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# LEARNING AN UNPRODUCTIVE PROCESS: TURKISH EMPHATIC REDUPLICATION

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**Abstract**

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Learning a morphological process requires generalizing which words undergo the process and what form these words take. Emphatic reduplication in Turkish (TER) is unproductively applied to a small set of adjectives. Despite its unproductiveness, Turkish speakers have been shown to learn the form that adjectives that undergo emphatic reduplication take (Demircan, 1987; Wedel, 1999). This project investigates whether Turkish speakers learn which adjectives can undergo reduplication based on semantic regularities across TER adjectives. The experiments presented here will show that native Turkish speakers generalize over the color semantic class when learning the process of reduplication.

Dedicated to lovers of the Turkish language.

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# Chapter 1

# Introduction

In learning a morphological process, a language learner must internalize *which* regular terms undergo the process, and *what* form these terms take. For example, the process of English pluralization applies to most nouns of the language, and comes in three forms ([əz], [z], and [z]).[1]

Whether a process is productive or unproductive impacts the generalizations the learner makes about the application and shape of such a process. For example, we consider pluralization to be productive in English because when new nouns are created they acquire regular nominal plural morphology (e.g. computers$_N$ [kəmpjutɚ-**z**], selfies$_N$ [sɛlfi-**z**]), and other grammatical categories do not take this morphology (e.g. *jankys$_A$ *[dʒe͡ɪnki-**z**]).

Unproductive processes, on the other hand, do not freely acquire new members. Velar softening in English, where *electric* becomes *electricity*, is considered an unproductive process because new Latinate stems are not actively adopted into English. Further, not all words that conform to the phonological template soften, as *manic* doesn't become **manicity*, nor does *static* doesn't become **staticity*. It could be that the restrictedness of velar softening is a result of English speakers simply memorizing which forms undergo the process and which forms do not. However, experimental evidence suggests that speakers of English do in fact generalize over some phonological information about the process (Pierrehumbert 2006).

[1] Which of these three exponents appears on the noun depends on stridence and voicing of the final consonant.

In many languages, knowledge of restricted/unproductive morphological processes have been shown to give rise to weak generalizations ("stochastically conditioned"), so called because speakers do employ them on novel stimuli but only in accordance with how accurate the generalization characterized the lexicon (Wedel 1999, Albright & Hayes 2002, 2003, Pierrehumbert 2006, Zuraw 2010). This paper is broadly concerned with uncovering what exactly people learn about (or "take in") an unproductive process. The assumption held here is that unproductive processes are not simply memorized. That is to say, unproductive processes are not a list of exceptions, and in fact some information about the input is generalized as a pattern by the learner. With respect to these issues, this project examines an unproductive process in Turkish called Turkish Emphatic Reduplication (henceforth TER). Two examples of TER are shown in (1):

(1) a. u**p**-uzun[2] 'very long' (semantic class: *dimension*)
b. si**m**-siyah 'very black' (semantic class: *color*)

Briefly, TER intensifies the meaning of the adjective it applies to, and only applies to around one hundred forms. The fixed linker segments in boldface in (1) are governed by a number of identity-avoidance restrictions, and speakers of Turkish show apparent knowledge of these restrictions when forced to reduplicate novel adjectives in an experiment (Demircan 1987, Wedel 1999). These one hundred forms appear to have some semantic class regularities—whereby color and dimension classes occur most frequently—which are of crucial interest to this project.

Work by Demircan (1987) and Wedel (1999) shows that Turkish speakers learn *what* form the reduplicated adjectives take. The project at hand will investigate whether or not Turkish speakers make generalizations about *which* adjectives can undergo reduplication on the basis of semantic class. Turkish speakers are shown here to have partial knowledge of the semantic classes that undergo reduplication, preferring to reduplicate novel adjectives that belong to the *color* class, but not to other semantic classes that usually can undergo reduplication. This suggests that even within an unproductive pro-

[2]Examples throughout this paper will use the Turkish orthography rather than the IPA transcriptions. This is because Turkish orthography is phonemically regular, and fine-grained phonological analysis–while interesting–is not the central interest of this paper.

cess, regularities available in the input are exploited by the learner. Speakers of Turkish are found here to not only make use of phonological information to determine which linker segment appears, but also to use semantic class regularities to decide whether or not a given adjective will undergo TER.

There is not much previous research on whether people learn unproductive **class membership** conditions.[3] In light of this, I will spend time situating this project within a broader literature that looks more generally at the tension between input and intake, both in the phonological and morphological domains.[4] Recent work on irregular past tense alternations, acquisition of noun classifiers, and acquisition of semantic categories lays the groundwork for this project (Pierrehumbert 2006, Albright & Hayes 2002, 2003, Gagliardi 2012, Culbertson & Wilson 2013, Xu & Tenenbaum 2007, Colunga & Smith 2005). This body of work shows that phonological, semantic, and syntactic information present in the input can be used by the learner to formulate generalizations about the lexicon.

## 1.1 Stochastic learning mechanisms: making a generalization is not a zero-sum game

While Turkish speaker judgments about TER are mostly rigid, some speakers report acceptable novel forms and some report variation at least in the selection of linker segments (Kaufman, fieldwork; linker segments are the bolded material in (1), see §3.1.1 for more discussion). The literature on restricted morphophonological alternations in English nicely parallels this collected TER data. It seems that English speakers do not *always* extend a generalization to novel forms, and particular morphophonological regularities within the lexicon can greatly influence but not guarantee the application of an alternation. The work shown here indicates that the reliability of a given phonological cue affects the strength of the generalization about the process; patterns across

[3] The term "class membership" is used here to refer to the set of lexemes that are able to undergo particular morphological processes.

[4] "Input" and "intake" are used here to refer to the separate domains of what linguistic information available to the learner and what linguistic information the learner can formulate generalizations about/reduce to a pattern (respectively).

language are gradiently learned.

Velar softening in English Latinate roots. The term "velar softening" describes the [k] ∼ [s] alternation that occurs before the nominalizing suffix *-ity* in English. For example, electric becomes electricity [ilɛktrɪ**k**] → [ilɛktrɪ**s**ɪti], opaque becomes opacity [oʊpeɪ**k**] → [oʊpæ**s**ɪti]. This alternation affects a relatively small subset of English words, only those Latinate roots that end in [ɪk].[5] In a series of production experiments, Pierrehumbert (2006) elicited velar softening in nonce words of English that were Latinate and semi-Latinate in phonological form, but did not replicate the softening in non-Latinate stems.[6] The results of Pierrehumbert's experiment are shown in (2).

(2) a. Latinate nonce stems: *interponic* to *interponicity*
velar softening across 93% of subjects
b. semi-Latinate nonce stems: *bowdec* to *bowdecity*
velar softening across 83% of subjects
c. non-Latinate nonce stems: *mork* to *morcity*
velar softening unattested; *morkness* attested

As shown in (2-b), semi-Latinate forms were softened less often than strongly Latinate forms. Further, the productivity of velar softening was not demonstrated in non-Latinate nonce words (e.g. *overglique* to *overgliqueness*, velar softening unattested **overglicity*) or the backformation task (e.g. given *interponicity*, the likelihood of a subject deriving *interponic* was only 18%). If the generalizations of the velar softening pattern were applied consistently, even in the restricted domain of Latinate roots, then the fact that the backformation task did not align with the production task in (2) would be surprising. Given the weaknesses of the generalization made here, the morphophonological cue of "Latinate-ness" is shown to be not 100% reliable.

[5] Some notable exceptions, though by no means an exhaustive list: opacity, ferocity.

[6] Whether or not a given form was labeled Latinate or semi-Latinate depended on the ending; Latinate forms were those that ended in /ɪk/, semi-Latinate in /ɛk/, and non-Latinate in /Ck/. Looked at the morphophonological interaction between the stem and affix, rather than just at the phonological (e.g. segment-by-segment) level alone.

Pierrehumbert claims that this asymmetry of productivity is "a reflex of statistical learning over patterns of the lexicon." She went on to say that these patterns could not be inferred by phonological frequency alone. If the generalization that underlies the application of velar softening were "given word-final [ɪti], the high likelihood of the preceding segment being [s]," then one could argue that English speakers are only inferring phonotactic likelihoods across the lexicon. However, observed data in English suggests that this could not possibly be the case: of the words in the English lexicon that end in /ɪti/, only 25% are preceded by /s/ [sɪti]. In light of this, Pierrehumbert suggests that velar softening is a process learned by morphological rather than phonological similarity.

Given the extent to which English speakers used the generalization, it is not the case that the process of velar softening was a memorized list of exceptions. Rather, speakers of English weighed morphophonological cues in order to predict the application of the morphological process to new words. Despite the restrictedness of the process, speakers of English were sensitive to morphological similarity and were able to extend velar softening to novel words.

Irregular past-tense alternations in English. Other morphophonological irregularities have been found to be gradiently conditioned. Albright & Hayes (2002) worked on a common irregular past tense rule of English, whereby words that end in /ɪŋ/ lower the [ɪ] to [ʌ] to form the past tense, e.g. fling ∼ flung, spring ∼ sprung, and on a less common irregular past tense rule whereby words that end in /iz/ sometimes back and lower [i] to [o] to form the past tense, e.g. freeze ∼ froze.[7] They found that speakers of English were able to extend these irregular past tense rules to nonce words. In order to verify this pattern as being a learnable generalization, Albright & Hayes used a rule-based model to formalize the phonological conditions governing the irregular past tense data and then constructed a set of four different categories of nonce words in order to test how gradient the productivity was in English. Each of these four categories is reproduced in (3).

[7]The generalization where [ɪŋ] becomes [ʌŋ] in the past tense is not entirely reliable; NB. bring ≠ *brung

(3) a. *blafe* : *blafed*, expected to sound particularly good as a regular past tense
b. *spling* : *splung*, expected to sound particularly good as an irregular past tense
c. *bize* : *bized* ∼ *boze*, expected to sound good both as regular and irregular
d. *gude* : ?, not covered by any especially reliable rules for (ir)regular past tense

They confirmed the predictions of the rule-based model by asking speakers of English to rate the various exponents of regular/irregular past-tense forms on the nonce words. They found that patterns associated with real words were extended to the nonce domain. Subjects demonstrated learned knowledge of the irregular past tense pattern, suggesting that English speakers are able to generalize phonological knowledge over morphological classes when learning an irregular past tense rule.

SUMMARY. Work by Pierrehumbert (2006) and Albright & Hayes (2002, 2003) supports the notion that in learning a restricted/partially productive process, morphophonological information present in the input is taken in by the learner in order to determine if a given process applies. These papers are part of a broader body of work concerned with *which* forms undergo a particular process, particularly the conditions on whether or not a word that meets class membership conditions is morphophonological in nature. The question remains if semantic information present in the input can be inferred by the learner.

## 1.2 Conditioning the rule: phonological cues are more salient, though less reliable, than semantic ones

The work by Pierrehumbert (2006) and Albright & Hayes (2002, 2003) indicates that morphophonological features available in the input and can be used by the learner to calculate the probability of a rule's application. However, there are other sources of information available in the input. This section will deal directly with how semantic information can guide the learning of noun classifiers in both Tsez, a Daghastani language spoken in the Caucuses, and in an artificial language. The evidence presented

here shows that semantic features in the input *can* be taken in by the learner. These semantic cues are less evident/salient to the child learner because they require higher levels of representation, which are acquired after phonological representations.

Noun classes in Tsez. With respect to noun classes, exponents of one syntactic category (the class morphology) are sensitive to the features of another (the noun-phrase that they attach to). Gagliardi (2012)'s work on the acquisition of noun classes in Tsez found that, given a highly predictive semantic component and a less reliable phonological correlate, young speakers of Tsez more readily acquire the phonological sub-regularities because they are easier to pick up on, at least at first.[8] As the children grow older, they come to rely more and more on the semantic cues because semantic cues are much more predictive.

Tsez has four different noun classes that are only visible with singular noun class agreement, shown in (4).

(4) Tsez singular noun class agreement (Gagliardi & Lidz 2014:page 7)

a. ∅-igu uži
**1**-good boy(1)
"good boy" (Class 1)

b. **j**-igu kid-bi
**2**-good girl(2)
"good girl" (Class 2)

c. **b**-igu k'et'u
**3**-good cat(3)
"good cat" (Class 3)

d. **r**-igu čorpa
**4**-good soup(4)
"good soup" (Class 4)

These classes correspond to four rough semantic categories; class 1: male human, class 2: female, human; class 3: animate, class 4: everything else. Those nouns that fall into these semantic categories have some predictable phonological features as well. The chart

[8] We might expect that a lower-level of representation, like phonology, is much easier for a child to learn rather than higher levels of representation like semantic class/connectedness.

in Table 1.1 shows the predictive power of both semantic and phonological features on noun class as calculated in a corpus study of Tsez.

| Class | Feature | Probability of class given feature | Probability of feature given class |
|---|---|---|---|
| 1 | male human | 1 | 1 |
| 2 | female human | 1 | 0.22 |
| 2 | paper,clothing | 0.52 | 0.04 |
| 2 | ɣ-initial | 1 | 0.14 |
| 3 | animate | 1 | 0.13 |
| 3 | b-initial | 0.51 | 0.10 |
| 4 | r-initial | 0.61 | 0.09 |
| 4 | -i final | 0.54 | 0.41 |

Table 1.1: Statistical reliability of features used in Classification Experiment (Gagliardi 2012)

Table 1.1 shows the four different noun classes of Tsez and the distribution of the semantic and phonological features across these classes, which act as cues for the noun class. In other words, there is a correlation of predictability between classes and their features. For example, Class 1 has the most predictable semantic features; given a noun that is [+male], the likelihood that the noun will take class 1 is 100%. And the converse is true as well. Given a noun with Class 1, the likelihood that the noun is [+male] is 100%. As shown in Table 1.1, the other three classifiers are not as reliably predicted either by semantic feature or phonological feature. There is an additional overall trend of semantic features being more predictable of the class than phonological ones. For example, given Class 3, the probability of that noun having the semantic feature [+anim] is greater than the probability of that same noun starting with the phonological features [+labial, -continuant, +voice].

