does not make further categorization. Also English and French corpora have “haplology” and “shift” as additional slip types, whereas Turkish corpus allows multiple slip types to be selected for a single slip. Those categories of slips that are

not defined in the German corpus are grouped under “other” category in the table. Also for the Turkish corpus, only the first slip type has been selected.

Syllabic structure of Turkish is another point of interest in this study, and we also seek information for the syllabic structure of Turkish. Percentage distribution of segmental[18] errors' syllabic positions is shown in table 9. There is only one exception for the syllable position constraint in 22 segmental errors. This ratio (1/22) supports the claim that Turkish has a hierarchical syllabic structure.

Table 9: Syllabic positions' percentage distribution for segmental errors

	Word Onset	Syllable Onset	Nucleus	Coda	Other	Sum
Addition					4,55	4,55
Anticipation	9,09	9,09	9,09	13,64		40,91
Anticipation & Addition				4,55		4,55
Anticipation & Perseveration			13,64			13,64
Blend						
Blend & Fusion/ Telescoping					4,55	4,55
Exchange						
Fusion/ Telescoping						
Perseveration		9,09	4,55	4,55	4,55	22,73
Perseveration & Addition			4,55			4,55
Substitution, Formal		4,55				4,55
Substitution, Semantic						
Substitution Semantic and Formal						
Total	9,09	22,73	31,82	22,73	13,64	100

4.3. CONCLUSIONS

The study revealed that, at least for the current size of the corpus, Turkish has more morphological and phonological errors. Also Turkish has more perseveration than anticipation or in equal number. It is assumed that both issues “having more perseverations than anticipations” and “having more phonological and morphological errors ” are related with the memory overloading of Turkish.

From the qualitative analysis we can assume that Turkish has similar, or same “language production system” but using different parts of the system, as morphology

18 With respect to table 3, linguistic units labeled as “Segment”, “Segment Cluster”, and “Syllable” are considered as segmental errors, excluding “Stress”, “Intonation”, and “Segment and Feature” since these errors are does not define the syllable position.

having greater control over the phonology. Also it is assumed that vowel harmony is operating above phonological level, more likely at morpho-phonological level, at least when root-morphemes are concerned. Another point is that evidence for parallel processing in word selection, thus both frame or slot approach or incremental grammar approach (as it is used in Levelt et al.'s 1999) can explain.

There is a need for experimental studies to further clarify the issues with phonological and morphological processing in Turkish. Otherwise it would be too opportunistic to catch a slip that highlights the reasons behind the more perseveration issue and more morphological errors issue.

It must be reminded that data collection and analysis of Turkish SOT is not finished. It is an ongoing effort, and much likely there will be three versions of the corpus, one for podcast based collection, one for Spoken Turkish Corpus, and for unified collection. We hope this approach might shed light on the contextual differences in SOT errors.

4.4. SUGGESTIONS FOR FURTHER STUDIES

In serial theories of language production, production starts by generating preverbal message. This production process continues until the speech is articulated. Each level of the processing does not start before the former processing level fully generate it's messages. These, syntactic, morpho-phonological and phonemic processes follows the top-down hierarchy. This is nearly the same for the interactive modules. Serial and interactive theories differs only when the lower level starts processing. Interactive theories assume former levels of processing starts upon generation of first chunk of the message. That is the creation of phonological score starts while surface structure is still processing, and articulation starts before phonological score is completed. What is called the hierarchy is the order of the processing. More clearly this order starts with syntactic processing, continues with morphological processing and syllabification with or without segmentation or phonemization, and ends with articulation. All of the aforementioned theories agree that production does not start without that order. Even in the picture naming tasks, these theories assume an empty sentence structure, or surface structure to explain the one word utterance.

