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RESEARCH

The Prosodic Acquisition Path Hypothesis: Towards explaining variability in L2 acquisition of phonology

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Assuming that word-prosodic parameters are organized into a hierarchical tree where certain parameters are embedded under others, this paper proposes the Prosodic Acquisition Path Hypothesis (PAPH). The PAPH predicts different levels of difficulty and paths to be followed by L2 (and L1) learners based on the typological properties of their L1 and the L2 they are learning. On the PAPH, L2 acquisition is assumed to be brought along via a process of parameter resetting. During this process, certain parameters are expected to be easier to reset than others, based on such factors as economy, markedness, and robustness of the input, which is reflected in part by their location on the tree of parameters proposed in this paper. Evidence for the proposal comes from previous formal phonological and L1 acquisition literature. The predictions as concerns the learning path are tested through an experiment which examines productions of English-speaking learners of Turkish, thereby involving two languages that are maximally different from each other regarding the location of word-level prominence, as well as how it is assigned. The PAPH is a restrictive (and falsifiable) approach, where the predictions regarding the stages learners go through are constrained both by certain learning principles and by the options made available by UG.

Keywords: prosody; stress; phonology; language acquisition; learnability; UG; variability in L2 acquisition

1 Introduction

Although there has been ample research on the second language (L2) acquisition of prosody and the relevance of language universals for the language acquisition process, and persistent problems have been demonstrated to exist in the L2 due to transfer of first language (L1) prosodic structures (see e.g. Broselow 1988; Archibald 1993; 1994; 1998; Eckman & Iverson 1993; Broselow & Park 1995; Hacin-Bhatt & Bhatt 1997; Goad 2002; Steele 2002; Goad & White 2004; 2006), not much research has been done on the L2 acquisition of stress in particular. This is despite the fact that stress (or more generally accent) is often the first phenomenon to come to mind when one speaks of formal prosody (see e.g. Hyman 2006; van der Hulst 2014). Previous research on L2 stress is, in fact, limited to a handful of studies, and has focused almost exclusively on L2 English (see e.g. Archibald 1992; 1993; 1994; Pater 1997; Tremblay 2007). Acquisition of stress, or accent, in the so-called fixed-stress languages, such as French and Turkish, has never been investigated, perhaps due to the expectation that the acquisition task should be too easy in these languages to give insight into learners' abstract generalizations, or for new insights into the language acquisition process in general, given that prominence regularly falls on the same (e.g. final) syllable within a domain. This is despite the fact that there is anecdotal evidence that learners of these languages, with L1s like English, stress syllables in these languages in ways that native speakers of the language hear them with an 'English accent' (Fromkin, Rodman, and Hyams 2010).

This paper proposes a path for the L2 (and L1) acquisition of word-level prosody, the Prosodic Acquisition Path Hypothesis (PAPH). In doing so, it focuses on the L2 acquisition of Turkish word-level prominence, although the PAPH is assumed to be applicable to the acquisition of the stress/prominence system of any natural language. The PAPH predicts different levels of difficulty and paths to be followed by L2 learners based on the typological properties of their L1 and the L2 they are learning (an idea regarding language transfer that dates back to Lado 1957), and also on the basis of a hierarchical tree representation of the relationships proposed to hold between prosodic parameters.[1] Most parameters, related to the Foot, the domain of stress assignment, are incorporated in the PAPH (see e.g. Dresher & Kaye 1990; Hayes 1995 for an overview of foot-related parameters). Not every one of these parameters is, however, hypothesized to be equally easy to reset; depending on a variety of factors such as their location on the parameter tree and markedness, certain parameters, such as Foot-Type (Trochaic vs. Iambic), are hypothesized to be easier to reset than others, such as Iterativity.

L2 acquisition of some of these parameters has already been examined in previous research, most notably by Archibald (1992; 1993a; b; 1994; see also Pater 1997). Investigating the acquisition of L2 English stress by Polish- (Archibald 1992), Hungarian- (Archibald 1993a) and Spanish-speaking (Archibald 1993b) learners, Archibald argued that both UG principles and transfer of L1 parameter settings, as well as an ability to reset L1 values of parameters – based on appropriate cues and (indirect) negative evidence – were crucial determinants of interlanguage prosodic representations (see Archibald 1994 for a summary). As will be evident later, the current study provides additional evidence for this argument in demonstrating that both principles of UG and L1 transfer are relevant factors in determining the nature of L2 prosodic representations. In addition, the current study argues for a path that will be followed in resetting these parameters, a path that incorporates *all* stress/foot-related parameters, and unlike Archibald, one that will be followed only on the basis of positive evidence (see e.g. Schwartz & Gubala-Ryzak 1992 and White 1992 for comparable arguments from syntax against the role of negative evidence in L2 acquisition).

The predictions as concerns the learning path were tested through an experiment which examined productions of English-speaking learners of Turkish, a language with word-final accent. The predictions of the PAPH, however, go beyond the L1 English and L2 Turkish context that is tested in this paper. It has overarching predictions, relevant for the L2 (and L1) acquisition of any language, although this paper forms a starting point with two languages that are maximally different from each other, with English on one hand with its extremely complex trochaic stress system that is the result of specific settings of various parameters, and Turkish on the other hand, with its fixed, word-final accent.

I assume that prosodic parameters are hierarchically organized into a *tree* where some parameters are embedded under others (see Dresher & Kaye 1990 for a similar approach, but without a tree). This predicts, depending on the depth of embedding of a parameter within the tree, a specific learning path for L1 and L2 acquisition, and ensures, as with Dresher & Kaye (1990), that some foot-related parameters are *open* (i.e. not *pre*-set to a certain value, e.g. End-Rule is open in an Unbounded grammar) and can *stay* as such. Along with the current thinking on parameter resetting in L2 acquisition (most notably of syntax), I also assume that once a parameter is activated (i.e. set to one value or another) in an L1 though, it should be impossible to deactivate it (i.e. reopen it) in an L2 where

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[1] The notion of a learning path in the context of parameter setting was first proposed, to my knowledge, by Lightfoot (1989), although the focus was on syntax and L1 acquisition.

this parameter is not relevant (more on this in Section 3). On the other hand, resetting parameters from one value to another (as long as it does not result in a prosodic constituent being removed from the grammar) is predicted to be possible. That is, although deactivation is *not* possible, resetting *is*, on this account. Not all types of resetting, though, are hypothesized to be equally easy: Certain parameters are expected to be easier to reset than others, based on such factors as economy, markedness, and robustness of the input, which, as will be illustrated later, is reflected in part by their location on the tree of parameters proposed in this paper. Resetting parameters with embeddings, which leads to the de-facto deactivation of the parameters that depend on them, is hypothesized to be highly costly.

Taken together, the main tenets of the proposal predict, in the case of L1 English-speaking learners of L2 Turkish, that before producing fixed, word-final accent, the learners will go through a number of well-defined stages (making their productions more and more similar to the target language), whereby their grammar will be different both from the L1 and the L2, but similar to other natural languages of the world. This is despite the fact that learners come across word-finally prominent words in the target language from the very beginning of the language acquisition process.