In a series of production experiments, Gagliardi created nonce nouns and asked young children to engage with pictures of both real and nonce words. The conversations between the experimenter and child were then transcribed in order to determine which class the child subject assigned to both the nonce and real words of Tsez. Despite the

high predictive power of semantic class, young children were more likely to rely on less-salient (but still somewhat correlative) phonological features on a given nonce word. This suggests that not all information available in the input is used by the learner, and also that both phonological and semantic features can conspire to condition a particular rule of language. For example, in Tsez, a noun with the phonological feature ɣ-initial and semantic feature *paper* will more predictably be placed in Class 2 than a *paper* noun without this phonological feature.

In contrast with the work done by Pierrehumbert (2006) and Albright & Hayes (2002, 2003), where only morphophonological information was taken in by the learner, Gagliardi (2012) shows that in Tsez *semantic* features are also used. With varying degrees, both the phonological and semantic features of nouns are used to determine class membership conditions of noun classes in Tsez.

Artificial grammar experiment in English. In Gagliardi (2012)'s work on noun classes, conflicting information in the input is resolved not necessarily by the feature with the highest predictive power, but by which cues are more evident/salient to the child learner. Because semantic and phonological features were both cues for noun class, there was no way of investigating whether or not semantic features alone could be reliable predictors of noun class in Tsez. In order to test this, Culbertson & Wilson (2013) conducted an Artificial Grammar experiment and modeled noun classifiers after observed classifiers in Mandarin. They assumed that if phonological features take precedent over semantic ones in the learning of classifiers, then removing correlation of type of classifier with phonological features in the artificial grammar would make subjects dependent on learning the semantic features.

They reasoned that if the semantic cues were salient enough for the learner to generalize over, then the absence of predictable phonological cues would not negatively impact the learning of the pattern. Further, by modeling the classifiers in the artificial grammar after observed classifiers in Mandarin, Culbertson & Wilson look at logical and attested semantic classes/families of classes.[9]

[9]By this I mean that the classifiers themselves connoted easy-to-group groupings, unlike other logically possible but unattested groupings such as *flat, blue, animate; *round, red, inanimate. This will be discussed more in §1.3.

Culbertson & Wilson constructed classifiers *ka* 'rigid, narrow, long' and *po* 'broad, flat, flexible,' on real words of English.[10] There were no reliable phonological cues in either class—that is to say, given the classifier *ka*, there was no way of predicting what type of noun it would surface next to based on phonological properties of the noun. Culbertson & Wilson then exposed (English-speaking) participants to real words of English with a classifier, alongside a picture. Examples of the text stimuli are shown below in (5).

(5) a. one-ka hammer
one-CL hammer
"one hammer"

b. two-po towel
two-CL towel
"two towels"

Culbertson & Wilson found that adults were able to successfully learn the classifiers by shape, and performed equally well on both seen and novel words in the artificial grammar experiment. For example, during a production task, if a subject saw a picture of a piece of paper, the subject reliably used the classifier *po*. These results suggest that in the absence of phonological cues, the learner generalizes over semantic features in an experimental environment.

Summary. Work on noun classifiers by Gagliardi (2012) and Culbertson & Wilson (2013) demonstrate that speakers of both Tsez and English have implicit knowledge of semantic class when figuring out whether a given process applies. While previous experiments have looked into the learnability of morphophonological classes—features that are especially salient to the child learner—the experiments presented here provide evidence for the generlation of semantic features into a pattern from the input. The section to follow will explore logical organizations of class, and will ask what fundamental properties underly taxonomies.

[10] Which correspond to classifiers in Mandarin, *zi[4]* and *jeung[4]* respectively.

## 1.3 Acquiring the rule

Gagliardi (2012) demonstrated that semantic features in Tsez noun classifiers are salient to the learner. But what properties about the bundles of features themselves make them into a learnable category? Further, why do we see classifiers that correspond to seemingly related features such as 'broad, flat, flexible' and not 'broad, flat, blue'? Work by Xu & Tenenbaum (2007) and Colunga & Smith (2005) investigate what ontological properties of the universe underly categories (which have a very transparent correspondence to class). They found that the learner internalizes categories and hierarchies.

Implicit knowledge of taxonomies. In a task designed by Xu & Tenenbaum (2007) speakers of English would rate the similarity of a set of pictures that were presented to the subject in one of three orders. The order of presentation of the pictures would fit into one of three hierarchical relationships: (1) subordinate: dalmatians, (2) basic: dogs, (3) superordinate: animals. If a number of dalmatians was displayed on-screen, the subject would expect the upcoming stimulus to be another dalmatian. In doing so, subjects would categorize the stimuli based on a subordinate structure; the taxonomy would relate to a species of dogs rather than a more subsuming taxonomic order.

Xu & Tenenbaum modeled the classifications by using a naive Bayesian learner[11] and found that subjects mirrored those results modeled by the learner. More compelling and relevant to the discussion at hand, however, is that subjects generalized over these natural hierarchical classifications. Notions about "kind" and "class" depend in part on hierarchies (Dewar & Xu 2010). While this finding is hardly surprising, interesting to note are the ways in which the presentation of materials can guide the learner to pay attention to a particular level of abstraction.

Knowledge about kinds in English and Japanese. Colunga & Smith (2005) demonstrated that notions about "kind" are learned at a young age, starting around age 2. In a series of experiments, Colunga & Smith tested whether associative learning

[11] Bayesian learners use Bayesian inference to model a particular data set by updating the previous hypothesis as additional information in incorporated.

strategies are compatible with the systematic ways in which children pay attention to the shape of solid objects and the material of nonsolid objects. The learner (child) was sensitive to semantic regularities of shape/material subclasses in interpreting a nonce word as a solid or not. Though the exact rates of association were different between English and Japanese speaking children, the children overall did in fact learn the solid/shape association.

Syntactic cues were found to strengthen (but not fully explain) these associations. Determiners cue children into the properties of the noun phrase contained within them. For example, countable noun phrases are more likely to be discrete and consequently nouns preceded by an existential determiner are more likely to be perceived as solid. While the determiner alone was not a reliable predictor of the solid/material distinction, the introduction of the mass/count distinction was found to aid a computational model in correctly modeling observed natural language learning.

Ontological properties of the solid items themselves informed how the child subjects perceived and classified a particular element. Colunga & Smith explain the solid/shape connection by appealing to the more stable properties of the nouns in question. They note that objects that are solid have invariant shape, and objects that are nonsolid have invariant material.[12] The learner pays more attention to properties that are invariant because those physical properties are more reliable in distinguishing solids from nonsolids (remember that solids have invariant shape, a reliable cue for solidness). These findings suggest that the learner pays attention to observations made of the real world, and that properties of the objects themselves can be abstracted into learnable associations amongst kinds.

Summary. Work by Xu & Tenenbaum (2007) and Colunga & Smith (2005) looked at those properties of the semantic classes themselves that determine whether and how a given association was learned. Their findings suggest that properties of the objects outside of language guide how the lexemes are categorized. The proposed project on

[12]They also note, interestingly, properties of physics that key into the shape/solid association: "certain kinds of shapes can with proper movement swim more easily than other kinds, certain kinds of shapes but no others afford carrying other things, and certain kinds of materials but not others can soak up liquids." (Colunga & Smith 2005).

Turkish seeks to investigate further how fundamental properties of the words—such as gradability and boundedness—can mirror the findings presented here.

## 1.4 Learning semantic class in natural language

Though there are phonological generalizations about the morphophonological shape that reduplicated adjectives take (Demircan 1987, Yu 1999, Wedel 1999, Kılıç & Bozşahin 2013), these generalizations are not predictors about which lexical item can undergo reduplication. That is to say, there is no correlation between the phonological features of a given lexeme and whether or not that lexeme holds class membership to TER. The experiments shown here will draw upon a long line of inquiry about whether a semantic feature is taken in by the learner within the morphophonological domain, and further what properties of the semantic class are learnable.

The experimental evidence presented thus far has established that determining if a process is memorized or learned is actually sensitive to weak generalizations made of the data (Pierrehumbert 2006, Albright & Hayes 2002, 2003). Further, the features that are easily generalized over by the child, the phonological features, are not the only learnable features for a given process as demonstrated by experimental work on noun classifiers. Semantic features can also be salient cues for classifications within language (Gagliardi 2012, Culbertson & Wilson 2013). But these classifications can interact with one another. In investigations into associative learning strategies and naive Bayesian learning models, experimenters have shown that physical properties of the nouns themselves can inform the learner about what associations amongst lexemes are tenable (Xu & Tenenbaum 2007, Colunga & Smith 2005).

# Chapter 2

# Turkish Emphatic Reduplication

The Turkish adjective *mavi* 'blue' can be intensified in a number of ways. One way is by adjoining the degree word *çok* 'very' to the adjective to become *çok mavi*. Another second way of intensification is by emphatic reduplication, which is the focus of this project. With TER, *mavi* becomes *masmavi*. Loosely speaking, the semantics of TER is maximally intense and somewhat idiomatic in meaning. For example, if one utters "the sky is *masmavi*", that one means that the sky is so blue that there isn't a cloud in sight. It is maximally—purely—blue. The set of adjectives that meet the class membership conditions of TER is very restricted; only 130 adjectives (and a handful of adverbs), are reported to undergo TER (Lewis 1967, Göksel & Kerslake 2005).

## 2.1 Phonology of TER

A notable phonological property of TER is the alternations in the fixed segment that occurs in the coda of the reduplicant morpheme (Alderete, Beckman, Benua, Gnanadesikan & McCarthy 1999). Each of the four fixed linker segments present in TER {[p], [m], [s], [r]} are shown in Table 2.1:

| | Adjective | Gloss | TER | Gloss |
|---|---|---|---|---|
| a. | uzun | 'long' | u**p**-uzun | 'quite long' |
| b. | dar | 'narrow' | da**p**-dar | 'quite narrow' |
| c. | mor | 'purple' | mo**s**-mor | 'very purple' |
| d. | toparlak | 'round' | to**s**-toparlak | 'very round' |
| e. | beyaz | 'white' | be**m**-beyaz | 'snow white' |
| f. | düz | 'flat' | dü**m**-düz | 'extremely flat' |
| g. | sefil | 'miserable' | se**r**-sefil | 'very miserable' |
| h. | temiz | 'clean' | te**r**-temiz | 'spotless' |

Table 2.1: Turkish Emphatic Reduplication

The linker segment is conditioned by surrounding phonological context, and is determined mostly by identity avoidance constraints (NB: the Obligatory Contour Principle). The linker segments are arbitrary and phonologically unnatural; morphology constrains which segment occurs.[1] The phonological component of the grammar evaluates which of the exponents will be least marked, given the neighboring segments. Informal constraints that condition which linker segment will occur are summarized in (1) (Demircan 1987, Yu 1999).

(1) Co-occurrence constraints on the fixed segment

a. **avoid full reduplication**
zor 'difficult', zo**p**zor 'very difficult' *zo**r**zor

b. **no gemination between linker and initial consonant of base**
sefil 'miserable', se**r**sefil 'very miserable' *se**s**sefil

c. **avoid a linker that is identical to any consonant in the base**

[1]By "unnatural", I use the notion of unnaturalness adopted by Pierrehumbert (2006). Essentially, there is no phonetic process that would insert {[p], [m], [s], [r]}. Because these segments are idiosyncratic, I adopt the view that the segment's insertion is morphologically conditioned. Which of the four exponents that appears is phonologically conditioned, though there may be interactions between the morphology and phonology.

kötürüm ‘fresh’, kö**s**kötürüm ‘very fresh’ *kö**m**kötürüm *kö**r**kötürüm

d. **avoid a linker that shares any features such as [labial], [strident], and [approximant] with any segment in the base**
berrak ‘clear’, be**s**berrak ‘very clear’ *be**p**berrak, *be**m**berrak, *be**r**berrak

Contextual restrictions on the four fixed segments are learned by the Turkish speaker. In spite of the fact that TER affects such a small set of words, the reduplicated forms are not memorized; if they were, this would predict that speakers of Turkish would be unable to extend those distributional generalizations in (1). This is, as mentioned, not the case. Given an adjective that never reduplicates, like *pullu* “scaly,” when forced, Turkish speakers will reduplicate the adjective as *pu**s**-pullu* rather than **pu**m**-pullu* or *pu**p**-pullu* (Wedel 1999).

## 2.2 Semantics of TER

The goal of this section is to come up with a coherent story for modification with emphatic reduplication in Turkish. Adjectives that undergo TER are assumed to be gradable predicates (more discussion on what gradability/degrees are in Appendix D). But briefly, different modifiers combine with gradable predicates, like *clean*, to select for different intervals/points the scale of cleanliness. The concept of an upper or lower limit on a scale is referred to here in terms of boundedness. Some gradable predicates, like *clean*, have a bound (something can be 100% clean, which selects the upper bound of the scale), whereas some predicates like *tall*, do not have a bound (something cannot be 100% tall). Particular modifiers select for different points on a scale; in (2-b), *completely* picks out the bound of the scale, whereas *very* does not.

(2) a. The table is **very clean**. $\models$ The table is **clean**.

b. The table is **completely clean**. $\models$ There is no amount of dirt on the table.