Record : 2007/04/03 MS 00:09:05,08

Error : Not error

Sentence : abi bi şey söyle-yece(ğ)i-m yanlız şöyle bir hata var be ou düzelt-mek ist-iyor-um

ILT : man one thing tell-fut-1sg merely like_this one error present I that correct-imp want-pcont-1sg

LT : Man, I want to say something, merely there is an error, I want to correct that

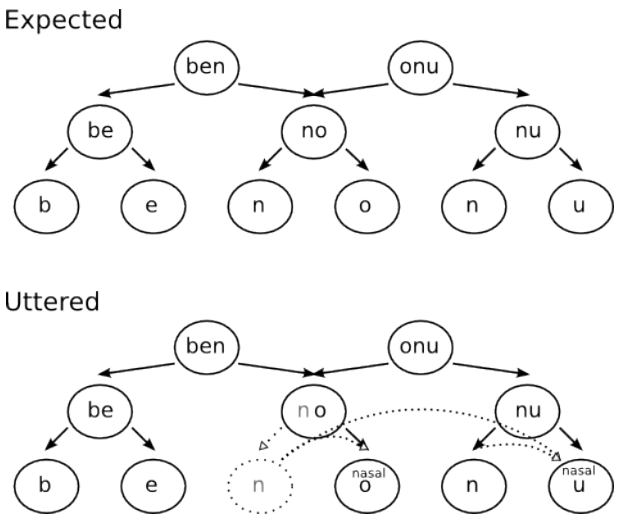

Figure 18: Expected and uttered segments of <ben onu>

Although this error is not considered as a SOT, it might highlight the processing priorities and implies, morphology have more precedence over phonology. It is thought that, the error is caused by morphological processing. The syllabification of the <ben onu> is <be-no-nu>. After creating the phonetic score of <be>, <no> syllable started to be processed. It is speculated that morphology, has a stronger relationship with the lexicon, forced phonemization process to ignore the <n>, which comes from <ben> as a result of syllabification. However, due to the fact that previously started spell out of word <ben> becomes incomplete, nasality feature is forced by syllabification processinn to complete word <ben>. Further, the error might also imply the suprasegmental feature /nasality/ has helped to drop <n> from <onu> but replaced <u> with nasal <u> as shown in figure 18.

Record : 2007/03/01 MS 00:18:10

Error : Semantic substitution

Sentence	: Biz onlar-ı asker-e gönder-di-k, kim-iniz-i, kim-iniz-i evlen-dir-dik, böyle sorum-lu-luk ol.. sorum-suz-luk olmaz yahu.
ILT	: We they-acc soldier(military service)-dat send-pat-2pl whom-2pl-acc, whom-2pl-acc marry-pass-2pl, such respons(ibility)-ass-sta be respons(ibility)-neg_ass-sta be-neg (emphasis)
LT	: We were present in the send off for the military service, and also we were present at marriages of those. So this much irresponsibility is unbearable to us.
Comments	: It is a morphological substitution of opposite meaning modifie, conflict seems to be arisen between "-suz" and "-lu". And the following suffix was starting with "-luk" so the error might be an anticipation of following suffix.

This error shows a substitution of <lu> instead of <suz>. There are two possible explanations to the error. First this could be a result of the increased activation <lu> morpheme from the <luk> morpheme, and this increased activation causes <lu> morpheme to win the race. Alternatively this error might be the result of increased computations caused by double negation, and processor ignored the first negation.

From an interactive production account, errors in morpheme selection like choosing <lu> instead of <suz> might be easily triggered by segmental anticipations. From this perspective, the erroneous selection of <lu> in <sorumluluk> can be result of parallel processing. Hence there are three slots for word <sorumsuzluk> for each of the <sorum>, <suz>, and <luk> morphemes, the process will continue in parallel for each of the slots, already active <luk> syllable's activation may help the <lu> morpheme to fill the second slot in the word frame, and frame might became <sormluluk> instead of <sorumsuzluk>.

Although this explanation of error is more speculation than what is actually happened, this explanation hints the existence of stronger link between segments, morphemes and syntax in Turkish. It is hypothesized that, these two examples in this section and examples from vowel harmony section lead the hypothesis of "Turkish has strong morphology that directs phonology, and vowel harmony functions as a part of morpho-phonological processing". This morphological dominance hypothesis and stronger link hypothesis need experimental verification.