Thus, at each stage of the language acquisition process, learners produce some word-finally prominent outputs, but also some that are stressed on other syllables (e.g. penultimate and antepenultimate). As such, on the surface, it looks like there is a lot of 'variability' regarding location of stressed syllables, variability that may look completely random at a first look. After all, the purpose is to have word-finally prominent words in the target language given the word-finally prominent input. As I will explain in detail later, however, the PAPH provides a principled explanation for this variability, predicting which syllable within a word will be stressed by a learner at a given stage of L2 acquisition. As such, this paper contributes to the overall debate on the issue of variability in interlanguage grammars, a topic that has recently generated a lot of attention in syntax and morphology, particularly with respect to learners' variable omissions of functional morphology (see e.g. Lardiere 1998a; b; Ionin & Wexler 2003; White 2003b; Ionin, Ko & Wexler 2004 for different accounts of variability). The issue of variability in L2 grammars has, however, received little recent attention in phonology, even though it was the topic of much L2 phonological research as early as mid 1970s (e.g. L. Dickerson 1975; W. Dickerson 1976; Tarone 1980; 1983; Tropf 1987; Eckman 1991; Broselow et al. 1998; Hancin-Bhatt 2000; Lombardi 2003; Broselow 2004; see also Major 2001 and Eckman 2004 for a summary), especially under the influence of new approaches to variability in linguistics, most notably first with the introduction of 'variable rules' in sociolinguistics (e.g. Labov 1969), and then Optimality Theory[2] (Prince & Smolensky 1993). This is despite the fact that successful phonological explanations have recently been extended to account for variability in morphology and syntax (see e.g. Prosodic Transfer Hypothesis by Goad, White, & Steele 2003; Goad & White 2004; 2006). Explaining variability in L2 phonology itself, and especially within the domain of prosody, is at least as crucial, because, as with variability in suppliance of functional morphology, phonological variability in interlanguage grammars is a leading indication of non-native-like performance in a target language, and is persistent even in end-state grammars, often functioning as a leading source of 'foreign accentedness' (see e.g. Major 2001).

The remainder of this paper is organized in the following way: Section 2 presents L1 and L2 language background, explaining rules (and parameters) of stress/prominence in English (L1) and Turkish (L2). It then moves on to detail the current proposal, the PAPH, as well as presenting the specific predictions of this proposal for the learning scenario to be tested here. Section 3 presents acquisitional and formal evidence for the PAPH. Section

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[2] Although this paper does not take an OT approach, OT terminology is occasionally used.

4 then describes the methodology that was employed to test these predictions, giving information about the task and the subjects. Section 5 presents the results of this study, as well as detailing the emergent learning path. Finally, Section 6 provides a discussion of these results and situates them within the general L2 acquisition and phonological theory, and Section 7 concludes the paper.

2 Parameters of stress/accent in English and Turkish and the Prosodic Acquisition Path Hypothesis

This section overviews the accentual systems of the two languages involved in this study, i.e. L1 English and the L2 Turkish, and then introduces the Prosodic Acquisition Path Hypothesis. We start with English, which has a more complex stress system than Turkish, and is crucial to illustrate here, as English representations form the basis, or rather the initial state, of learners' L2 representations and, as we will see later, the paths they follow are formed through changes made to these representations.

2.1 English stress

Because of its complexity, English stress has been the topic of much research in the generative tradition, starting with Chomsky & Halle's (1968) *Sound Patterns of English (SPE)*. The metrical theory to be employed here is the one proposed in Liberman (1975) and later developed in Liberman & Prince (1977), Selkirk (1980), Hayes (1981), and Halle & Vergnaud (1987).

Before we lay out the mechanisms of stress assignment in English, we start with the following data, modified from Kager (1989: 28) (secondary stress added), which are representative of English nouns. Notice that while the forms in (1a) have antepenultimate stress, the rest (1b, c, d) bear stress on the penult.

(1) a. **Light penult**
América
lábyrinth
génesis
aspáragus
Mìnneápolis

b. **VV penult**
Àrizóna
Màssachúsetts
aróma
Òklahóma
Àpalàchicóla

c. **VC penult**
Àtlánta
ellípsis
appéndix
agénda
synópsis

d. **Light penult/bisyllabic**
Ánna
Vénice
cábin
vílla
éffort

As Kager (1989) notes, the same pattern is shared by suffixed nouns and adjectives, too, as illustrated in (2) (again slightly revised from Kager):

(2) a. présid-ent
munícip-al
signífic-ant
calámit-ous

b. compón-ent
anècdót-al
compláis-ant
desír-ous

c. detérg-ent
fratérn-al
relúct-ant
treménd-ous

d. prés-ent
pén-al
léth-al
jeál-ous

What these data show, as was first noted by Chomsky & Halle (1968), is that primary stress, in English, falls on the antepenult, if present and if the penult is light, and on the penult otherwise.[3] In a parametric theory (e.g. Selkirk 1980; 1984; Hayes 1981; 1995; Prince 1983), these patterns reveal several things about the correct settings of prosodic parameters in English. First of all, the last syllable is always invisible to stress assignment, suggesting that Extrametricality is set to *Yes* in English; the final syllable of English nouns, as well as (almost) all adjectival suffixes, is invisible to stress assignment (Hayes 1981; 1982), although, exceptionally, some words with final heavy syllables, such as *políce* and *raccóon*, have final stress (see Halle and Vergnaud 1987 for more on these).

(3) Extrametricality: **Yes** | No

Note that the notion of Extrametricality was first introduced in Liberman & Prince (1977) to account for the exceptional behavior of a set of English suffixes. The version introduced by Hayes applies more broadly to all polysyllabic English nouns.

If final syllables are extrametrical, the antepenultimate stress pattern observed in (1a) is evidence that foot construction is right-to-left and feet are left-headed (trochaic):

(4) Direction of foot construction: **Right-to-Left** | Left-to-Right
(e.g. [A($\overleftarrow{\text{méri}}$)<ca>])

(5) Foot-type: **Left-headed (trochee)** | Right-headed (iamb) (e.g. [A(**mé**ri)<ca>])

Only under these assumptions can words like *América* and *génesis* (both from (1a)) receive a unified treatment. Given only a word like *América*, right-to-left trochees and left-to-right iambs predict the same surface stress: [A(méri)<ca>] and *[(Amé)ri<ca>] respectively. Given also *génesis*, on the other hand, it is evident that the analysis should be based on (right-to-left) trochees, i.e. [(géne)<sis>]; analyzing it as involving a left-to-right iamb would violate Hayes' (1995) Priority Clause since there would, then, have to be a degenerate (nonbinary) foot located at the edge where foot construction starts: *[(gé)ne<sis>].

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[3] Verbs behave slightly differently as we will explain below.

A comparison of the data in (1a) with (1b) and (1c) illustrates, further, that Weight-Sensitivity is set to _Yes_ in English, for heavy syllables, when present, are stressed. In other words, syllables that are heavy, whether through a long vowel as in (1b) or through a coda as in (1c), have to be in the head position of a foot:

(6) Weight-Sensitivity: **Yes** | No

The _Yes_ setting of Weight-Sensitivity is, then, the reason for the lack of antepenultimate stress in words of the profile in (1b) and (1c). Therefore, no patterns such as *_ároma_ and *_éllipsis_ emerge, for they would have a heavy syllable in the dependent position of a foot: *[(ároʊ)<mə>] and [(ílɪp)<sɪs>] respectively (i.e. instead of the attested [ə(róʊ)<mə>] and [ɪ(líp)<sɪs>].

Further, that words like _aróma_ and _ellípsis_ do not have initial secondary stress, i.e. that the initial light (L) syllable is left unparsed, is evidence that Foot Binarity is satisfied in English, and is satisfied at the moraic level. That is every foot, in English, must be composed of at least two moras:

(7) Foot Binarity: **Yes** | No (at the moraic level)

The alternatives, that feet are binary at the syllabic level or a non-binary degenerate foot at the end of foot construction, would both incorrectly result in initial stress in _aroma_ and _ellipsis_, with parses like *[(ároʊ)<mə>] and *[(à)(róʊ)<mə>] respectively.