In (2-a), *very* emphasizes the amount of cleanliness a given nominal has. In contrast, *completely clean* selects the upper bound of cleanliness; saying something is *completely clean* entails something much stronger than simply that the nominal is clean. As shown in (2-b), *completely clean* entails that there is no degree of dirt. In Turkish, is

it the case that TER combines with adjectives in a similar way to *very* in English, or does it operate more like *completely*?

As I will show, TER behaves similarly to *very*, in that it intensifies the meaning of a gradable predicate and operates on a scale of degrees. But unlike *very*, TER shows sensitivity to the boundedness of adjectives, and more commonly combines with bounded adjectives. This results from the fact that TER selects for an interval that includes the upper or lower bound. Whereas *completely* selects for the upper bound itself, TER selects for an interval subsuming this bound. When there is no such bound available, for example with relative adjectives like *uzun* "long", TER finds some contextual point to shrink around. In addition to acting over a scale of degrees, in certain cases (if not in all cases) TER also imparts a prototypical flavor that takes an entity amongst a comparison class and returns a prototype of that comparison class.

### 2.2.1 Modification in Turkish

Emphatic reduplication is oftentimes translated as "very," though as I will show here the meaning of TER must be nuanced in order to accurately account for its distribution.

The adjective *mavi* 'blue', as mentioned previously, can be intensified in a number of ways. Some different usages are shown below in (3).[2][3]

(3) a. bu gör-düğ-üm **en mavi** kazak
this see-PST.PART-1.SG **most blue** sweater
"That is the most blue sweater I have ever seen." (superlative)

b. ne **mavi** kazak
what **blue** sweater
"What a blue sweater!" (exclamative)

c. bu kazak mavi, ama **daha mavi** ol-abil-ir
this sweater blue, but **more blue** be-ABIL-PASS
"This sweater is blue, but could be bluer." (comparative)

d. bu **çok mavi** kazak
this **very blue** sweater

[2]Abbreviations used here: PST = past tense, PASS = passive voice, PART = participle, ABIL = abilitative aspect, SG = singular agreement, 1 = first person agreement

[3]Special thanks to Guliz Günes, Turhan Karadeniz, and Yusuf Gören for their help with these data.

"This sweater is too blue."[4] (excessive)

e. bu **mas-mavi** kazak
this **emph-blue** sweater
"This sweater is very blue." (emphatic)

This project has focused on the last two intensifications in (3-d) and (3-e). When modifying particular adjectives, *çok* can be translated either as "too" or "very", e.g. çok güzel "very/too pretty", çok yeşil "?very/too green." Which of these possible interpretations of çok surfaces is dependent both on context and on the semantics of adjective being modified (Lewis 1967, Göksel & Kerslake 2005). That is to say, the excessive interpretation of *çok* in (3-d) can be instead interpreted as emphatic if the context demands it. However, speakers report that in order to express "very" with color adjectives, the overall preference is to use TER rather than the adverbial *çok* form. In these instances, *çok* does not translate to "very," but rather translates to the excessive meaning "too" in (3-d), a classic case of morphological blocking as identified time and time again (Poser 1992).[5]

In a superlative context like "That is the bluest sweater I've ever seen!" and in

[4] As will be shown later, *çok* here can translate to either "very" or "too."

[5] The difference in interpretation of *çok* may lie in the scale structure of the adjectives being modified. For gradable predicates, modification references some point on an ordered scale. As described by Rotstein & Winter (2004) and Kennedy & McNally (2005), scalar adjectives fall into two broad classes: absolute and relative. There are those with an inherent bound, e.g. smooth, flat, whereby there is either a minimum or maximum degree that is specified in the adjective itself. These **bounded** adjectives are absolute adjectives. The other type of class of scalar adjectives do not have inherent maxima or minima, but are rather confined within some contextually determined standard, e.g. long, wide. A good diagnostic to distinguish between absolute and relative scalar adjectives is the "completely" test. Absolute adjectives can be modified with "completely," and relative ones cannot:

(4) That table is completely smooth/flat/*long/*wide.

Describing something as "tall" or "wide" is meaningful only within a particular context: a tall mouse is still much shorter than a short giraffe, for example. With absolute scalar adjectives like *mavi* "blue", *çok* is biased towards an excessive reading, "too." And with relative adjectives like güzel "pretty," *çok* is neutral, and depending on context can be interpreted as "too" or "very." It is interesting to note that despite the differences in the interpretation of *çok* with adjectives like *mavi* vs. *güzel*, both types of adjectives can — and do — undergo reduplication.

an exclamative context, like "What a blue sweater!", *masmavi* can be used where *çok mavi* cannot:

(5) a. bu gör-düğ-üm en {**mavi/mas-mavi/*çok mavi**} kazak
this see-PST.PART-1.SG most {**blue/emph-blue/*very blue**} sweater
"That is the most blue sweater I have ever seen."

b. ne (kadar) {**mavi/mas-mavi/*çok mavi**} bir kazak
what (much) {**blue/emph-blue/*very blue**} a sweater
"What an (incredibly) blue sweater!"

The ungrammaticality of using *çok* in (5-a) and (5-b) is both because of the incompatibility of the excessive reading in these contexts and because degree operators cannot themselves be arguments for other degree operators (Kennedy & McNally 2005). These are important in showing how in particular constructions, TER and *çok* are in complementary distribution. The grammaticality of TER in (5) shows that degree operators such as *en* "most" and *kadar* "much" can take TER but not *çok* as an argument.

PROTOTYPICALITY. Adjectives that have undergone TER can be an argument for a degree operator, shown in (5). But as mentioned previously, there is some additional work that TER does. It does not just pick out a particular interval that includes the bound of a predicate, but it also adds a prototypical flavor. "Prototype" here is understood as the notion that categories are associated with particular defining characteristics (Rosch 1983, Kamp & Partee 1995). For example, a flower's characteristic features might be considered [+stem], [+petal], [+pollen]. These binary features that define a flower as a flower are considered *prototypical* of a flower. With colors, a prototypical *red* might be something more along the lines of a bright, intense, blood-like red, rather than a duller, purpler maroon. Consider the translations in (6):

(6) a. kas-katı
EMPH-hard
"hard as a rock"

b. sim-siyah
EMPH-black
"raven black" (Göksel & Kerslake 2005)

The adjective *katı* in (6-a) is unbounded—something cannot be completely hard, there

is no bound to hardness. Its translation is "hard as a rock"; the "rock" imposes a bound for the interval of TER to shrink around. The bound that TER picks out, a rock in the case of the predicate *katı*, is not arbitrary, but rather is prototypical for the notion of hardness. In (6-b), the bound of the color *siyah* is not located on a scale but on a plane (e.g. a spectrum of color). So in addition to TER selecting for the bounded point of black and some interval around that point, TER also picks out a prototype of blackness. In this case, the raven—which is the prototype of blackness.[6] I assume that prototypes differ and are culturally established.

Most speakers report TER being used in advertising contexts: a restaurant, for example, might emphasize how *taptaze* "extremely fresh" its salads are, or a cleaning product company might declare that your sheets will never be so *bembeyaz* "snow white" as when you use their product. This illocutionary force draws from—and contributes to—the prototypical and emphatic meaning that TER contributes to the adjectives that it modifies. In this way, TER is different from more "normal" adverbial modification (Cf. *çok*).

### 2.2.2 Related phenomena in Italian and Czech

It is unsurprising to note that the scalar properties of adjectives always interact with what sort of modifiers they can take. This is no exception for Italian and Czech, which will be shown here to have two different patterns of combination with respect to scale structure and modification.

Italian. Modification with the *-issimo* suffix in Italian is insensitive to the scalar structure of the predicate it combines with. That is to say, *issimo* occurs with both gradable and ungradable predicates even in contexts where the adverbial modifier *molto* cannot, as shown in (7):

(7) Italian intensification

[6]These translations pick out the prototypes of English, as "hard as a rock" and "raven black" are idioms in English. Presumably, Turkish has analogous translations, but perhaps with different prototypes of hardness and blackness.

a. La casa è {bell-issima /molto bella}
the.SG.F house is {beautiful-ISSIMO.F /very beautiful}
"The house is {extremely beautiful/very beautiful}." (*beautiful*, gradable predicate)

b. Fumare dal benzinaio è proibit-issimo /??molto proibito}.
smoking in gas.stations is {forbidden-ISSIMO /??very forbidden}.
"Smoking in gas stations is forbidden." (*prohibit*, ungradable predicate)

Beltrama & Bochnak argue that in light of the fact that *issimo* can modify gradable adjectives that have a scale and ungradable adjectives that do not have a scale, *issimo* is not a degree modifier but rather a noteworthiness operator. Any apparent emphasizing effect falls out of the semantics of noteworthiness. Because *issimo* does not operate on scales, it is entirely insensitive to scales.

CZECH. On the other hand, emphasizing adjectives in Czech is indeed sensitive to the scalar structure of the predicate. Intensification in Czech can be expressed with the modifier *velmi* "very" or with reduplication of the affix *-li-*:

(8) Czech intensification

a. velmi čistý "very clean"

b. čist'ou**lili**nký "very very clean" (Dočekal & Kučerová 2011)

While there are virtually no restrictions on what kinds of gradable predicates can occur in a construction with *velmi*, as in (8-a), Dočekal & Kučerová claim that *li* is restricted to certain types of bounded adjectives. Total adjectives like *čistý* "clean", *zavřený* "closed" can be reduplicated whereas partial adjectives like *špinavý* "dirty", *otevřený* "open" cannot.[7] In this sense, the *li* reduplication is truly an instance of degree modification, since the operator makes specific reference to the scalar properties of the predicate that

[7]Their typology comes from Rotstein & Winter (2004), and as described in their paper: "Here we are concerned with two basic types of antonym adjectives: partial and total adjectives. We semantically represent total and partial adjectives by a scale and a standard value. A partial adjective indicates some amount of the relevant property (moisture, dirt, sickness etc.), while a total adjective indicates no amount of such property (e.g., a dirty object has some degree of dirtiness, but it is not necessarily free of cleanliness; in contrast, a clean object is free of dirtiness)."

it modifies.

The data presented here from Italian and Czech intensification offer insight into possible characterizations of Turkish Emphatic Reduplication. To recap, Italian *issimo* is not a degree operator, but rather a noteworthiness operator. Czech *li* is a degree operator, and is sensitive to the scalar structure of the predicate it modifies. So what about TER? Here are the generalizations about TER:

1. TER occurs with gradable adjectives, is questionable with ungradable adjectives
2. TER occurs with both gradable adjectives that select for an endpoint on a scale (such as *temiz* "clean") and those that do not (such as *güzel* "beautiful")
3. TER is in complementary distribution with *çok* for color adjectives
4. TER does not pick out an endpoint of a scale, but rather the interval that includes the bound
5. When no bound is available, the prototypicality operator establishes a contextual bound

**Is TER like Italian or Czech?** It seems as though TER patterns mostly with gradable adjectives and operates differently over different types of scalar properties of adjectives. Even though speakers report that TER is more emphatic than just *very*, it is not the case that TER picks out the upper bound of a scale. If it did, we would expect the constructions in (9-b) and (9-c) to pattern differently from one another, and also for (9-c) to be a contradiction.

(9) a. bu kazak **mavi**, ama daha mavi ol-abilir-di
this sweater **blue**, but more blue be-ABIL-PASS
"This sweater is blue, but could be bluer."

b. bu kazak **çok mavi**, ama daha da mavi ol-abilir-di
this sweater **very blue**, but more CL blue be-ABIL-PASS
"This sweater is very blue, but could be bluer."

c. bu kazak **mas-mavi**, ama daha da mavi ol-abilir-di
this sweater **emph-blue**, but more CL blue be-ABIL-PASS
"This sweater is extremely blue, but could be bluer."

The loose proposal here is that TER is a hybrid of both Italian and Czech. As with Italian, TER has some sort of prototypicality operator (instead of noteworthiness operator), but similar to Czech, it does show sensitivity to scales and bounds. The section to follow looks at what kinds of predicates occur with TER most frequently.

### 2.2.3 Distribution of reduplication, a corpus study

As mentioned, speakers of Turkish demonstrate knowledge of *what* form reduplicated adjectives take. The question at hand is if information about semantic class present in the input is inferred by the learner when determining the class membership conditions of TER. In order to determine the distribution of semantic class in the input, I investigated the occurrences of attested TER forms in the Turkish National Corpus. The Turkish National Corpus is comprised of 45 million words pulled from news sources and other online material.

The results show that the most frequent reduplicated forms generally fall into the semantic classes of *color* and *dimension*, shown in Table 2.2 below (Turkish National Corpus).

| TER | Gloss | Frequency per million | Color | Dimension | Bound? |
|---|---|---|---|---|---|
| yepyeni | 'very new' | 27.79 | | | Y |
| bambaşka | 'very different' | 25.23 | | | N |
| koskoca | 'incredibly huge' | 22.56 | | ✓ | N |
| büsbütün | 'absolutely all' | 20.27 | | | Y |
| bembeyaz | 'snow white' | 19.71 | ✓ | | Y |
| sımsıkı | 'very tight' | 17.25 | | | N |
| apaçik | 'wide open' | 13.49 | | ✓ | Y |
| tertemiz | 'spotlessly clean' | 13.45 | | | Y |
| kıpkırmızı | 'bright red' | 13.1 | ✓ | | Y |
| besbelli | 'totally clear/evident' | 12.17 | | | N |
| dimdik | 'super steep' | 11.35 | | ✓ | N |
| bomboş | 'entirely empty' | 10.41 | | ✓ | Y |
| yemyeşil | 'very green' | 9.78 | ✓ | | Y |
| upuzun | 'really long' | 9.42 | | ✓ | N |
| simsiyah | 'raven black' | 8.71 | ✓ | | Y |
| kapkara | 'raven black' | 8.42 | ✓ | | Y |
| dümdüz | 'entirely flat' | 7.22 | | ✓ | Y |
| masmavi | 'super blue' | 6.38 | ✓ | | Y |
| sapsarı | 'bright yellow' | 6.11 | ✓ | | Y |
| dosdoğru | 'very straight' | 4.78 | | ✓ | Y |

Table 2.2: Top 20 most frequently attested reduplicated forms in Turkish (Turkish National Corpus)

Because the process of reduplication is in some ways idiomatic and mostly used in discourse, the only available Turkish spoken word corpus did not have a large enough sample pool with only 18,000 tokens.[8] The numbers in Figure 2.2 suggest that semantic

[8]In a corpus search of the Spoken Word Corpus of Turkish, there were only 3 hits of reduplication, and all three corresponded to the color adjective *kapkara*. Because of the small sample size, this finding is not statistically significant, but interesting to report here.

classes that are more frequently attested are color or dimension adjectives.[9] In addition, the majority of the most frequently attested TER adjectives also have a scalar bound. This data shows that the semantic class distinction is available in the input. The experiments to follow test whether or not this information about semantic class membership in TER is inferred by the learner.