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APPENDICES

APPENDIX A. TURKISH PHONOLOGY AND MORPHOLOGY

INTRODUCTION

In this part only important points for Turkish SOT will be explained[19]. The intention is not making a summary of Turkish Phonology and Morphology, but to highlight points that will avoid confusions. Also only native Turkish words obey the phonology rules.

Table 10: Features of Turkish Vowels, Back-front, Rounded-Unrounded

	Rounded		Unrounded	
	Open	Close	Open	Close
Front	ö	ü	e	i
Back	o	u	a	ı

There are two types of the vowel harmony, first all vowels in a word must be either front or back vowels. Second if first vowel is unrounded than the rest must be unrounded (a → a, ı; e → e, i; ı → ı, a; i → i, e), and if the first vowel is rounded the rest must be etiher rounded-close or unrounded-open (o → u, a; ö → ü, e; u → u, a; ü → ü, e). How ever this rule cannot be applied to the loan words, mutated native words (ana → anne), and some suffixes (*-(i)yor*, *-(i)ken*, *-leyin*, *-(i)mtrak*, *-ki*, *-taş*, and *-gil).*

19 Unless otherwise mentioned information on this appendix is based on (Demircan, 2001) (Demircan, 2005)(Balpınar, 2006). All examples are also taken from those resources.

Table 11: Turkish Consonants

	Voiceless		Voiced	
	Fricative	Stop	Fricative	Stop
Labial	f	p	m,v	b
Dental	s,ş	ç,t	j,l,n,r,z	c,d
Palatal	-	k	ğ,y	g
Pharyngeal	h	-	-	-

Turkish has a consonant harmony, voiced consonants (*b, c, d, g, ğ, j, l, m, n, r, v, y, z*) can be followed by voiced consonants and voiceless consonants (*ç, f, h, k, p, s, ş, t*) can be followed by voiceless consonants like *içki, kurt, çapkın*. If the difference in consonant does not make difference in meaning, This rule is also effective in word-suffix joints, like *alıntı* and *alındı*, and *kitapçı*.

There is also another consonant harmony that does not alter phonemes but phones. Consonants in Turkish generally change phones to obey vowel harmony, like k in *okul (oqul), ekin,(ekin)*and *kel (cel)*.

The rules that must be emphasized for Turkish SOT are:

1. Turkish employs elision[20] for the loan words, if the word is bi-syllabic, first vowel is open, second vowel is closed, and the attached suffix that starts with a vowel, then second vowel will be dropped (filim → filme, ömür → ömrü, turizim → turizme). This is a bit different from English hence the mechanism is employed to loan words only
2. Turkish employs epenthesis in three different cases[21]
    a) It is the reversal of epenthesis of loan words (filme → filim, ömrü → ömür, turizme → turizim).
    b) Could be employed before the *-cik* suffix if the attached root ends with consonant (bir-cik → biricik, genç-cik → gencecik). The difference between glue and this is basically, the vowel is determined in glues but

20 It is an apocope actually, the last vowel is removed.

21 Although observational, voiced dental fricatives at word onsets causes much trouble in Turkish in the form of epenthesis.

not in this case, generally the last vowel of the root.

c) A vowel could be attached to the beginning of a loan word, if the word starts with consonant (ramazan → ı-ramazan, limon → i-limon).

d) If a syllable starts with CC cluster, then a vowel inserted between the cluster, thus inserting a syllable at the beginning, *spor → s[ı]por.*

3. Vowel could become closed (apophony) if the attached suffix starts with *y* then root's last vowel becomes a closed vowel (*alma-y-an → almıyan*; *görme-y-en → görmiyen*).
4. Turkish also employs gemination, like *hak-ı → hakkı*
5. Regularly blends are employed, as *anne-anne → annane (also degemination and vowel lengthening employs and becomes ana'ne)*, *sütlü-aş → sütlaç*.
6. Utterances like *ekşi → eşki*, is a well know phenomenon, especially in the local dialects and children's utterances.
7. Turkish phonology employs assimilation
   a) According to place of articulation
      - n preceded by b becomes m as in *penbe → pembe*
      - n preceded by palatal stops (k,g) becomes ŋ as in *renk (ɾɛŋc)*
   b) According to voicing assimilation for the words ending with consonants, the suffixes consonants reflects the root's last consonants voicing status, as in *kitap-cı → kitap-çı*.
8. Final devoicing occurs on words ending with consonants, if the ending consonant is a voiced stop (b,c,d,g). In this case voiced stops becomes voiceless (p,ç,t,k) as in *kitab → kitap*.