Note that in bisyllabic words with a light penult (see e.g. _vílla_ (1d) and _léthal_ (2d)), which are stressed on the penult, satisfaction of Foot Binarity would result in a violation of Extrametricality, e.g. [(σ́σ)]. Satisfying Extrametricality, on the other hand, violates Foot Binarity, i.e. [(σ́)<σ>]. That is, in order to satisfy a higher-ranking requirement, that every PWd must have at least one syllable that is stressed, a stress pattern emerges in the language which is in conflict with the correct setting of one of these two lower-ranked parameters. For words that end in a final light syllable (e.g. _Ánna_, _vílla_), a violation of either Foot Binarity or Extrametricality would equally be sufficient to account for these data, i.e. [(ví)<lə>] and [(vílə)] respectively. Violation of Extrametricality will, however, not be able to account for the initial stress in bisyllabic forms that end in a heavy syllable (e.g. _Vénice_, _cábin_), where the (light) penult is stressed. If Extrametricality was exceptionally violated in these cases, final syllables would bear stress, given that Weight-Sensitivity is set to _Yes_ in English, i.e. *[kæ(bín)]. So Foot Binarity is exceptionally violated in bisyllabic words with a light penult, i.e. *[(kǽ)<bɪn>]. Of course, as mentioned above, it is not possible to know, in bisyllabic words with two light syllables, such as _villa_, [vílə], whether this is due to a violation of Foot Binarity or Extrametricality. Nevertheless, for expository reasons, I will assume here that it is always Foot Binarity that is violated in bisyllabic words with a light penult.

Turning back to longer forms in (1) and (2), the fact that secondary stress appears in words that are long enough for the creation of more than one binary foot, such as _Mìnnesóta_ and _Àpalàchicóla_ is evidence that the Iterativity parameter is set to _Yes_ in English (see (8)), which is illustrated in (9) below:

(8) Iterativity: **Yes** | No

(9) a. [(mìnə)(sóʊ)<tə>]
 b. [(æ̀pə)(læ̀tʃə)(kóʊ)<lə>]

The words in (9) further illustrate that feet are _maximally_ binary in English, i.e. bounded, since patterns with only primary stress such as *[(mínəsoʊ)<tə>] and *[(ǽpəlætʃəkoʊ)<lə>] are not observed:

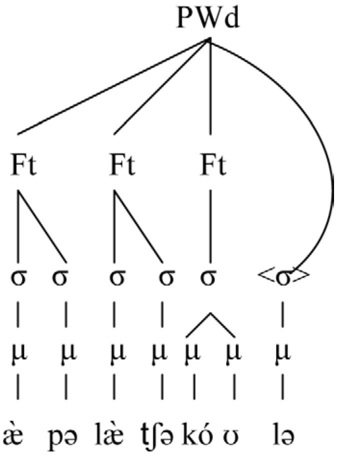
(10) Boundedness: **Yes** | No

Finally, as the words in (9) illustrate, End-Rule, in English, is set to *Right*, as the head of the rightmost foot bears primary stress. In other words, the rightmost foot within the PWd heads the PWd:

(11) End-Rule: Left | **Right**

All of these parameter settings are illustrated with the following representation for the word *Àpalàchicóla*: right-to-left iterative binary (moraic) trochees with Extrametricality set to *Yes* and End-Rule set to *Right*:

(12)



Verbs behave slightly differently than nouns (and derived adjectives) in English. Though nouns will be the subject of the experiments in this paper, a complete account of English stress must also capture the facts observed in the verbal domain. Consider the words below in (13), slightly modified from Kager (1989: 29):

(13) a. **VC-final**
devélop
astónish
surrénder
demólish
embárrass

b. **VVC-final**
màintáin
appéar
eráse
revéal
allów

c. **VCC-final**
tòrmént
usúrp
expéct
collápse
molést

On the surface, the words in (13b) and (13c) seem not to reflect the parameter settings we have illustrated above, for they can even be stressed on their final syllable. As Hayes (1982) has demonstrated, however, all the parameter settings for English verbs are the same as English nouns, with the exception of Extrametricality; for verbs, the final consonant is extrametrical, rather than the whole syllable.[4] This is illustrated in (14) below:

(14) a. [dɪ(vɛ́lə) < p >]
b. [ɪ(réɪ) < s >]
c. [kə(lǽp) < s >]
d. [(tɔ̀r)(mɛ́n) < t >]

In conclusion, the parameter settings for stress in English can be summarized as follows:

(15) a. Boundedness: Yes
b. Foot-type: Left-headed (i.e. trochee)
c. Iterativity: Yes
d. Direction of foot construction: Right-to-left (R-L)
e. Extrametricality: Yes (final syllables for nouns, final consonants for verbs)
f. Foot Binarity: Yes
g. End Rule: Right

In other words, English builds iterative, binary, weight-sensitive trochaic feet from right-to-left, ignoring the rightmost syllable (or consonant in the case of verbs), and the head of the rightmost foot bears primary stress, by means of End-Rule/Right.

2.2 Accent in Turkish

Unlike English, the accentual system of Turkish is rather simple (at least on the surface); word-level accent in Turkish falls on the last syllable of prosodic words (e.g. Lees 1961; Lewis 1967; Underhill 1976; Sezer 1983; van der Hulst & van de Weijer 1991; Hayes 1995; Kornfilt 1997; Inkelas & Orgun 1998; 2003; Inkelas 1999; Kabak & Vogel 2001; Özçelik 2014; to appear). This is demonstrated in (16) below; notice that irrespective of the rhymal profile of the syllables involved (i.e. whether they have a coda or a long vowel or not), word-level accent falls on the final syllable of the word:

(16) (from Kornfilt 1997: 26)

a.	kadín	'woman'
b.	cumhuriyét	'republic'
c.	hastá	'ill'
d.	beklé	'wait'
e.	va:lí	'governor'

Furthermore, as (17) and (18) illustrate, each time a suffix is added to the word, whether it is derivational as in (17) or inflectional as in (18), word accent moves to the right, meaning that it always falls on the final syllable of the word, regardless of the morphological composition of the word:

(17) (from Kabak & Vogel 2001: 316)

a.	kitáp	'book'
b.	kitap-lík	'bookcase'

(18) (from Özçelik 2014: 231)

a.	tabák	'plate'
b.	tabak-lár	'plates'

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[4] Underived adjectives behave like verbs in English; see e.g. *illícit*, *remóte* and *ovért* (which pattern similarly to the verbs in (13a), (13b) and (13c) respectively. In fact, it could be stated that all adjectives behave like verbs, but derived adjectives, involve morpheme (suffix) Extrametricality (Hayes 1982).