We can also learn from the most infrequently attested forms of TER.[10] We might expect two different generalizations to arise from the most infrequently attested TER adjectives: (1) more uniformity of semantic class since we know that exceptions to the rule tend to be frequently attested, (2) that these infrequent words are perhaps novel forms that only one or a few people coincidentally manufactured, which would indicate some level of productivity for what has frequently been referred to as a fixed process. The 10 least attested forms are presented below, calculated using the same metric as for the previous table, all with only 1 hit in the TNC. The semantic class information is summarized in Table 2.3:

[9] One committee member notes that the dimension class is not coherent in the same sense that the color class is. I argue that this intuition contributes to the findings of the experiments to follow. Dimension adjectives were so classed because they referenced a spatial property.

[10] Thanks are in order to Matt Wagers for bringing this to my attention.

| TER | Gloss | Frequency per million | Color | Dimension | Bound? |
|---|---|---|---|---|---|
| tupturuncu | 'very orange' | 1 | ✓ | | Y |
| sepserin | 'very cool (cold)' | 1 | | | N |
| yapyaş | 'incredibly humid' | 1 | | | Y |
| gepgergin | 'very nervous' | 1 | | | N |
| gepgece | 'really nocturnal' | 1 | | | Y |
| düpdüzgün | 'perfectly smooth' | 1 | | ✓ | Y |
| dipdinç | 'really youthful' | 1 | | | N |
| besbeter | 'even worse' | 1 | | | N |
| besberrak | 'very evident/clear' | 1 | | | Y |
| basbaya | 'extremely beautiful' | 1 | | | N |

Table 2.3: Top 10 least frequently attested reduplicated forms in Turkish (Turkish National Corpus)

The table of the least frequently attested forms seems to show no real pattern: 50% of the predicates are bounded, 20% of the predicates fall in the *color* or *dimension* class. Some of the others, such as *baya* "beautiful" and *serin* "cool" describe physical properties of an object or person. Since there is no discernible pattern of boundedness or semantic class in Table 2.3, then maybe these words are recently coined words, lending credence to the notion that even in what has historically been described as a rigid, unproductive process, there is some productivity after all.

Though the most infrequently attested forms of TER do not show any real pattern here, it is important to note that there is some level of productivity and definite variation across attested TER forms. And amongst the *most* frequently attested TER words, there *does* seem to be a discernible pattern of bounded adjectives as well as color and dimension adjectives.

# Chapter 3

# Quantifying speaker knowledge of TER: experimental studies

The experiments presented here investigate to what degree Turkish speakers are able to generalize over semantic properties of those adjectives that undergo emphatic reduplication. In the pilot experiment, four native speakers of Turkish informally provided elicitations of previously unattested forms of TER. In the first experiment, nonce words were designed to represent two of the frequently attested semantic classes, color and dimension, and two completely unattested semantic classes, texture and mental state. The second experiment uses real words of Turkish to determine whether or not speakers of Turkish were analogizing novel forms to extant words of the language in Experiment 1.

## 3.1 Pilot

The question at hand is whether or not color and dimension adjectives are more likely than other semantic classes to be productive in TER. The pilot experiment sought to determine if it was possible to reduplicate unattested forms in those classes that have been shown to be more frequent in the lexicon. The findings presented here suggest that yes, TER is possible in unattested forms, but the judgments are gradient.

Four native Turkish speakers were contacted via email for elicitation of unattested emphatic reduplication of TER. They are referred to in Figure 3.1 as $G_1$, $G_2$, $O_1$, and

$A_1$. The speakers varied in their linguistic background (for example, one older Turkish speaker $A_1$ had not spoken Turkish at home for decades) but still claimed to have native speaker judgments. The consultants were not compensated for their time.

### 3.1.1 Materials & Results

A list of thirteen "color" or "dimension" adjectives were sent out; speakers were asked to both reduplicate and judge those novel reduplicated forms that they produced. Due to experimenter error, the list was not equally split between color and dimension adjectives.

The list of materials and their attested forms (with comments) is shown in Table 3.1.

| **Base** | **Elicited TER** | **Translation** | **Comments** |
|---|---|---|---|
| fuşya | fu[p/m]fuşya | 'very fuchsia' | attested by $G_1$, ?$O_1$ |
| bordo | bo[p,m,s]bordo | 'very burgundy' | attested by $G_1$, ?$O_1$ |
| gri | gipgri | 'very gray' | attested by $G_1$, $O_1$ |
| altuni | apaltuni | 'very gold' | attested by ??$O_1$ |
| nilgün | nipnilgün | 'very navy blue' | attested by ?$O_1$ |
| eflatun | epeflatun | 'very lilac' | attested by ??$O_1$ |
| turkuvaz | tupturkuvaz | 'very turquoise' | attested by ??$G_1$, ?$O_1$ |
| galibarda | gapgalibarda | 'very hot pink' | attested by ?$O_1$ |
| enli | epenli | 'very wide' | attested by $G_1$, ?$O_1$ |
| bemol | be[m,s]bemol | 'very flat' | attested by $G_1$, ?$O_1$ |
| patlak | paspatlak | 'very flat' | attested by $G_1$, $A_1$, $O_1$ |
| sık | sımsık | 'very dense' | attested by $G_1$, $A_1$, $O_1$ |
| tam | ta[p,s]tam | 'very full/complete' | attested by ?$G_1$, $A_1$, $O_1$ |

Table 3.1: Pilot - Elicitations of unattested reduplication

Alternations in the fixed segment are noted by brackets []. For each speaker, "questionable" reduplications are noted with a question mark ?. Especially forced reduplications are noted with two question marks ??. Speaker $G_2$ was unable to reduplicate the

forms, and instead produced closely related/more common reduplications (suggesting that $G_2$ strongly avoids novel reduplications).

The data presented in Figure 3.1 support a number of claims made by this paper. First, the data very clearly shows gradient judgments across speakers. A reduplication of *enli* → *epenli* was judged questionable by speaker $O_1$ but sounded perfectly natural to speaker $G_1$. Because TER is unproductive in the language, these novel reduplications are not always judged in a straightforward *good* or *bad* way, but somewhere on a cline between the two. Second, the data confirm some notion of semantic class in the TER process; speaker $A_1$ was only able to reduplicate unattested dimension adjectives and found all other color adjective reduplications ungrammatical. This could suggest that in $A_1$'s grammar, only the semantic class of dimension was learned across all of the forms for TER.

The following experiment will more rigorously quantify judgments reported in Figure 3.1.

## 3.2 Experiment 1

The experiment to follow tests Turkish speaker knowledge of semantic class in TER. This experiment uses wug testing with preceding semantic context to determine how native Turkish speakers react to reduplicated forms of novel adjectives. The novel adjective contexts fall into either an observed TER semantic class (color, dimension), or an unobserved one (texture, mental-state adjective). The prediction is that those nonce words that subjects are led to believe are *color* or *dimension* (observed semantic class of TER) will be rated higher than nonce words in an unobserved class. This experiment did not include boundedness as a factor.

### 3.2.1 Materials

This task used carefully constructed contexts that established which semantic class a nonce word fits into. Four different semantic classes were chosen in order to fit into either a TER semantic class that is observed/attested or a TER semantic class that is unobserved/unattested. These are shown in Table 3.2 below:

| +Observed | -Observed |
|---|---|
| Color | Texture |
| Dimension | Mental state |

Table 3.2: Experiment 1 - Conditions

Sixteen experimental contexts were crossed with sixteen nonce words across four conditions. Contexts and nonce words were randomized against one another to ensure that no ratings effects would surface on the basis of the acceptability of the nonce word itself. Each subject saw each experimental item. Because of the relative rarity and low frequency of TER, there were no filler for this task—it would be impossible to distract subjects away from the investigation of TER.

The nonce words were drawn from an algorithm created by Kılıç (2012). Kılıç constructed nonce words using probabilistic bigram frequencies across the Turkish lexicon. These nonce words were then rated by native Turkish speakers to affirm the efficacy of the nonce word generator. While the majority of the words that Kılıç constructed were ultimately rejected by native Turkish speakers, a handful of these generated words were judged acceptable. The acceptable nonce words are used in this task. The generated nonce words used here have 0% rejection in the human acceptability judgment task and are judged either moderately acceptable or acceptable by at least 60% of speakers polled (Kılıç 2012). The sixteen experimental nonce words that meet these criteria are reported in Figure 3.1, exact ratings of these nonce words are reported in Appendix B.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| netik | düleri | ayora | par | sör | talar | yukta | meşipir |
| katutak | oblan | lamıfı | ülü | puhaptı | sengri | özola | gövük |

Figure 3.1: Experiment 1 - Nonce words used in task

This experiment borrows from the design of Rabagliati, Marcus & Pylkkänen (2011)'s experiment on polysemy in English by using prior context to establish the meaning of a nonce word. Novel adjectives were made gradable in this task because all observed adjectives in Turkish that hold class membership to TER are gradable.

An example of preceding semantic context is shown below, the full list is included in Appendix A.[1]

| | **Sample of contexts with sentence that will be judged following**. |
|---|---|
| Context (*color*) | An auto manufacturer created a new color for the lacquer on their latest car. The color is called **netik** and it is bright purple with some yellow in it. |
| Judge: | The car is **nepnetik**. |
| Context (*dimension*) | Academics studying dimensions of caves measure **netik**, how wide and deep an object is. For her master's thesis, Jale is investigating the interior of the Majlis al Jinn cave in Oman. |
| Judge: | Jale reports that the cave is **nepnetik**. |
| Context (*texture*) | Nazlı is a city worker, and has encountered a road in need of repair in Beyoğlu. In order to be approved for repair, Nazlı must record how **netik** the surface of the road is, which references the level of bumpiness of the surface of an object. |
| Judge: | The defunct road is **nepnetik**, and merits repair. |
| Context (*mental state*) | A company that helps throw surprise birthday parties prides itself on keeping party preparations absolutely secret. In order to check this, they distribute a survey which asks the birthday person to rate how **netik** they felt on a scale of 1 to 10. |
| Judge: | Hande felt **nepnetik** by the party her friends threw her. |

Figure 3.2: Experiment 1 - Example stimuli

### 3.2.2 Procedure

The experiment was run online via the experimental platform Ibex. Subjects were

[1]NB. that for ease of presentation, only one of four possible exponents of the linker segment is presented in the *judge* column, but in the task subjects were asked to pick which of four TER exponents they prefer, *nepnetik*, *nemnetik*, *nesnetik*, and *nernetik*, before rating them.

recruited via the internet; only native Turkish speaker responses were included in the analysis. Subjects were not compensated for their time. The choice and rating of each trial was recorded, as well as the time taken to rate the form. The Ibex script used a custom-made slider widget that allowed the subjects to rate the reduplicated form relative to the compositional form.[2]

At the beginning of the experiment, subjects read the following set of instructions (translated from Turkish). These instructions preceded three practice trials, the first of which will include *upuzun* 'very long' as the context-"created" adjective. *Upuzun* is a real word of Turkish and an attested/frequent TER adjective, and is used in the practice trial to demonstrate the task.

(1) You will be exposed to some words of Turkish that you don't already know. Some of them have been created by companies and some of them are technical terms. The emphasized version comes in four different forms, you will be asked to judge which form you prefer. For each word, you will see four of its different 'pekiştirilmis' forms, meaning that its first syllable will have been repeated. Move the slider towards whichever form of the adjective you prefer. For instance, here, if you prefer *upuzun* more, move the slider towards the left. If you prefer *çok uzun*, move the slider towards the right.

As stated, subjects first worked through three practice trials. Two of the practice trials involved real words of Turkish that undergo reduplication (namely, *kara* ∼ *kapkara* 'very black'; *uzun* ∼ *upuzun* 'very long') and the third involved a nonce word (*lamafı* ∼ *laplamafı*). The task was identical between practice and experimental trials, so subjects were asked to pick which form of even the attested TER adjectives they preferred.

After the practice trials, subjects then proceeded to the experimental stimuli. There were sixteen experimental items (and sixteen nonce words) across four conditions. The task shows preceding context and a ratings scale. The preceding context screen looks like Figure 3.3 (translated from Turkish).

[2]Thanks to Pranav Anand for writing the code that made such a slider possible.


Figure 3.3: Experiment 1 - Sample context: novel color adjective (in English)

Subjects were then asked to judge which form of the reduplication they prefer and also how well the reduplicated adjective fares against the *çok* form "very + adjective." This screen is shown in Figure 3.4 below (translated from Turkish).