SYLLABIC STRUCTURE

Although there is a claim that Turkish could not be a mora based language(Schiering, 2006), recent studies in Turkish tend to show structures both in terms of CV phonology and moraic structure (Kabak & Vogel, 2001; Topbaş & KopkallI-Yavuz,

2009). Mora based structure representation that are used in Turkish basically tries to explain the syllabification problems. As an example *kurt*, is a root word with CVCC structure, but if a suffix starting with a vowel attached, then it becomes *kur-dun*, having a syllabic structure of CVC-CVC. This segment transportation from one position to another position also implies that Turkish does not have a hierarchical syllable structure in terms of CV phonology. Splitting root's last consonant and attaching to a suffix hard to explain with CV-Phonology. (Kabak & Vogel, 2001) Argues that Turkish has a maximal two mora one syllable structure. Any syllable with CVCC structure has an extended mora. In syllabification process, if it is possible, third mora could be saved by three different rules, long vowel shorting, degemination, and vowel epenthesis. Degimination and vowel shortening keeps the number of syllables but vowel epenthesis increases the number of syllables.

In the Turkish phonology allowed syllable structures are only V, VC, CV, CV, CVCC. No syllable in Turkish can start with CC cluster. Even though the word has CCVC (*spor*) or CCVCC (*transfer)* their representations in surface structure obey this rule like, *profesör* → *p[u]rofesör/p[o]rofesör*, transfer → *t[ı]ransfer*, *spor* → *s[ı]por*. These representations indeed changes the syllabic structure especially words starting with CC cluster, in the surface structure an additional syllable have been inserted.

APPENDIX B. SOT CLASSIFICATION

- **Type of slip**: Substitution, (Semantic, Formal, Semantic & Formal), Blend, Anticipation, Perseveration, Anticipation & Perseveration, Exchange, Metathesis, Fusion/Telescoping, Addition, Deletion, Tongue Twister, Not Error, Need Revision
- **Slip unit**: Phrase, Word, Morpheme, Syllable, Segment-Cluster, Segment, Feature, Intonation, Stress
- **Slip Domain**: Noun, Verb, Adjective, Adverb, Determiner, Auxiliary Verb, Prepositions, Conjunctions, Pronouns, Noun Phrase, Verb Phrase, Prepositional Phrase, Adverbial Phrase, Adjective Phrase, Complementary Phrase, Inflectional Phrase, Sentence, Syllable Template, Prosodic Unit,Morphology, Phonology
- **Lexical Control**: All/Yes/No
- **Lexical Category**: Adjective, Adjectival Phrase, Adverb, Adverbial Phrase, Adpositional Phrase, Noun, Noun Phrase, Pronoun, Prepositional Phrase, Sentence, Verb, Verb Phrase, Word
- **Lexical bias**: All/Yes/No
- **Distance in Words**
- **Distance in Morphemes**
- **Distance in Syllables**
- **Distance in Segments**
- **Morphological Control**: Yes/No/Partial