Although most Turkish words are finally prominent as illustrated above, the language also has a small set of words that bear non-final accent. When accent is non-final in Turkish, it is commonly referred to as 'exceptional stress' (see e.g. Kaisse 1985; 1986; van der Hulst & van de Weijer 1991; Inkelas & Orgun 1995; 1998; 2003; Kabak & Vogel 2001; Özçelik 2014; to appear). Exceptional stress can involve either roots, as in (19) (which are mostly borrowed words or place names, Sezer 1983; Kornfilt 1997), or some affixes, as demonstrated in (20), most of which are pre-stressing ((20a/b)), with some bisyllabic suffixes which are stressed on their first syllable ((20c)):

(19)	a.	bánka	'bank'	(Italian)
	b.	táksi	'taxi'	(French)
	c.	fútbol	'soccer'	(English)
	d.	Istánbul	'Istanbul'	(place name)

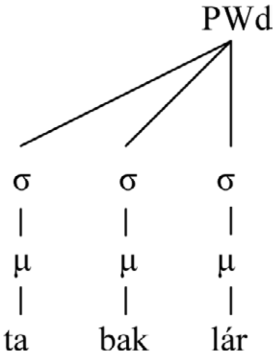
(20) (adapted from Inkelas 1999)

(20)	a.	arabá	'car'
		arabá-jla	'car-INST/COM'
	b.	bɨrák	'leave'
		bɨrák-ma	'leave-NEG'
	c.	gel	'come'
		gel-íyor	'come-PROG

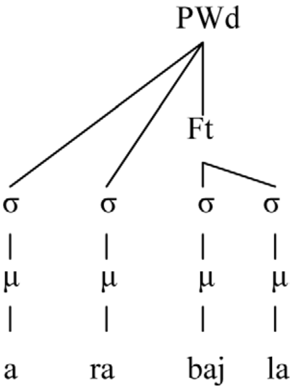
In pursuit of a unified account of the two types of prominence, and without making any recourse to the Foot, Kabak & Vogel (2001) argue that prominence in Turkish falls on the last syllable of PWds, but that some suffixes, such as exceptional stress driving suffixes are outside of the PWd. Özçelik (2013; 2014; to appear) goes one step further, and argues that UG allows for footless languages and that Turkish is such a language. The Turkish grammar, on this account, does not assign foot structure, and thus that in the absence of feet, intonational prominence (and thus, not 'stress') falls on the final syllable of PWds. Pre-stressing and stressed exceptional suffixes such as those in (20) differ however; these are pre-specified with foot edges in the underlying representation and this foot emerges in the surface too because of faithfulness to this information. Therefore, the grammar on this account is unable to parse syllables into feet (i.e. the constraint PARSE-σ is low-ranked), but keeps feet if they are already present as part of a word's lexical representation. As Özçelik (2014; to appear) demonstrates, this proposal receives both formal evidence (see Özçelik 2013; 2014; to appear) and also independent additional evidence from the acoustic correlates of prominence/stress in Turkish: whereas the acoustic correlates of exceptional stress involve both intensity and a sharp rise in F0 (which is a pattern typical of trochaic languages), regular final prominence is only accompanied by a slight F0 rise that is optional (e.g. Konrot 1981; 1987; Pycha 2005; Levi 2005). Therefore, given the criteria presented in the phonetic literature (see e.g. Beckman 1986; Ladd 1996; Hualde et al. 2002), and given the lack of greater intensity or duration associated with the prominent syllable in Turkish regular accent, as well as the optionality of pitch rise (in addition to its weak nature), 'regular stress' in Turkish is not stress nor does it involve foot structure; it is rather intonational (footless) prominence (see Özçelik to appear for a detailed argument for this stance, as well as a discussion of the typological implications of such a proposal).

Given the discussion above, Turkish words with regular accent/prominence can be represented as in (21). Notice that this representation, unlike the one in (12) for English, has no foot structure, and syllables are immediately dominated by the PWd, with no other constituent in between. Compare this with (22), the representation of a Turkish word with exceptional stress, where the single foot available results from faithfulness to the information in the UR of the exceptional suffix –(j)la, instead of being assigned by the grammar.

(21)



(22)



I investigate, in this paper, the second language (L2) acquisition of Turkish word-level accent by learners whose first language (L1) is English, a language with a well known and a highly complex iterative stress system, where the interaction of several different parameter settings determines the location of word-level stress. As was mentioned in Section 2 above, I assume, along with recent formal research on Turkish, that Turkish is a language whose grammar does not assign foot structure (Özçelik 2013; 2014; to appear), and regular final prominence is assigned by an intonational prominence rule (as with French, see e.g. Beckman 1986; Ladd 1996; Hyman 2014). I also assume, as with most previous literature, that English differs from Turkish in this regard in that it requires every lexical word to be footed. Given these differences between the two languages, and given a specific learning path for prosody to be proposed in this section, there are certain predictions for English-speaking learners of L2 Turkish, if one views the initial state of L2 acquisition as that of the L1 settings of parameters, as with the Full Transfer Full Access (FTFA) Hypothesis (e.g. White 1989b; Schwartz & Sprouse 1994; 1996).

2.3 Prosodic Acquisition Path Hypothesis

The Prosodic Acquisition Path Hypothesis (PAPH) follows from a proposed representation of prosodic parameters in a tree where some parameters are embedded under others (see also Dresher & Kaye 1990 for a similar approach without the tree). Based on this hierarchical tree representation of prosodic parameters, a prosodic learning path is predicted first for L1 acquisition. In addition, it is assumed that all foot-related parameters, such as Foot-Type, Iterativity, etc., are initially *open* in L1 acquisition (i.e. not pre-set to a certain value) and can stay as such. Once a parameter is *activated* (i.e. set to one value or another) in an L1, though, it should be impossible to deactivate it (i.e. make it open again) in an L2 where this parameter is not relevant. On the other hand, resetting parameters from one value to another (as long as it does not result in a prosodic constituent being removed from the grammar) is predicted to be possible, given that positive evidence is available for both directions (e.g. *Yes* to *No* and *No* to *Yes*). That is, though deactivation is *not* possible, resetting *is*, on the PAPH, forming, respectively, the first and second main components of the proposal. Not all types of resetting, though, are hypothesized to be equally easy: certain parameters (and parameter values) are expected to be more difficult to reset than others, on grounds of economy, markedness, and robustness of input, which, as we will see later, is, for the most part, reflected by their location on the tree of parameters proposed in this paper.

All things considered, the PAPH is an attempt at proposing a restrictive and falsifiable account of L2 prosody: not only does it predict certain things to happen, but it also predicts certain things *not* to happen, even when they are, in principle, allowed by UG. Certain phenomena are predicted not to occur on the current proposal, even though they would not necessarily violate principles of UG. For example, as we shall see, certain learning paths (and interlanguages attained through such paths) are predicted not to occur.

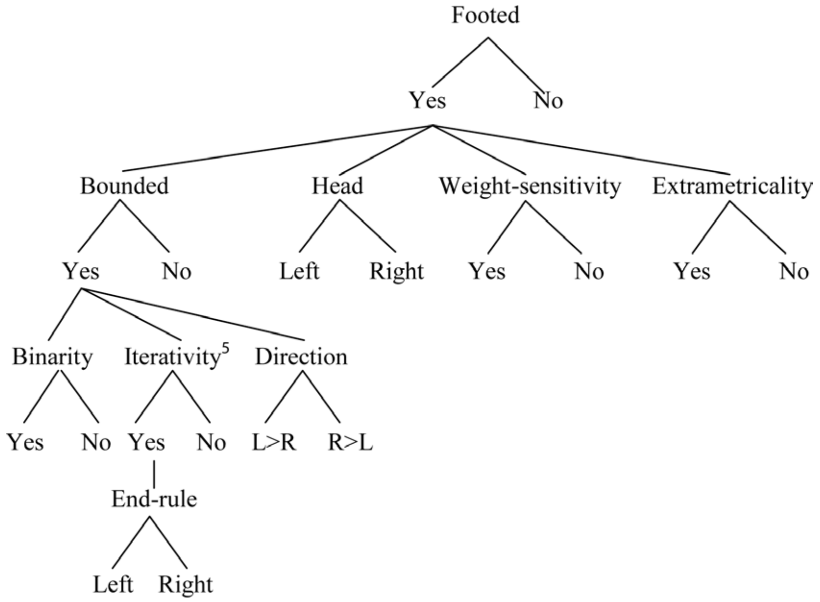
The remainder of this section is organized in the following way: Section 2.3.1 outlines the hierarchical organization that is hypothesized to hold among prosodic parameters. Section 2.3.2 outlines the PAPH, and its two main building blocks (justifications for these are later provided in Section 3).