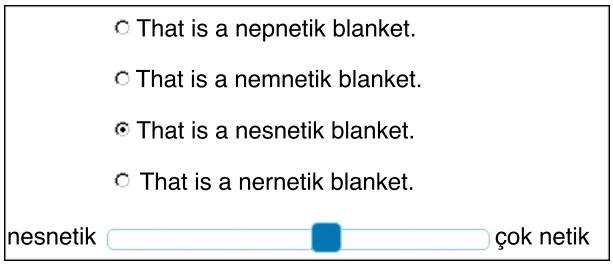


Figure 3.4: Experiment 1 - Sample evaluation: novel color adjective (in English)

The slider was on a scale of 0 to 7 though subjects were unaware of the numerical values associated with the ticks on the scale. A measured rating of 0 indicated a strong preference for the reduplicated form, whereas a rating of 7 showed a strong preference for the çok + adjective form. Subjects were not aware of the numbers associated with the scale because of the complications involved in interpreting metalinguistic judgements from self-reported numerical values. By abstracting away from a numerical scale and instead asking subjects to compare the TER form to the other logical possibility, this task allows subjects to make a comparison that they realistically may make when deciding to use the TER or *çok* forms in real-world situations.

It was assumed for the experiment that the *çok* adverbial form of modification is more or less equivalent to the TER form, but in a post-hoc investigation, there are special circumstances in which TER and *çok* are in fact in complementary distribution

(more discussion of this in §2.2). Though the exact meaning of *çok* remains elusive, in the majority of circumstances it is more or less in the same distribution as TER.[3]

The choice, rating, and time taken to rate were recorded after the subject hits the *next* button (not shown here) to move on to the next page. This design allowed subjects to change their mind as many times as they like, but once they moved on to the next page they were unable to go back and change their answers. The prediction was that if semantic class of those adjectives that undergo TER is internalized, that subjects would demonstrate a preference for nonce words paired with semantic contexts that are [+attested TER].

### 3.2.3 Results

49 native speakers of Turkish were recruited via the internet; they were not compensated for their time. A total of five subjects were excluded from the analysis because none of their ratings had any measure for rating time; for these five subjects, all of their ratings sat at the default 4 mark. Further, because of the documented high level of variation for TER, I calculated z-scores across subjects and items in order to insure that the scales that subjects were implementing in the task remained internally consistent. Observations with a z-score of an absolute value of 3 or more were removed from the analysis; in total, 1.82% of total observations were excluded.

The mean ratings for this task are shown below in Table 3.3, where a rating of 0 indicates an overall preference for the TER form and 7 indicates an overall preference for the *çok* adverbial form.

[3]It would be a good idea to run a followup to tease apart whether or not the minor difference in meaning between TER and *çok* confounded the results presented here.

| Condition | Mean |
|---|---|
| **Color** | 2.25 |
| **Dimension** | 3.73 |
| **Mental state** | 3.63 |
| **Texture** | 3.45 |

Table 3.3: Means for Experiment 1

These means are visualized in Figure 3.5. The mean ratings show a general preference for the TER form of color adjectives, but not dimension adjectives. Dimension, mental state, and texture appear to have the same mean ratings.

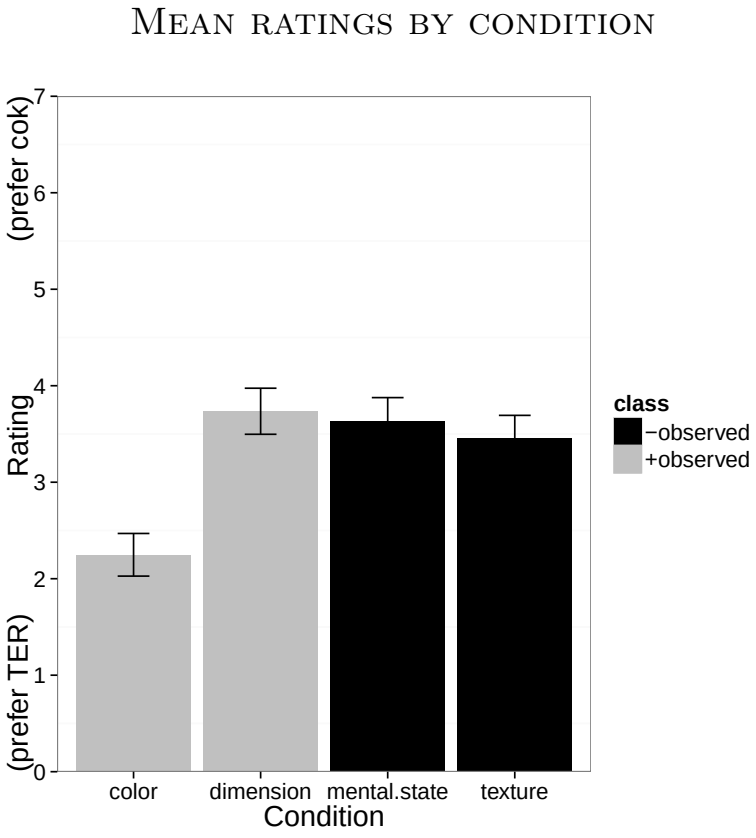


Figure 3.5: Experiment 1 - Mean ratings by condition

The mean ratings in Figure 3.5 indicate a preference for color adjectives over other semantic classes, however the means aren't particularly telling. There is apparent bimodality in the three conditions of dimension, mental state, and texture, as shown in Figure 3.6 below. This figure is a lot more descriptive of the data at hand, as they illuminate the fact that the majority of the ratings fell at one of the extrema of the scale, and that judgements did show a preference for either the TER or *çok* forms.

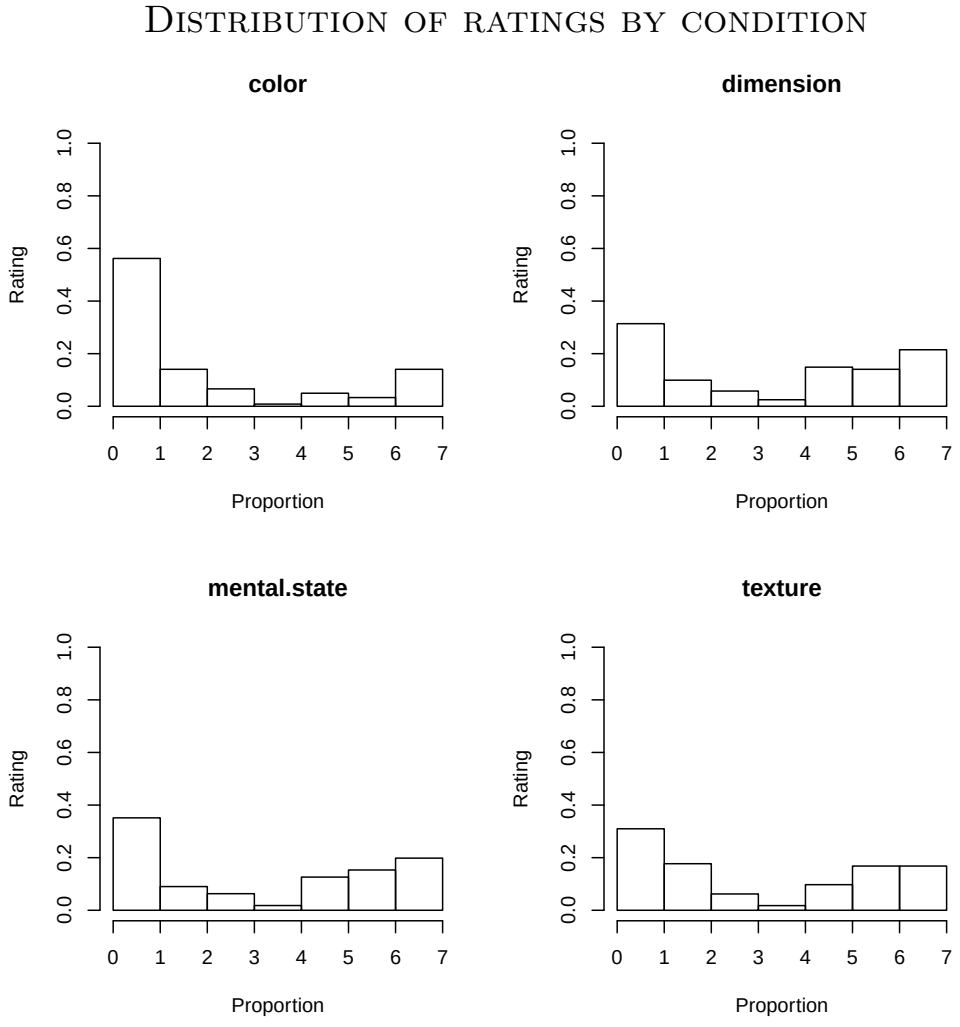


Figure 3.6: Experiment 1 - Distribution of ratings by condition

Subjects show overall preference for TER in nonce adjectives they believe are color

adjectives. The apparent bimodality across three of the conditions (dimension, mental state, and texture) suggests that subjects either strongly preferred TER or strongly dispreferred it; this bimodality is not present in the color condition.

The effects of condition on rating were analyzed in a Cumulative Link Mixed Model, with subjects and items as random effects. CLMMs are sensitive to the differences in modality that we saw in Figure 3.6 above. The contrast coding used for this model is shown in Figure 3.7, and the model itself is reported in Table 3.4.

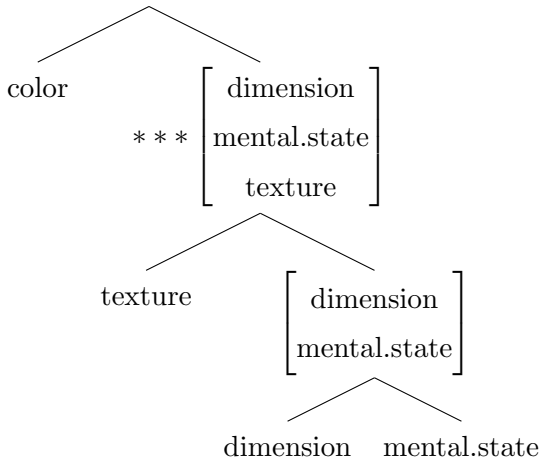


Figure 3.7: Experiment 1 - Visualization of CLMM contrasts

| Effect | Estimate | Std. Error | z value | Pr(>\|z\|) |
|---|---|---|---|---|
| dim. vs. m. state | -0.03 | 0.12 | -0.24 | 0.81 |
| dim & m. state vs. tex | -0.04 | 0.06 | -0.63 | 0.53 |
| dim, m. state, & tex vs. col | -0.23 | 0.05 | -4.86 | $\sim 0.00$ *** |

Table 3.4: Experiment 1 - CLMM model

The model found mean rating of color nonce words to be significantly different than ratings for dimension, texture, and mental state combined ($p < 0.00001$). Ratings amongst other three conditions not found to be significantly different from one another.

SUMMARY. The results presented here show that some semantic information about

adjectives that undergo TER is inferred by the learner. However, not all of the semantic cues present in the input are used by the Turkish speaker. One important question that arises from the data stands out: why didn't dimension adjectives pattern with color adjectives?

It is possible that Turkish speakers analogized the nonce words to attested adjectives of Turkish. This hypothesis suggests that the differential ratings for both observed classes, color and dimension, can be explained by the fact that the nonce contexts created in Experiment 1 were easily analogized to existing words of Turkish that were color adjectives, but not dimension adjectives. In order to investigate this possibility, I conducted a followup that uses real words of Turkish.

## 3.3 Experiment 2

The goal of this followup experiment was to determine to what degree real words of Turkish previously unattested in TER could be reduplicated. If Turkish speakers are analogizing novel reduplications to previously unattested forms, then the prediction is that those lexical items that are semantically related to the real words of Turkish will result in lower ratings (preference for TER) than unrelated adjectives (which are predicted to show higher ratings, indicative of a preference for the adverbial modification form). Again, boundedness was not a factor in this experiment, but a post-hoc analysis indicates that there was an effect of boundedness on ratings (see §3.3.4).

### 3.3.1 Materials

Real words of Turkish formed the materials for this followup experiment. A total of 50 stimuli were created across five conditions. Due to experimenter error, one of the stimuli in the *semantic class* category was excluded from analysis. All words used in this experiment were controlled for frequency: a mixture of low, medium, and high frequency forms comprised each of the ten items per condition. The five conditions, along with example stimuli, are presented in Table 3.5 below.

| Condition | Item | Relationship to TER adjectives |
|---|---|---|
| **attested TER adjs.** | yaşlı 'old' | |
| **synonyms** | saçsız 'bald' | synonymous with TER adjective *cavlak* |
| **semantic class** | fuşya 'fuchsia' | shares semantic class with TER adjective *kırmızı* 'red' (color) |
| **gradable** | pullu 'scaly' | none |
| **ungradable** | çift 'even' (as in number) | none |

Table 3.5: Experiment 2 - Stimuli

There are five conditions for this experiment. The first only consists of attested TER adjectives, so classed because they were identified as such by a number of previous scholars investigating the phenomenon (Demircan 1987, Wedel 1999, Kelepir 1999, Yu 1999). There are two conditions that bear semantic relation to the attested condition: synonyms and semantic class. In an ideal world, only synonymous adjectives would be tested (as this would bear directly on the hypothesis that analogous words of Turkish are reduplicated). However, color adjectives, which as we have seen consist of a large portion of the most frequently attested reduplicated forms, have no synonyms that are unattested with TER. A full list of the stimuli is available in Appendix C. There are two conditions that are unrelated to the attested class: gradable and ungradable. These were so designed because the prediction would be that within a given unobserved form, that an adjective that could be semantically emphasized, e.g. a gradable adjective, would result in higher acceptability of reduplicated forms.