- **Word Errors**
  - **Grammatical Category**: Lexical Category, Functional Category
  - **Position**: Specifier, Head, Complement
  - **Syntactic Role**: Adjunct, Object, Subject, Verb
- **Paradigmatic Errors**
  - **Semantic Relation**: Antonym, Co-Hyponym, Hyperonym, Hyponym, Meronym (Part/Whole)
- **Morpheme**
  - **Lexical Category**: Lexical Category, Functional Category
  - **Boundness**: All, Bound, Free
  - **Abstractness**: All, Concrete, Abstract
  - **Position**: All, Prefix, Stem, Suffix
- **Segments**
  - **Category**: All, Consonant, Vowel
  - **Postion**: Body, Coda, C-Root, Nucleus, Rhyme, Syllable Onset, Word Onset
  - **Feature Distance**
- **Syntagmatic Errors**
  - **Error Domain**: CP, IP, NP, PP,VP
- **Blends**
  - **Level of Conflict**: Conceptual, Feature Level, Morphological, Segmental, Syntactic, Word
  - **Level of Resolution**: Conceptual, Feature Level, Morphological, Segmental, Syntactic, Word
- **Repair**

- **Repair Attempt**: Yes, No
- **Repaired**: All, Yes, No, Partial
- **Noticed**: Yes, No
- **Locus of Repair**: After Word, Before Word, Delayed, Within Word
- **If Delayed, After**
- **Backtracking**: Beginning of Morpheme, Beginning of Phrase, Beginning of Sentence, Beginning of Word
- **Editing**: Yes, No
- **Kind of Editing**: Non-Verbal, Para-Verbal, Pause, Verbal, Feature

- **Comments**

APPENDIX C. SAMPLE SLIP RECORD IN DETAIL

Record Information

Record ID	86
Date	2008-01-02
Show	Radyo ODTÜ Modern Sabahlar
Podcast	

Edit Record Delete Record

Slip Audio Information

Slip ID	66
Start Time	00:50:22,67
Duration	14
Speaker	Ebru
Slip Audio	
Sentence Audio	

Edit Slip Delete Slip

Contents

Interpretation 75

Analysis 73

Interpretation Information

Interpretation ID	75
Intention	di-yorlar
Intention (En)	say-pcont-pl
Utterance	di-yor-lar-dı
Utterance (En)	say-pcont-pl-pp
Sentence Context	g: Bana, ben ilköğretimde öğretmen**di**m, öğrenciler, 1. sınıflar teyze diyorlar**dı**. o:sonra istifa mı ettiniz g: yok istafa etmedim, bir şey demiyorum, yani, mecburen katlanıyoruz
Sentence Context (En)	

Add Interpretation Edit Interpretation Delete Interpretation Contents

Analysis Information

Analysis ID	73
Slip Type	Anticipation Need Revision
Slip Unit	
Slip Domain	Complemental Phrase (1) Complemental Phrase (2)
Lexical Control	
Lexical Category	
Lexical Bias	
Distance in Words	
Distance in Morphemes	
Distance in Syllables	
Distance in Segments	
Morphological Control	
Word Errors	
Grammatical Category	
Position	
Syntactic Role	
Paradigmatic Errors	
Semantic Relation	
Morpheme	
Lexical Category	
Boundness	
Abstractness	
Position	
Segments	
Category	
Postion	
Feature Distance	
Syntagmatic Errors	
Error Domain	
Blends	
Level of Conflict	
Level of Resolution	
Repair	

Repair Attempt	No
Repaired	
Noticed	No
Locus of Repair	
If Delayed, After	
Backtracking	
Editing	No
Kind of Editing	
Conduite	
Comments	
Comments	Add - There should be syntax in the slip domain Syntact'c fearure, past tense had been anticipated from *diyorlardi* to *ogretmendim*. The error and source is extremely far away. It also a morphological error because of addition *-di* to correct form *ogretmen-im*, without causing hesitation or any change in the phonemic level. Even though the meaning of the sentence changed dramatically (from "I am a teacher" to "I was a teacher") and the reporter remarks this change, the speaker herself is unaware of it. Hence, the monitor is not necessarily sensitive to the resulting semantics of a slip, as long as syntactically the form satisfies all requirements. There is a very remote possibility, which is actually weird, that the -dim might come from the -tim of ogretim. However, -tim is not a morpheme but part of the root ogretim. That's why it should not be considered a good source. With -di of diyorlad-di it is different. This is a licit morpheme. ogret -im og-re-tim -di+m -tim

Add Analysis Edit Analysis Delete Analysis Contents