2.3.1 Prosodic parameters in a tree

Before discussing the two components of the PAPH, we consider what prosodic parameters look like under this approach.

The tree diagram in (23) below provides a near complete set of prosodic parameters that capture word-level stress in the world's languages. All of these parameters have been proposed independently in previous research as mentioned in Section 2 above; the proposal in (23) departs from this literature in that it *embeds* these in a tree (see also Dresher & Kaye 1990 for a similar approach to relationships between parameters). As we will see later, this will be relevant in that it will help determine what is hypothesized to be a more vs. less difficult learning direction, on the current approach, for L2 learners.

(23)



If Footed is set to *Yes* in (23) above, speakers of footed languages such as English will have most (or all) of the parameters that are associated with having a foot set to

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[5] Note that in certain rare circumstances, Iterativity can be a property of unbounded feet, too. Such cases are, to my knowledge, limited to languages that are quantity-sensitive, and in which every heavy syllable heads a foot, which is not true Iterativity, as multiple feet originate from weight, not from the *Yes* setting of Iterativity.

one value or another (either *Yes* vs. *No* or *Left* vs. *Right*). For speakers of languages like Turkish, on the other hand, since their language has no foot structure, parameters related to footing are all "open," as with child L1 learners of all languages (including English), for whom these parameters are initially open, and are waiting to be set (see also Section 3.3.2.1 below).

It is presumed here that first language acquisition follows the path demonstrated in (23). Once the Foot is projected, the parameters in (23) for which there is positive evidence are set to their correct values, from top to bottom. Only after a *Yes* setting of a parameter can the parameters embedded under it be set to one value or another; they will, otherwise, stay open. If Boundedness is set to *No*, for example, the parser does not look further down, and the parameters below it stay open. If, on the other hand, it is set to *Yes*, the parameters below it may also be activated and set to their correct value based on positive evidence. Similarly, End-Rule can be set (to one value or another) only after Iterativity is set to *Yes*. If Iterativity is set to *No*, the L1 learner will not entertain a setting for End-Rule. In fact, as Dresher & Kaye (1990) point out, the positive cue for End-Rule, i.e. main stress to the left or right of a secondary stress will not be available in languages with non-iterative footing (see e.g. Fikkert 1994; 1998; Kehoe 1998 for evidence for such a developmental path from L1 acquisition in Dutch and English respectively).

The assumption behind this learning principle is that the parser is deterministic (Marcus 1980; Berwick 1985; Dresher & Kaye 1990). A deterministic parser cannot undo previously created structures (or substructures) if the parse does not work. It is *local* and is data-driven, which makes acquisition easier (Berwick & Weinberg 1984; Dresher & Kaye 1990). That it is local means, in the current case, that all the parameters in (23) will be handled one by one, and eventually set to their correct values on the basis of positive evidence, and this will be done following a path from top to bottom, treating errors also locally. For example, if the learner has not yet set Iterativity to its correct value (i.e. if it is still open), and the parser is faced with structures that the current grammar cannot capture, e.g. the presence of words with secondary stresses, it will only attempt to change the value of Iterativity (from open/none to *Yes*), and will not backtrack and attempt to change, for example, the value of Headedness or Weight-Sensitivity, if Headedness and Weight-Sensitivity have already been set to their corresponding values. As suggested by Dresher & Kaye (1990), a nondeterministic parser with an unlimited backtracking capacity would not only undo incorrect structures but also correct ones, which would lead to problems in acquisition, and particularly in learning prosody given that certain output cues can be interpreted by the child as triggers for different and completely unrelated prosodic parameters (Dresher & Kaye 1990). For example, a word composed of a sequence of light and heavy syllables and is stressed on its final syllable, as with LH́, can either be a an iamb or a weight-sensitive trochee. Note that, all this means, for L1 acquisition at least, that there will not be any mis-set parameters (see Synder 2007 and Snyder & Lillo-Martin 2011 for similar approaches from the syntactic acquisition literature; see Hyams 1983; 1986 for an alternative account where a child could temporarily choose a non-adult parameter setting). Instead, as was argued for related parameters in the syntactic acquisition literature, the parameters in the tree in (23) are made available following a maturational schedule (Gibson & Wexler 1994), where the amount of input the learner has received influences maturation (Bertolo 1995).

2.3.2 Prosodic acquisition path

The main theoretical assumptions behind the PAPH are summarized in (24) below, followed by a summary of the two main components of the PAPH in (25). All of these assumptions will later be supported with both formal and acquisitional evidence later in Section 3.

(24) Main theoretical assumptions:
  a. All prosodic parameters are initially open in L1 acquisition, and are, then, set to the correct value based on positive evidence (i.e. all the parameters in (23)).
  b. For some of the parameters that are initially open, i.e. the Yes/No parameters in (23), markedness can be invoked, since, for certain settings of these parameters (the *Yes* setting), the positive evidence available is more robust (and unambiguous) than it is for the other setting. For others, i.e. the Left/Right parameters in (23), both values are equally unmarked, and the positive evidence available is equally robust.

The predictions of the PAPH, given these assumptions and given (23), are summarized in (25) below:

(25) The two main components of the PAPH:
  a. It is impossible to deactivate a parameter altogether. Thus, L2 learners will not be able to deactivate the parameters in (23).
  b. Parameter resetting is possible when positive evidence is available.
    i. L2 learners will have an easier time resetting terminal parameters than parameters which have other parameters dependent on them. Though resetting a parameter with embedding is costly, it is still not impossible.
    ii. For all parameters with *Yes/No* settings, whether embedded or not, L2 learners will have an easier time moving from the *No* value of a parameter to the *Yes* value than vice versa.
    iii. For parameters with *Left/Right* values, learners will have equal difficulties with going from *Left* to *Right* and *Right* to *Left*.

These two general predictions form the two main tenets of the PAPH. Although the acquisitional scenario tested here is English-speaking learners of Turkish only, I assume these two general components of the PAPH to hold true for any language combination to be learnt.

Section 3 below will present formal and empirical evidence for the assumptions made here in proposing the Prosodic Acquisition Path Hypothesis, both from L1 acquisition literature and from the nature of the input.

3 Acquisitional and formal evidence for the PAPH

This section presents acquisitional and formal evidence for the two components of the PAPH presented in (25) above. It then ends with an outline of the predictions of the PAPH for the learning scenario to be tested in this study.