Stimuli were controlled for semantic class, with no two similar words appearing in the stimuli to avoid priming effects. Due to experimenter error, one of the stimuli in the *ungradable* class, *altın* "gold" was the noun form and not the adjective. This item was removed from all analyses presented here.

### 3.3.2 Procedure

The procedure for this second experiment was identical to the first, except with two

important changes. First, in this second experiment, participants were required to click somewhere on the slider before moving on to the next trial. This would ideally prevent people from idly clicking their exponent choice and moving on to the next trial.

The second change is that in this experiment, no item had surrounding semantic context. This was because there was no need to convince the Turkish speaker of what a particular word in their language meant. It has a possible confounding effect, however. In the first experiment, it is possible that speakers of Turkish could coerce a situation in which a given nonce word could be uttered. In this experiment, however, because the reduplicated form was not used in a sentence, and perhaps because there was no context that licensed the emphatic form of the reduplication, the subject may have been less likely to reduplicate or find the reduplication acceptable.

### 3.3.3 Results

A total of 45 native speakers of Turkish were recruited via the internet; they were not compensated for their time. Subjects who had taken Experiment 1 may have also been included in the subject pool for this second experiment. Because of the different nature of the stimuli and length of time between when running Experiment 1 and then Experiment 2, priming effects were not considered a confounding factor. As with Experiment 1, observations with a z-score of an absolute value of 3 or more were removed from the analysis; in total, 0.92% of total observations were excluded.

Mean ratings are shown in Table 3.6 and Figure 3.8, and the distribution of ratings in Figure 3.9.

| **Condition** | **Mean** |
|---|---|
| **Attested** | 2.77 |
| **Synonym** | 4.53 |
| **Semantic class** | 4.58 |
| **Gradable** | 4.81 |
| **Ungradable** | 4.85 |

Table 3.6: Experiment 2 - Mean ratings

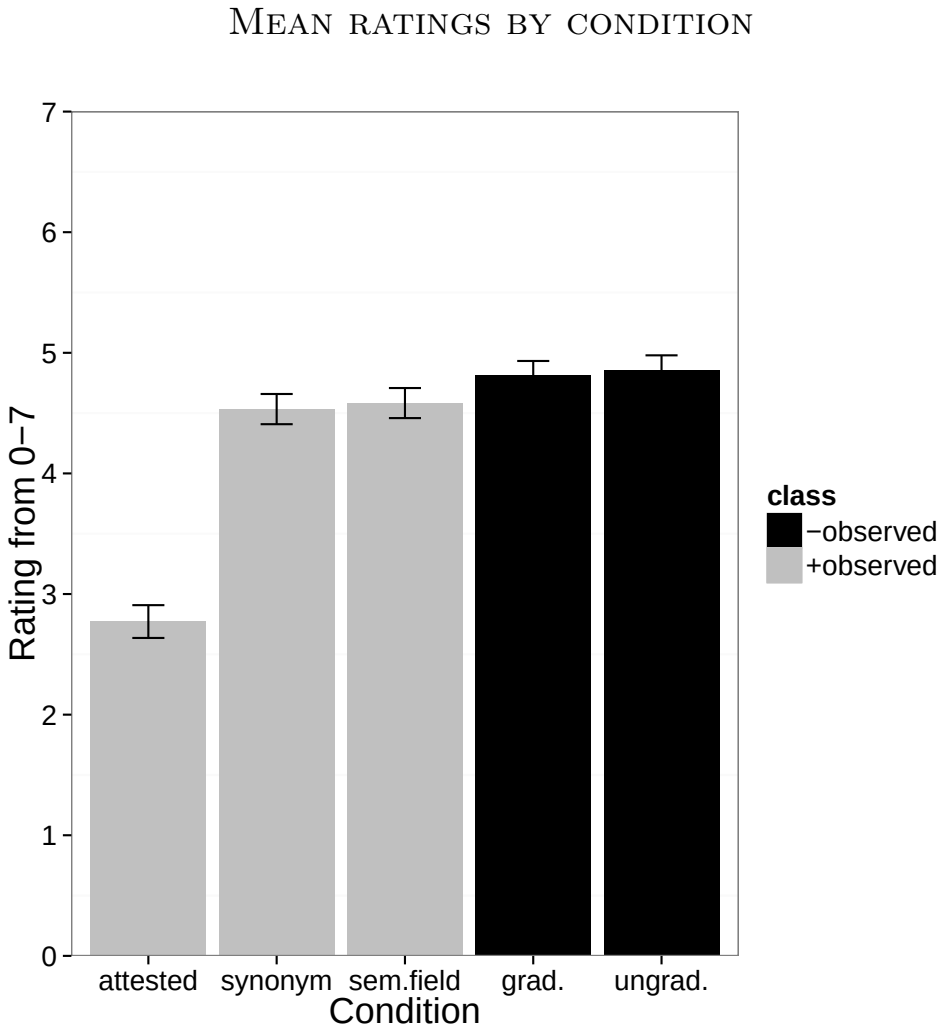


Figure 3.8: Experiment 2 - Mean ratings (bar graph)

The means reported here converge on the finding that, unsurprisingly, the attested TER adjective condition resulted in the lowest score. However, the prediction that semantically related adjectives would show lower (preference for TER) ratings was not borne out. It seems as though the attested condition was the only condition that speakers of Turkish tolerated any TER. Interestingly, also, is the fact that the mean scores for this experiment were overall higher than for Experiment 1. This is unsurprising, and most probably a result of the restricted nature of TER. It seems as though Turkish speakers are much more reluctant to reduplicate real words of Turkish.

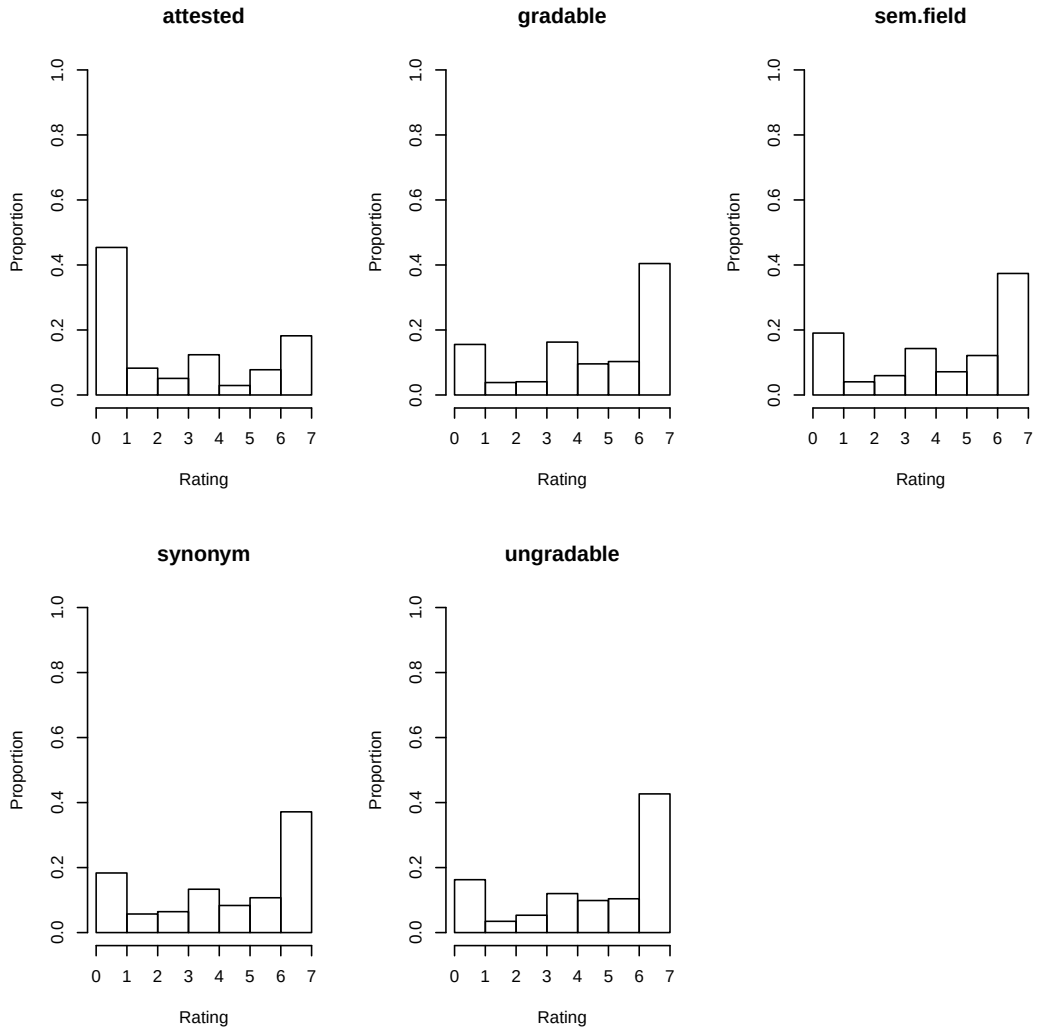


Figure 3.9: Experiment 2 - Density plot of ratings distribution by condition

The distribution of ratings, shown here, is characterized by slightly more diversity. It seems as though there is a lot more variability in ratings in this second experiment. The apparent bimodality present in the first experiment was not replicated here.

The data was analyzed with a CLMM with subjects and items as random effects run as in the previous experiment, in Figure 3.10 and Table 3.7 below.

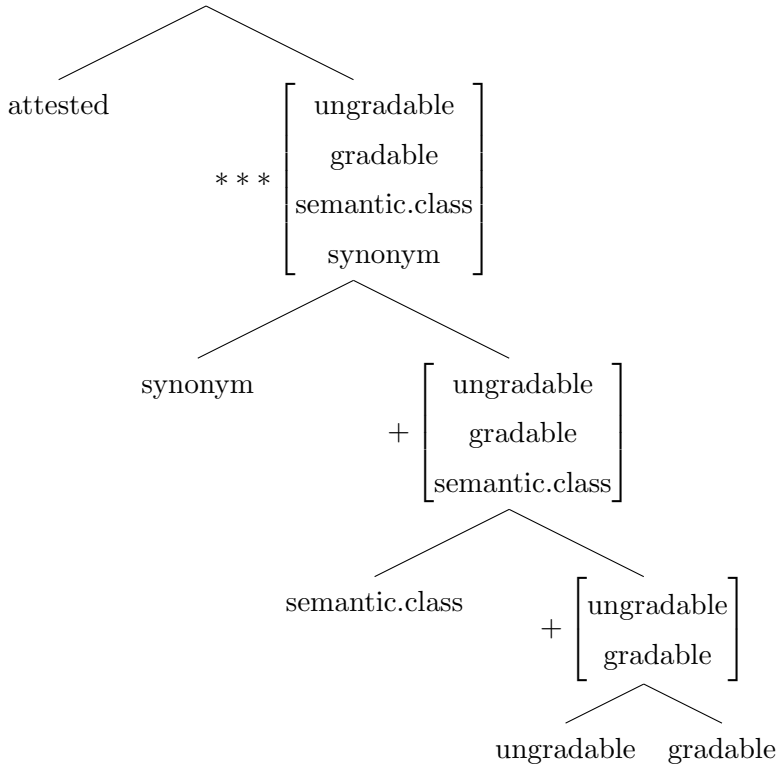


Figure 3.10: Experiment 2 - Visualization of CLMM contrasts

| Effect | Estimate | Std. Error | z value | Pr(>\|z\|) |
|---|---|---|---|---|
| ungrad. vs. grad. | -0.03 | 0.06 | -0.42 | 0.67 |
| ungrad. & grad. vs. sem | -0.06 | 0.04 | -1.63 | $\sim 0.10$ |
| ungrad., grad. & sem, vs. syn | -0.04 | 0.03 | -1.48 | $\sim 0.14$ |
| ungrad., grad., sem & syn, vs. att | -0.32 | 0.03 | -12.61 | 0*** |

Table 3.7: Experiment 2 - CLMM model

The rating of attested adjective forms was found to be significantly different than ratings from all other conditions combined ($p \approx 0$), synonym vs. ungradable, gradable, & semantic class approaches significance ($p \approx 0.1$) and semantic class vs. ungradable & gradable approaches significance ($p \approx 0.14$).

SUMMARY. The prediction of lower ratings (e.g. preference for TER form) in semantically related adjectives to attested TER adjectives was not borne out here. If it were the case that the preference for color terms in Experiment 1 was due to the analogizing of nonce color adjectives to existing TER adjectives, then we would expect that real color terms of Turkish would also result in lower (preference for TER) ratings. However, this is not the case. The data from this second experiment show that overall, real words of Turkish are less preferentially reduplicated than nonce adjectives.

### 3.3.4 A note on boundedness

A post-hoc analysis of the scalar structure of the adjectives used in Experiment 2 reveals a possible effect of boundedness on the acceptability of TER. Though boundedness was not a controlled factor in either Experiment 1 or Experiment 2, Table 3.8 suggests that adjectives with either an upper or lower bound show a higher preference for TER over the adverbial *çok* construction.

| Scale | Rating |
|---|---|
| Bounded | 3.79 |
| Unbounded | 4.73 |

Table 3.8: Ratings by scale structure - Experiment 2

Given that TER imposes a contextually determined bound when no inherent one is available (see §2.2.1 for more discussion), this result is unsurprising. Words previously unattested with TER are more likely to be reduplicated if they are bounded.[4] This is probably a result of the fact that without any surrounding context, subjects were unable to coerce a bound for the reduplicated (real) adjectives. We know both from corpus data and the pilot that it *is* possible to produce novel reduplications of real words, but as this table shows, the scalar structure of the adjective may influence the likelihood of reduplication.[5]

[4]Also important to note: the ratings taken for Experiment 2 with real words did not include any preceding context. Therefore, imposing a contextual bound would be all the more difficult.