3.1 Impossibility of deactivating parameters

The status of the relationship between open vs. already-activated parameters has not, to my knowledge, been discussed in the L2 acquisition literature. There is, however, good reason, based on findings of related research, to assume that once a parameter is set in an L1, it should be impossible to deactivate it (make it dormant). Given the extensive evidence for the proposal that L2 learners start with the L1 settings of all parameters (White 1985; Schwartz & Sprouse 1994; 1996) and that moving from a marked value to an unmarked one is very difficult (see e.g. White 1987; 1989c; 2003a), if deactivation of parameters were possible, L2 learners should be able to deactivate all parameters, regardless of the availability of positive evidence, and should, thus, be able to start from scratch, like children, for this would be the most effective way of acquiring a second language, as would be predicted by the Full Access (without Transfer) Hypothesis (e.g. Flynn & Martohardjono 1994; Flynn 1996; Epstein et al. 1996). There would, then, be no formal differences between learning a marked vs. unmarked value of a parameter since all learners would have the same starting point, or would at least be able to switch, in a reasonable time period, to the open value of a parameter without much difficulty. Consequently, regardless of the L1 background, the end state of L2 acquisition would be the same target-like grammar. That is, if deactivation of parameters were possible, L2 acquisition would be no different from L1 acquisition.

Since we do not observe this, as demonstrated by previous experimental research, I will hold to the position that it is impossible to deactivate parameters that are already set to one value or another. It should, therefore, be easier to move from an L1 which has not yet set a parameter to one that has already done so rather than vice versa. In the present case, then, L1 English learners of L2 Turkish will *not* be able to deactivate the parameters under Footed = Yes in (23) that are irrelevant for Turkish regular stress/prominence. For example, they will not be able to get rid of the concept of Headedness (foot type) or Boundedness in learning Turkish, although they can, I hypothesize, reset the former from *Left* to *Right*, and the latter from *Yes* to *No*.[6] That is, resetting is possible, whereas deactivation is not (more on the issue of resetting in the next section).

There can, however, be '*de facto* deactivation', for some parameters in (23) are dependent on others: a parameter can be de facto deactivated when the parameter it is dependent on is reset from *Yes* to *No*. For example, Iterativity is reset from *Yes* to *No*, this means, automatically, that End-Rule is no longer relevant, i.e. is de facto deactivated. Similarly, when Boundedness is reset from *Yes* to *No*, Binarity and Iterativity (and any parameter under them) will be de facto deactivated. Resetting the Footed parameter at the very top in (23) from *Yes* to *No* would also result in de facto deactivation of all parameters under Footed = Yes in (23), although this will be very difficult (see below), for it requires the de facto deactivation of all foot-related parameters (a big change in the grammar), and, in addition, results in the loss of a prosodic constituent, unlike the parameters underneath.[7]

Notice at this point that this predicts certain things *not* to happen; there should, for example, be no interlanguage grammar where a learner deactivates End-Rule, but keeps Iterativity or Boundedness set to *Yes*. This is despite the fact that iterative systems with no End-Rule are attested, e.g. Tübatülabal (e.g. Voegelin 1935; Hayes 1981; Prince 1983). All stresses in a given Tübatülabal word are equally strong; thus, there seems to be no main stress (Kager 1993). In other words, the End-Rule parameter, in Tübatülabal, is open, as opposed to in languages such as English. The only way for English-speaking learners to avoid rendering one foot stronger than the other is, then, through resetting Iterativity or Boundedness to *No* (i.e. through *de facto* deactivation of End-Rule, rather than true deactivation).

In sum, the PAPH predicts, one cannot deactivate a parameter altogether, though de facto deactivation, in the form of resetting a parameter with embeddings from *Yes* to *No*, thereby rendering the parameters underneath irrelevant, is possible.

3.2 Resetting certain parameters/values is more difficult than resetting others

3.2.1 Greater difficulty with resetting parameters with embeddings

In the absence of being able to deactivate parameters (see 3.1), how does the L1 English learner of L2 Turkish (or any other footless language) proceed through the acquisition

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[6] For hypothesized differences in the difficulty of resetting *Yes* to *No* vs. *No* to *Yes*, or *Left* to *Right* vs. *Right* to *Left*, etc., see Section 3.2.2 and 3.2.3 below.

[7] Recent approaches under the OT framework also view the requirement that a language assigns feet (i.e. PARSE-σ on such accounts) as different from the other parameters (or rather 'constraints' on such accounts), for PARSE-σ refers to the Prosodic Hierarchy but not to prominence, whereas other parameters, including Iterativity (or *LAPSE on recent OT accounts), have to do with prominence, but not the Prosodic Hierarchy (see e.g. McCarthy 2003)

process? The PAPH predicts that although such learners may have difficulties attaining the target end state grammar of Turkish, they should still be able to resort to a variety of UG-constrained options that result in their interlanguage sounding, on the surface, more and more target-*like* by means of changing the parameter values in (23). In doing so, I predict that they will initially change the settings of terminal parameters, rather than those with embeddings, for terminal parameters have no parameters dependent on them, and so their being reset does not require other parameters to be (de facto) deactivated. This, in turn, leads to a smaller change in the grammar (thereby making it a more *economical* - and local - decision). Therefore, resetting Iterativity (or Boundedness) from *Yes* to *No* will likely not be the first option L2 learners will consider, for this will render the End-Rule parameter that is dependent on Iterativity (de facto) inactive, and that, though possible, should be costly, as it involves a big change in the grammar, a change that affects the destiny of multiple parameters. In this regard, resetting Boundedness from *Yes* to *No* should be the most difficult option (excluding expunging the Foot altogether), for Boundedness is the parameter in (23) with the greatest number of parameters dependent on it, other than Footedness (which has the most and its resetting would in addition result in expunging a prosodic constituent). Options such as switching Extrametricality from *Yes* to *No* should be relatively easy, on the other hand, for it is a terminal parameter with no other parameters dependent on it. This also means that, for parameters with embedding, *Yes* values will be more difficult to reset to *No* than vice versa, for it is the *Yes* values in (23) that have other parameters dependent on them.

3.2.2 Easier to reset from *No* to *Yes*

I predict that, for the parameters with *Yes/No* settings, whether embedded or not, moving from *Yes* to *No* should be more difficult than from *No* to *Yes*, as the *Yes* settings in (23) are more marked than the *No* settings.[8] Therefore, on markedness grounds, since moving from an unmarked value of a parameter to a marked value is presumed to be easier because of the nature and greater availability of positive evidence (see e.g. White 1987; 1989c; 2003a; Schwartz & Sprouse 1994; 1996), moving from *No* to *Yes* should always be easier than the converse. When the positive evidence is more robust, this should be easier, and, with the parameters under focus, this is usually the case when moving from *No* to *Yes*.[9]

Take, for example, Weight-sensitivity. In a weight sensitive language, every heavy syllable will be the head of a foot, and will, therefore, be stressed, which is robust information that there is something special about the role of heavy syllables. In a language that is not weight-sensitive, on the other hand, some heavy syllables will still happen to be stressed, whereas some will not (depending on the settings of other parameters, the number of syllables in a word, etc.); this may appear to give conflicting information as to whether the language is weight-sensitive or not (see also the discussion below for additional evidence from L1 acquisition).

Another way to look at this, as was pointed out by a reviewer, is that weight-insensitive systems posit fewer *contrasting* syllable types than weight-sensitive systems. In other words, in weight-sensitive system, words of the form LLL, LLH, LHL, HLL, LHH, HLH, HHL, HHH potentially contrast with respect to stress. In a weight-insensitive system, on the other hand, these would all be a single type regarding stress, i.e. σσσ. Assuming in

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[8] This is probably too broad a generalization; it likely does not hold, for example, for Binarity, though see Dresher & Kaye (1990), who assume binary feet are more marked than non-binary for quantity sensitive languages based on availability of input.