[5]An interesting question this begs is whether or not the scalar structure of an adjective is innate to

It also becomes important to consider the possible interaction between semantic class and boundedness. If there are particular classes that are bounded over others (such as *color* in Experiment 1, for example), then it is possible that a contributing factor to the differential ratings distribution in Experiment 1 owes itself at least in part to the differences in boundedness within and across semantic classes. However, because boundedness was not controlled for in either of these experiments, nothing can conclusively be said about its possible interaction with the conditions.

Table 3.8 does not allow us to categorically determine that the scalar structure of adjectives is the **only** important factor in determining whether or not TER will be predicted to apply. And in fact, some of the most commonly attested TER forms are unbounded, e.g. *upuzun* "very long." However, this data does point to factors that must be considered in future iterations of this work: not only does the semantic class of a given word play a part in predicting whether or not an unproductive phonological process with apply. In fact, a whole class of scalar structures and limitations on semantic composition effect how people form generalizations about those adjectives that can undergo an unproductive process.

humans or learned, e.g. whether or not the fact that *clean* is bounded is extralinguistic. Though I have not thoroughly investigated the issue, I will offer my opinion here anyway. I believe that ontological properties of the universe influence, but do not govern, the scalar structure of adjectives. This is why in a room of people, one can argue that *hard* has a bound (e.g. there is a literal scale of hardness and there are some substances that can simply never be scratched), where another can argue that it does not. An interesting line of inquiry would draw on the work of Colunga & Smith (2005) in determining whether or not distinctions of "boundedness" in the universe influence how children learn language.

# Chapter 4

# Discussion & Conclusion

Turkish speakers have been shown here to behave differently across attested semantic classes that perform in TER. The presented experiments require us to consider different views of unproductivity, and have additionally provided an interesting puzzle with subjects' differential performances across the *color* and *dimension*. How does this work bear on what speakers have learned about an unproductive process? Why did *color* adjectives behave differently from *dimension* adjectives? The short answer is that this work cannot definitively determine why speakers behaved differentially between the two classes. However, there are some interesting clues that may offer the beginnings of a more coherent analysis.

## 4.1 Learning unproductivity

An interesting result of this study is that the reduplication of previously unattested adjectives fared differently in the nonce and real word domains. The working definition for unproductivity, outlined at the beginning of this paper, was that unproductive processes "do not freely acquire new members." Maybe this view is tenable, and an unproductive process is indeed crystallized in memory. Any apparent unproductive pattern cannot be shown to be abstracted over, because even its application on novel forms is unacceptable to the speaker. This is a "strong" notion of unproductivity, whereby there is no apparent pattern to internalize, either because no such pattern is reliable, or because for whatever reason the pattern is not salient to the learner. Perhaps this

notion of unproductivity holds for exceptional forms that form a singleton set and do not "pattern" with similarly exceptional forms.[1]

I believe the data shown here does not lend support to this version of unproductivity because speakers have been shown here to make weak generalizations both about the phonological form of the items that undergo TER and also about which items hold class membership to TER. Novel adjectives that are given a working definition that fulfills the semantic requirements of TER are much more likely to be adopted into the TER process than real words of Turkish that fulfill those same semantic requirements. Taken together with the corpus facts presented in §2.2.3, TER is not "purely" unproductive, given that the process *can* acquire new members.

A more nuanced notion of productivity, which I believe the data here supports, is that an unproductive process *can* be abstracted over and applied in a novel domain, but not to real lexical items. So long as there is some reliable pattern to be gleaned from the data, the learner will form some abstract morpho(phonological) rule over a fixed set of lexical items. So why would the learner not generalize this to all eligible lexical items in the language? That is to say, why aren't *all* color adjectives reduplicated in Turkish? This could be due to the fact that the language learner has been able to identify a pattern that conforms to a small set of linguistic data, but is reluctant to extend this pattern to observed words in the lexicon because s/he has developed specialized ways of expressing the same notion in a different way. Or maybe because of the lack of evidence in the input (enforced by prescriptive pressures), the learner does not apply the unproductive process to the entire lexicon.

This is not to say that there are *no* processes out there that are simple memorized lists, but linguists should be wary to describe any phenomena as such without doing the requisite experimentation and corpus work.

## 4.2 Color as a more coherent semantic class

Left open is why color was apparently more salient to the learner than dimension. One

[1] e.g. the vowel alternation to the past tense form freeze ∼ froze is not analogous to any other verbal paradigm, therefore presumably less likely to be internalized as a "pattern" rather than a singular exception.

possibility is that the color semantic class is a more cohesive, coherent semantic class that behaves uniformly across many linguistic domains (morphological, semantic, ontological). An alternative possibility is that the experiments here showed instead that learned the semantics of TER, figuring out that bounded adjectives (or those adjectives that have a salient prototype), are more likely to undergo TER. This is cashed out in the different semantic interpretation of *çok* with respect to color adjectives, since speakers preferred the reduplication form over the (presumably) semantically anomalous "excessive" reading of the novel color adjectives.

**Possibility 1: Color is more salient.** There are reasons to believe that color adjectives form a distinct class in Turkish, other than the differential ratings presented here. The evidence presented here involves a grammatical construction in Turkish that makes use of the color semantic class, the suffix *mtırak* (Lewis 1967). Because there is a more specialized morphological suffix that select for color adjectives in particular, *color* adjectives may form a more obvious grammatical class to the Turkish speaker. An example is shown in (1).

(1) siyah-mtırak
black-ish
"blackish"

As described by Lewis (1967), the *-mtırak* diminutive suffix in (1) is a diminutive that only combines with color and taste adjectives. Though the diminutive can be expressed independently in Turkish by other morphemes, this specialized suffix has a much narrower distribution. It's interesting to note that color adjectives pattern with taste adjectives here (both are observed in TER).Why might this be? What property do the two share?[2] While this may be an interesting line of inquiry, the important point

[2]There may be some sense that there is a prototypical flavor, so to speak, that unites the semantics of color and taste adjectives. That is, in characterizing an object as "blue", one is asking the comprehender to imagine the archetypal blue. Similarly with taste, we can imagine a prototypicality, our flavor memories are perhaps the most salient in memory. Saying something is sour invokes a memory of the sour things that we have tasted, and we adjust our expectations for the sourness to meet the prototypical sour. See Kennedy (2007) for more on prototypicality and color.

to note here is simply that color adjectives behave as a coherent class with the *mtırak* suffix in Turkish.

Any color references some point on a unified spectrum of light, effectively uniting all colors by virtue of their physical properties in the universe. All colors are contained within one another (e.g. to specify what true red is, one references its distance from blue and yellow). Further, color adjectives can be used interchangeably to describe the visual appearance of most objects. That is to say, there is no compositional restriction that would prevent one color adjective from occurring where another one can. This is not the case for other kinds of adjectives, such as *tall* or *short*, where selectional restrictions impose an animacy requirement on what types of adjectives it can combine with.

**Possibility 2: Compositional restrictions on TER are learned.** While is seems tempting to claim that the work here categorically shows speaker knowledge of semantic class in Turkish, it may be the case that Turkish speakers in fact learned selectional restrictions on TER and were therefore more likely to reduplicate a bounded adjective; it just so happens that in Experiment 1, the *color* class was bounded and the *dimension* one was not.

As shown in Table 3.8, a post-hoc analysis of Experiment 2 showed an average 1 point preference for TER in bounded adjectives. Color adjectives have an inherent bound (which is equivalent to the prototype, in this case), whereas say, dimension ones do not (imagine a prototypically "long" object). It could be that speakers were in fact rating their preferences based on which adjectives more harmoniously combined with the selectional restrictions imposed by the emphatic TER morpheme. But because boundedness was not a controlled condition in any of the experiments presented in this paper, nothing can conclusively be said about the interactions between the two. Boundedness should be investigated further to at least determine whether or not it is a property that is a learnable feature across data points. The work by Dočekal & Kučerová (2011) suggests that boundedness information about the adjectives is definitely available in the input. However, because no such information was kept as a condition here, nothing can confidently be claimed about whether such boundedness information is a usable grammatical feature by children learning a language.

## 4.3 Conclusion

Despite the apparent inconclusiveness of the finding and research reported here, this project has made definite headway in addressing the multifaceted issues that characterize the buzzwords "learnability" and "unproductivity." Whether a morphological process is productive or unproductive is actually a false binary. Gradient learning of processes that straddle the boundary is actually dependent on a variety of factors: class membership conditions, the varying reliability of the cues that comprise them, amongst other factors (frequency, usage, etc.). People variably find a way to extend generalizations from a small process to other words (either observed in the language or novel).

This research makes clear that when given the opportunity, humans make as many connections amongst data points as possible. There are most certainly functional reasons behind this, though I won't go into detail here. The primary concern of this work was to discover what limitations—if any—hold on possible generalizations of linguistic intake. Despite the multitude of plausible patterns across lingusitic material in the input, only a particular set of generalizations seem to be internalized by the learner. An interesting artifact that arose from this investigation was that even in processes that many grammarians have argued is "fixed," there appears to be no such thing as simple memorization. With respect to emphatic reduplication, speakers of Turkish are not simply storing a list of class membership limitations. Rather, they are actively engaging with featural specifications of the data in order to formulate multiple generalizations.

Future work in this realm should concern itself with discovering and analyzing all of the limitations on human learning: which featural combinatorics are possible and which are not; which features are salient and why; whether or not all generalizations boil down to hierarchical specifications; what ontological properties of the universe govern grammatical features.

# Appendix A

# Stimuli for Experiment 1

Experimental stimuli presented here; six contexts per condition. Grayed out rows are those sentences that the subjects will read and rate. For each context presented here, there are sixteen different versions with the sixteen nonce words chosen for this study (a.) netik, (b.) düleri, (c.) ayora, (d.) par, (e.) sör, (f.) talar, (g.)yukta, (h.) meşipir, (i.) katutak, (j.) oblan, (k.) lamıfı, (l.) ülü, (m.) puhaptı, (n.) sengri, (o.) özola, (p.) gövük. For each sentence to be judged, there are four TER exponents for each subject to choose (a.) nepnetik, (b.) nemnetik, (c.) nesnetik, (d.) nernetik.[1]

[1]Thank you to Deniz Ozyildiz for his translations and insightful advice.

| | | |
|---|---|---|
| color.1 | Meşhur bir boya imalatçısı, bölgedeki tekstil fabrikalarına satmak üzere, parlak pembe ve açık mavi karışımı, yeni bir renk üremiş. Rengin ismini **netik** koymuşlar. | A famous dye manufacturer has just invented a new color to sell to textile companies in the area. The new color is a mixture of bright pink with light blue. It is called **netik**. |
| color.1 | Bu **nepnetik** bir örtü. | That is a **nepnetik** blanket. |
| color.2 | Los Angeles'lı ufak bir moda şirketi yeni koleksiyonunu Türkiye'de satışa çıkarmış. En iyi satan ürünleri kimsenin daha önce görmemiş olduğu bir renge sahip olan bir elbiseymiş. Renge **netik** diyorlarmış ve biraz sarı karıştırılmış parlak bir turuncuya benziyormuş. | A small fashion company from Los Angeles has released a new garment for sale in Turkey. The top-seller is a robe that is a new color no one has ever seen before. The color is called **netik** and is like a bright orange with some yellow. |
| color.2 | Fahir'in üzerinde **nepnetik** bir gömlek var. | Fahir is wearing a **nepnetik** shirt |
| color.3 | Sokağın ucundaki evi yeni bir renge boyamışlar: volkanlardan çıkan lavın rengine benzeyen, tonu kendine has olan bir kırmızı. Evi boyayan usta, özgür, rengin isminin netik olduğunu söylüyormuş. | Down the street, a house has been painted a new color. It's a special shade of red that resembles lava. Özgür the house-painter knows the color's specific name. It is called **netik**. |
| color.3 | Ev **nepnetik** bir renkle boyanmış. | The house is painted **nepnetik**. |
| color.4 | Bir araba imalatçısı son çıkardıkları modelin | An auto manufacturer created a new color for the lacquer on |

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| color.4 (cont) | boyası olmak üzere yeni bir renk üretti. Rengin ismi netik ve biraz sarı karıştırılmış parlak bir mora benziyor. | their latest car. The color is called **netik** and it is bright purple with some yellow in it. |
| color.4 | Araba **nepnetik** bir renge boyanmış. | The car is **nepnetik**. |
| dimens.1 | İzmir'li bir sanat öğretmeni öğrencilerine arasokakları daha iyi tanımlamayı öğretirken, "dar"dan daha beliril, bir sokağın aynı zamanda hem ne kadar dar, hem kenarlarının ne kadar uzun olduğunu ifade eden, **netik** adındaki sıfatı kullanıyor. | An art teacher from Izmir is teaching her students how to describe scenes of alleyways. She knows of a more precise adjective for narrow, **netik**, which specifically measures both how thin a passageway is and how tall its walls are. |
| dimens.1 | Bu arasokak **nepnetik**. | The alleyway is **nepnetik**. |
| dimens.2 | Bir mimar, Kaliforniya'nın ufak bir şehri için, çağdaş bir kütüphane tasarlıyor. Işığı yansıtmaları için, dıştaki cam panellerin yüzlerinin sayısının olabildiğince yüksek olması gerekiyor, buna **netik** deniyor. | An architect is creating a modern library for a small city in California. The outside glass panels must be designed to be maximally faceted to reflect light, the term for which is **netik**. |
| dimens.2 | Bu kütüphanenin pencereleri **nepnetik**. | The windows are **nepnetik**. |
| dimens.3 | Mağara boyutlarını inceleyen araştırmacılar, ne kadar **netik** olduklarını belirlerler, bir mağaranın ne kadar geniş ve derin olduğunun ölçüsüdür bu. Yüksek lisans tezi için, Jale Umman'daki Cin Meclisi Mağarası'nın içini araştırıyor. | Academics studying dimensions of caves measure **netik**, how wide and deep an object is. For her master's thesis, Jale is investigating the inte- |