[9] Note that this is different from what would be predicted by the Markedness Differential Hypothesis (Eckman 1977; 1981a; b), according to which moving from an unmarked to a more marked value should (always) be more difficult.

addition that we have a principle, as is argued by Dresher (to appear), entailing that learners make only as many contrasts as the data require, we reach the same conclusion, i.e. that weight-insensitivity is the default/more unmarked, as is argued here.

As an additional example, consider Boundedness: every bounded foot is maximally binary. There is, for example, no way to misanalyze a hypothetical word like *pátakàtalàta* as unbounded; it would likely be footed as (páta)(kàta)(làta), which gives robust evidence that the foot is maximally binary (i.e. bounded). A word like *pátakatalata*, on the other hand, could be analyzed as bounded or as unbounded: (i.e. (páta)katalata or (pátakatalata) respectively), meaning that the evidence for the *No* setting of Boundedness is not as robust. In fact, if Bounded-*Yes* were the unmarked option provided by UG, there would likely be no unbounded languages in the world (except those with weight-sensitivity).

For the other Yes/No parameters, i.e. Extrametricality and Iterativity, I follow Fikkert (1995) in assuming that *No* is the unmarked setting for both. Dresher & Kaye (1990) similarly assume that *No* is the unmarked value for Extrametricality, but differ in their claim that the *Yes* setting is unmarked for Iterativity, arguing that there is positive evidence for the *No* setting of this parameter in the form of the absence of secondary stress. As Fikkert (1995) points out, however, one could also argue that the ‘presence’ of secondary stress is a positive cue for the *Yes* value of this parameter and, therefore, assume the unmarked value to be *No*. She also presents evidence for this from Dutch child language acquisition data/order: Although stress assignment in Dutch is iterative and weight-sensitive (e.g. Trommelen & Zonneveld 1989; 1990), child learners of Dutch go through a stage where they have only one left-headed foot per word at the right edge of a prosodic word (Fikkert 1995; 1998); that is, even though Dutch is weight-sensitive and iterative, child Dutch is not. Fikkert distinguishes four stages in the acquisition of stress in Dutch, and shows that Iterativity is only learnt at Stage 3 (around age 2;2).

In addition, all things being equal, it should always be easier to notice the presence of something rather than its absence (see Markus 1993 for L1 acquisition); noticing the absence requires access to more forms to be sure that the relevant property is indeed absent. Take, for example, the following situation: In a trochaic weight-sensitive language, trisyllabic words can have secondary stress in words with weight profiles of e.g. HHL, HLL, etc.: (H̀)(H́)L and (H̀)(ĹL) respectively. That is, seeing words with surface stress profiles of H̀H́L and H̀ĹL is sufficient for a learner to activate the *Yes* setting of Iterativity. The converse, however, is not true. If the same learner came across words with stress profiles of HH́L and HĹL, i.e. words *without* secondary stress, this does not necessarily mean that Iterativity in the language being learnt is set to *No*; this could alternatively be due to the possibility that the relevant language is not weight-sensitive (and thus that H is not bimoraic). Alternatively, it could also be due to (leftmost) Extrametricality, if such languages exist (see Kager 1989). Yet another possibility is that there is destressing in clash, resulting in one single stress in forms like HH́L and HĹL. Such a learner will clearly need to come across longer words or more word types in order to activate the *No* setting of Iterativity. In sum, moving from the *Yes* setting of Iterativity to the *No* setting would clearly require more evidence than vice versa, another reason why the *No,* instead of *Yes,* setting must be the default.

To summarize so far, there are two different factors leading to the *Yes* to *No* direction being more difficult than the *No* to *Yes* direction. The effects of the two factors can be disentangled, for we expect much more difficulty in the case of parameters with embedding being reset from *Yes* to *No* than terminal parameters. On the other hand, there should be no difficulties for the *No* to *Yes* direction; this is, after all, a movement towards a marked setting and does not result in the (costly) de facto deactivation of any parameters, for no parameters are embedded under the *No* values.

3.2.3 Left to Right vs. Right to Left are equally easy

Finally, for parameters in (23) whose values express directions, e.g. left-headed vs. right-headed feet or Left-to-Right vs. Right-to-Left footing, both values are predicted to be equally easy to reset to. These, I argue, are equally unmarked (see below).[10]

From the perspective of robustness of the input, the evidence for either value is equally robust for these parameters, unlike Yes/No parameters. For example, the evidence for whether a foot is left-headed or right-headed is equally robust; the only thing that differs between left-headed feet vs. right-headed feet is the location of the stressed syllable, e.g. (σ́ σ) vs. (σ σ́). Similarly, the difference between a word tree that is strong at the left edge (End-Rule-Left) vs. one that is strong at the right edge (End-Rule-Right) is the location of the word edge where the most prominent stressed syllable occurs, e.g. [(σ́ σ)(σ̀ σ)] vs. [(σ̀ σ)(σ́ σ)] for a trochaic language or [(σ σ́)(σ σ̀)] vs. [(σ σ̀)(σ σ́)] for an iambic language.

Likewise, the only difference between left-to-right and right-to-left footing (Directionality) is whether an initial/final or peninitial/penultimate syllable is stressed in words with an odd number of syllables, e.g. [(σ́ σ) σ] v.s. [σ (σ́ σ)] for a left-to-right vs. right-to-left trochaic language and [(σ σ́) σ] vs. [σ (σ σ́)] for a left-to-right vs. right-to-left iambic language. Although it might be argued here that there is better evidence for the left-to-right direction for trochees and right-to-left for iambs, in the form of adjacent syllables that are unstressed, the balance is changed in favor of the opposite direction in languages that allow degenerate feet, in the form of adjacent syllables that are stressed, e.g. [(σ́ σ)(σ́)] vs. [(σ́)(σ́ σ)] for a left-to-right vs. right-to-left trochaic language and [(σ σ́)(σ́)] vs. [(σ́)(σ σ́)] for a left-to-right vs. right-to-left iambic language.

In sum, both directions in all Left/Right parameters seem to involve equally robust evidence. There should, therefore, be no difference in level of difficulty between moving from one setting to the other for any of the prosodic parameters in (23) whose values express directions.

3.2.4 Evidence from L1 acquisition

Most of the evidence cited above for the equally unmarked status associated with both values of Left/Right parameters and the more marked status of the *Yes* setting of Yes/No parameters came from formal assumptions made about robustness of the input. There is, in addition, some evidence for these assumptions from the findings in the L1 acquisition literature.

Although not all parameters have been studied in L1 acquisition research, one parameter, Foot-Type, a Left/Right parameter, has particularly been investigated. Some of the findings of this line of research are, in addition, informative of the assumptions made here about the other parameters, including Yes/No parameters. Section 3.2.4.1 below provides an overview of the findings of L1 acquisition research on the Foot-Type parameter and discusses its implications for the current proposal. Section 3.2.4.2, then, overviews the implications of some of the findings of this and similar research on the other parameters discussed above.

3.2.4.1 Against the Trochaic Bias Hypothesis

Early research on the L1 acquisition of stress claimed that there is an initial universal trochaic phase for all learners, including those learning iambic languages (Allen & Hawkins 1978; 1980). This suggests that *Trochaic* is the default setting provided by UG for the Foot-Type parameter, contra the arguments made above for the equally unmarked status

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[10] This is similar to the head-directionality parameter in syntax; head-initial and head-final languages are viewed as equally unmarked by almost all syntacticians (though see Kayne 1994, who only recognizes left-headedness in his framework of Antisymmetry).

of trochaic and iambic grammars, as well as other parameters that express directionality, whose default value, I have assumed, is open (i.e. not initially set to one value or the other).