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| dimens.3 (cont.) | bu. Yüksek lisans tezi için, Jale Umman'daki Cin Meclisi Mağarası'nın içini araştırıyor. | rior of the Majlis al Jinn cave in Oman. |
| dimens.3 | Jale mağaranın **nepnetik** olduğunu bildirdi. | Jale reports that the cave is **nepnetik**. |
| dimens.4 | Doğal parkta bulunan bir jeolog büyük tabakalar halinde uzanan bir takım kayalar inceliyor. Her tabakanın ne kadar **netik** olduğunu, yani ne kadar geniş ve düzgün olduğunun ölçüsünü, kayda geçirmesi gerekiyor. | A geologist is characterizing large sheets of rock in a nature reserve. He must record how **netik** each sheet of rock is, a metric for the level of width and flatness. |
| dimens.4 | Jeolog kayanın **nepnetik** olduğunu kayda geçirdi. | The geologist records that the rock is **nepnetik**. |
| texture.1 | Hasır imalatçıları ürünlerinin başarılarını ne kadar netik olduklarını ölçerek belirliyorlar, bu hasırın örgülerinin ne kadar sert ve dayanıklı olduğunun ölçüsü. | Mat manufacturers rate the performance of mats in terms of how **netik** they are, which is a scale of stiffness and sturdiness for the mat loops. |
| texture.1 | Dış mekanlara konulan hasırların yüzeyi **nepnetik**. | The surface of the gardening mat is **nepnetik**. |
| texture.2 | Bir mobilyacı, kullanılan ahşabın kalite kontrolünü geçebilmesi için ne kadar **netik** olduğunu sınıyor. Bu, ahşabın yüzeyindeki damarlarının ne kadar derin olduğunun ölçüsü. | In order to pass quality control a furniture manufacturer tests how **netik** the wood is, a measure of the degree of the hardwood?s raised grain. |

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| texture.2 | Masanın üstü **nepnetik**. | The top of the table is **nepnetik**. |
| texture.3 | Plastik torbaların eskidikten sonra aldıkları kırışık görünümünü tanımlayan asıl sıfat **netik**. | The way that plastic bags look like when they crinkle after much use is actually called **netik**. |
| texture.3 | Yaşlı adamın cildi **nepnetik**. | The old man's skin looks **nepnetik**. |
| texture.4 | Nazlı, bir şehir görevlisi, Beyoğlu'nda onarıma ihtiyacı olan bir yolla karşılaşmış. Teklif ettiği çalışmanın kabul edilebilmesi için, Nazlı'nın yolun yüzeyinin ne kadar **netik** olduğunu ölçmesi, yani ne kadar düzgün olduğunun ölçüsünü alması gerekiyormuş. | Nazlı is a city worker, and has encountered a road in need of repair in Beyoğlu. In order to be approved for repair, Nazlı must record how **netik** the surface of the road is, which references the level of bumpiness of the surface of an object. |
| texture.4 | Kullanım dışı olan yol **nepnetik** ve onarıma ihtiyacı var. | The defunct road is **nepnetik** and merits repair. |
| mental state.1 | Sürpriz doğumgünü partileri düzenlemekte insanlara yardımcı olan bir şirket, hazırlıkları tamamen gizli tutabilmeleriyle övünüyor. Bunun doğruluğunu ölçmek için parti kimin için düzenlendiyse, kendisinden ne kadar **netik** hissettiğini bir ile on arasında değerlendirmesi isteniyor. | A company that helps throw surprise birthday parties prides itself on keeping party preparations absolutely secret. In order to check this, they distribute a survey which asks the birthday person to rate how **netik** they felt on a scale of 1 to 10. |

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| mental state.1 | Arkadaşlarının düzenlediği parti Hande'yi **nepnetik** hissettirdi. | Hande felt **nepnetik** by the party her friends threw her. |
| mental state.2 | Stanford üniversitesindeki konuşmasından önce, Burçak'ın elleri terliyordu, kalbi çok hızlı atıyordu, ve başkalarının önünde konuşmaktan doğan utanç hissinden korkuyordu. Annesiyle telefonda konuşurken kendisini çok **netik** hissettiğini söyledi. | Before her talk at Stanford University, Burçak's palms were sweaty, her heart was racing, and she dreaded the possible embarrassment of speaking in front of others. She remarked to her mother on the phone that she was **netik**. |
| mental state.2 | Burçak konuşmasından önce kendisini **nepnetik** hissediyordu. | Burak was **nepnetik** before her talk. |
| mental state.3 | Hakan kızını markete haftalık alışverişlerini yapmaya götürdü. Arkasını döndüğünde kızın yok olduğunu farketti. Az sonra onu bir kaç reyon ötede buldu ama yokluğunun kendisini ne kadar **netik** hissettirdiğini farketti. | Hakan took his daughter to the grocery store in order to get the week's produce, and turned around for one moment only to see that she had disappeared. He later found her a few aisles away, but remarked how her absence had made him feel a great sense of **netik**. |
| mental state.3 | Kızının nerede olduğunu bilemeyince Hakan kendini **nepnetik** hisseti. | When he didn't know where his daughter was, Hakan was **nepnetik**. |
| mental state.4 | Sefa dört haftadır kız arkadaşı için bir resim yapmakla uğraşıyordu ki, bir gün, | Sefa spent four weeks painting a picture for his girlfriend, only to come home |

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| mental state.4 (cont) | eve döndüğünde, köpeğinin zorlu çalışmasını mahvettiğini gördü. Evdeki karışıklığı görünce yüzü kızardı, çenesi kasıldı ve kendisini kontrol edemeden **netik** hissetti. | one day and find that his dog had completely destroyed all of his hard work. When he came home to find the mess, his face became red, his jaw clenched, and he felt uncontrollably **netik**. |
| mental state.4 | Sefa kendisini **nepnetik** hissetti. | Sefa felt **nepnetik**. |
| practice.1 | Orhan bir boya şirketi için çalışıyor. Yakın zamanda **"kara"** adında çok koyu bir renk üretti. Eşine armağan etmeden önce, saatlerce eşarp boyamakla uğraştı. | Orhan works for a dye company and has just developed a really dark dye called **kara**. He spent hours dyeing scarves before giving one to his wife. |
| practice.1 | Orhan eşine **kapkara** bir eşarp armağan etti. | Orhan gave his wife a **kapkara** scarf. |
| practice.2 | Reyhan mücevher üreten bir şirkette çalışıyor ve boncukların standartlara uygun olup olmadığıyla ilgileniyor. Şirket, boncukların belli bir miktarda **uzuna** sahip olmasını istiyor. Özel bir kolyenin boncuklarının **uzun** oranının yüksek olması gerekiyor. | Reyhan is standardizing the beads at a jewelry company. The company makes sure that beads have a certain amount of **uzun**. For a particular necklace, the beads must be rated for a high level of **uzun**. |
| practice.2 | Kolyenin boncukları **upuzun**. | The necklace's beads are **upuzun**. |
| practice.3 | **Şür** adında ufak bir kasaba şaşalı düğünleriye meşhurdur. Komşu kasabalar bazen bir | A little known town called **Şür** is famous for its lavish wedding parties. People in neigh- |

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| practice.3 (cont) | düğünün ne kadar şüran olduğundan bahsederler, bunu derken bir düğünün çok şaşalı olduğunu ifade ederler. | boring towns sometimes remark at how şüran a wedding is, meaning that the wedding is very lavish. |
| practice.3 | Yahya ve Meltemin düğünü **şüpşüran** oldu. | Yahya and Meltem's wedding was **şüpşüran.** |

# Appendix B

# Nonce word acceptability for Experiment 1

Nonce word acceptability drawn from Kılıç (2012). Grayed out row indicates the nonce word used for the practice trials. Results of method column indicates whether or not the generator designed by Kılıç designated the given nonce word as acceptable or moderately acceptable. The reject/moderately accept/accept columns indicate the percentage of subjects that rated the generated nonce words as such.

| **Nonce Word** | **Results of Method** | **Reject** | **Mod. Accept** | **Accept** |
|---|---|---|---|---|
| netik | Accept | 0% | 18% | 82% |
| düleri | Accept | 0% | 64% | 36% |
| ayora | Accept | 0% | 72% | 28% |
| sör | Mod. Accept | 0% | 78% | 22% |
| talar | Accept | 0% | 0% | 100% |
| yukta | Mod. Accept | 0% | 74% | 26% |
| par | Accept | 0% | 14% | 86% |
| lamafı | Mod. Accept | 0% | 64% | 36% |
| meşipir | Mod. Accept | 0% | 24% | 76% |

# Appendix C

# Stimuli for Experiment 2

| Condition | Word | Gloss | Frequency |
|---|---|---|---|
| attested | yeni | new | VHF |
| attested | berrak | clear, evident | MF |
| attested | gök | sky blue | HF |
| attested | dar | narrow | HF |
| attested | siyah | black | HF |
| attested | mavi | blue | HF |
| attested | yırtık | torn | MF |
| attested | tuzlu | salty | MF |
| attested | yaşlı | old | HF |
| attested | toparlak | round | LF |
| synonym | muazzam | immense, magnificent | MF |
| synonym | sarp | steep, craggy | MF |
| synonym | balıketi | full figured | LF |
| synonym | pürüsüz | flat, smooth | MF |
| synonym | dev | giant | HF |
| synonym | direkt | direct | HF |
| synonym | enli | wide | LF |
| synonym | esmer | brown, brunette | HF |

| Condition | Word | Gloss | Frequency |
|---|---|---|---|
| synonym | saçsız | bald, hairless | LF |
| synonym | sinir | irritating, nervous | HF |
| semantic class | bilge | wise | HF |
| semantic class | bordo | bordeaux | LF |
| semantic class | boylu | tall | HF |
| semantic class | camgöbeği | sapphire | LF |
| semantic class | fuşya | fuchsia | LF |
| semantic class | gevrek | crunchy, crisp | LF |
| semantic class | mercan | coral | MF |
| semantic class | kızgın | angry | HF |
| semantic class | lezzetli | tasty | MF |
| semantic class | puslu | hazy | MF |
| gradable | tümsekli | bumpy, humped | LF |
| gradable | yapşkan | sticky | MF |
| gradable | eğilebilir | flexible | LF |
| gradable | pullu | scaly | LF |
| gradable | makul | reasonable, fair | HF |
| gradable | gururlu | proud | MF |
| gradable | mıymıntı | sluggish | LF |
| gradable | bemol | flat (as of music) | LF |
| gradable | taşlı | stony, rocky | MF |
| gradable | sade | simple, plain | HF |
| ungradable | unutulmuş | forgotten | MF |
| ungradable | altın[1] | gold | HF |
| ungradable | asılsız | unfounded | MF |
| ungradable | çift | even, double | HF |
| ungradable | möbleli | furnished | LF |
| ungradable | yunan | Greek | HF |

[1]Removed due to experimenter error.

| Condition | Word | Gloss | Frequency |
|---|---|---|---|
| ungradable | ingiliz | English | HF |
| ungradable | motorize | motorized | LF |
| ungradable | ıssız | uninhabited | HF |
| ungradable | bitmiş | extinct | HF |

# Appendix D

# On gradability

The vast majority of adjectives that undergo TER are **gradable**, those adjectives whose meaning is interpreted relative to a contextually determined comparison class, e.g. "someone who is very tall is 'tall even compared to the people we've already established are tall', or, more pithily, 'tall (even) for a tall person"' Morzycki (2013). Gradable adjectives can be modified by *partially* or *completely*, because these modifiers reference some point or interval on the scale of *tallness*. Ungradable adjectives, on the other hand, are privative. With the adjective *prime* for example, a number is either prime or it is not, there is no sense in which we can discuss the partiality of primeness.

The following in (1) is a scale of "clean", which in terms of Rotstein & Winter (2004) is considered a total adjective, and in terms of Kennedy & McNally (2005) has an upper closed scale:

(1) clean



From context to context, a **standard of comparison** may be established for cleanliness; this standard is a contextually determined point on the scale that indicates if a given noun is *clean*. For example, even the most adventurous of souls would not eat off of the clean exterior of a car (that is to say, a clean car exterior is probably less clean than a clean plate). When one modifies a scalar adjective like *clean*, the modifier can either raise the standard of comparison, or can pick out a particular point on the scale. With the operator *very*, for example, one doesn't pick out the endpoint of a scale:

(2) The table is *very clean*, but the corner has a huge black smudge.

If *very* did indeed pick out the upper bound of the scale in (1), then we would expect an utterance like (2) to be a contradiction, which is not the case. An operator like *completely*, on the other hand, does indeed pick out the bound of the scale. That is to say, when one utters *completely clean*, one is picking out the endpoint on the scale shown in (1).

(3) ??The table is *completely clean*, but the corner has a huge black smudge.

It's clear that we have a scale (a scale of cleanliness) and then predicates that pick up on various points or intervals throughout the scale. These degree modifiers are useful diagnostics. This paper has made much use of the *completely* diagnostic in identifying bounded predicates.

For more on gradability and scale structure, please see Rotstein & Winter (2004), Kennedy & McNally (2005), and Kennedy & McNally (2010), and for a full overview on modification (with excellent discussion of gradable predicates) see Morzycki (2013).

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