If the current proposal is correct, then the so-called Trochaic Bias Hypothesis should be incorrect; that is, there should *not* be an initial trochaic phase for all learners, i.e. for those learning iambic languages. Rather, learners of trochaic languages should start with a trochaic (left-headed) foot (once they get enough positive evidence), and learners of iambic languages should start with an iambic (right-headed) foot. In both cases, the parameter should be set to the correct value from the beginning on the basis of positive evidence, since it is not a parameter with values in a subset/superset relationship, nor is it a Yes/No parameter, but is rather a Left/Right one, and thus, neither markedness nor the availability of positive evidence will predict one setting to be earlier than the other.

This prediction seems to hold true, for there has been virtually no evidence so far for a "Trochaic Bias" from L1 acquisition research. In fact, the hypothesis was offered based on the behavior of English-learning children (Allen & Hawkins 1978; 1980), and virtually all evidence for it comes from learners of trochaic languages, e.g. English (Gerken 1991; 1994; Kehoe 1998), Dutch (Fikkert 1994; Wijnen, Krikhaar & den Os 1994), and Greek (Kappa 2000). That is, as will be demonstrated below, it is only children learning trochaic languages who seem to choose trochees from the onset of acquisition, and not those learning iambic languages. To my knowledge, the only exception to this so far has been Hebrew-learning children, who were argued to have a trochaic bias (Adam & Bat-El 2008) despite acquiring an iambic language (Bat-El 1993); however, recent analyses of Hebrew stress have proposed that the language may actually be trochaic (see Becker 2003). All things considered, then, there seems to be little evidence for a Trochaic Bias.

In fact, there is some evidence *against* it from both trochaic and iambic languages: Hochberg (1988), for example, demonstrates that children have a "neutral start" in acquiring Spanish stress, meaning that, at the beginning, they produce many iambic, as well as trochaic, profiled words; that is, they do not have a bias towards trochaic stress. This is despite the fact that Spanish is analyzed as trochaic by most researchers (see e.g. Roca 1988; 1991; Harris 1991; 1992). Similarly, according to Prieto's (2006) study, children have a neutral start in learning Catalan, a language that is usually analyzed as trochaic (Serra 1996; Bonet & Lloret 1998), but Catalan stress is contrastive, and is, thus, also compatible with an iambic analysis (Wheeler 2004).

The so-called bias that is demonstrated for English- and Dutch-learning children should, then, come from the rhythmic properties of the input children receive in learning these languages. Once they are subject to enough input from the target trochaic language, they set the value of the Foot-Type parameter, accordingly, to *Trochaic*. If so, even for English-learning children, at very early stages, there may be no preference for trochaic feet. This prediction seems to hold true: Vihman, DePaolis & Davis (1998) demonstrated, for English-learning children, that during the babbling stage, they produce an equal number of trochaic and iambic patterns in their bisyllabic utterances (see also Klein 1984 for similar results).

Conversely, if there is no "Trochaic Bias," children learning languages that are not trochaic should not start with trochaic utterances. Children learning iambic languages should, for example, favor iambs to trochees. This prediction, too, is borne out, though most of the evidence comes from the acquisition of French (e.g. Paradis, Petitclerc & Genesee 1997; Vihman et al. 1998; Archibald & Carson 2000; Goad & Buckley 2006; Rose & Champdoizeau 2007; Goad & Prévost 2011) and Turkish (Aksu-Koç & Slobin 1985), two languages that probably have no foot structure (Özçelik to appear). So lack of a trochaic bias in learners of these languages might also be attributed to these languages being footless. There are, though, two other studies from languages that have been argued to be iambic in the literature: Yucatec Mayan (Archibald 1996) and Northern East Cree (Swain 2008). Learners of these languages produced utterances that were consistent with an iambic analysis. Out of these, the latter, Northern East Cree, seems to be truly an iambic language (i.e. probably not footless), as it demonstrates such properties as boundedness and quantity-sensitivity (see e.g. Dyck, Brittain & MacKenzie 2006; Wood 2006), as with other languages from the Algonquian family, e.g. Ojibwa (Bloomfield 1957; Piggott 1980; 1983). The point would, of course, have been clearer if there had been more studies with learners of indisputably iambic languages. However, even the results of studies with Spanish- and Catalan-learning children, as well as learners of English at the babbling stage, should suffice to be evidence *against* the default status of trochaic stress, as they demonstrate that children do not necessarily start with trochees even when learning a trochaic language.

3.2.4.2 More from L1 acquisition on default vs. open settings

Little research has been done on the L1 acquisition of other Left/Right parameters. Fikkert (1994), however, demonstrates that when children learning Dutch start producing words composed of more than one foot, they produce equal stress on the head of each foot. I interpret this observation as lack of a default option for the End-Rule-Left/Right parameter; the parameter had probably not yet been set to either value, and was still open, as was argued here to hold for the initial setting of all parameters that result from having foot structure.

I expect all Left/Right parameters in (23) to behave in the same way. As argued above, there is no principled reason why, for these parameters, UG should make one value the default option, given that positive evidence is *equally* available in both directions. In fact, having a default value for these parameters would not only not help an L1 learner in the acquisition process, it would, rather, serve to increase the burden on the learner since a previously assumed (default) analysis would, then, need to be altered based on positive evidence.

Unfortunately, Yes/No parameters have not received the same attention in L1 acquisition research as Left/Right parameters have. Most of the arguments given above for the marked status of the *Yes* setting have come, therefore, from the formal assumptions about the comparative robustness of input. There is, however, some evidence in support of these arguments that indirectly comes from the literature on the Trochaic Bias Hypothesis.

First, virtually none of the learners tested in these studies showed Extrametricality, even when learning a language with extrametrical final syllables. Kehoe (1998), for example, found that target English nouns of the shape (H́L)<H> were often produced with final stress by children, which suggests that the *Yes* value of this parameter had not yet been set. This is evidence that the *Yes* setting is more marked, since errors, in L1 acquisition, are usually made only by children learning a language with the marked value (see e.g. Fikkert 1994). Therefore, errors should take the form of the unmarked or the open value of a parameter (though, here, no activation and the unmarked *No* value, on the surface, yield the same outputs).

Second, one type of evidence that is often cited as support for the Trochaic Bias Hypothesis is that target LH́ forms such as *balloon* which have final stress are often produced as ĹH (with initial stress) by learners of both English and Dutch (see e.g. Fikkert 1994; Kehoe 1998). The problem with taking these facts as evidence for a trochaic bias is that the change from final to initial stress in such words does not turn them into trochaic (they already are trochaic), so the behavior cannot have been caused by a preference for trochaic feet. Rather, the change potentially signifies that children have a preference for weight-insensitive grammars, which is predicted by the PAPH, since Weight-Sensitivity is a Yes/No parameter, unlike Foot-Type, and weight-sensitive grammars have the marked setting of this parameter. Weight-sensitive systems, therefore, should arise later only on the basis of positive evidence.

In sum, as both the formal arguments about the nature of the input and the findings of L1 acquisition literature indicate, there is no reason, for Left-Right parameters, to have a value that is more unmarked than the other, whereas there is good reason to make such an assumption for Yes/No parameters. In either case, all parameters that follow from having a foot are initially open. Whereas open means, as far as L1 acquisition is concerned, a neutral start for Left/Right parameters (one that favors neither Left nor Right), it is empirically equivalent to the *No* setting for (most) Yes/No parameters.

3.3 Predictions

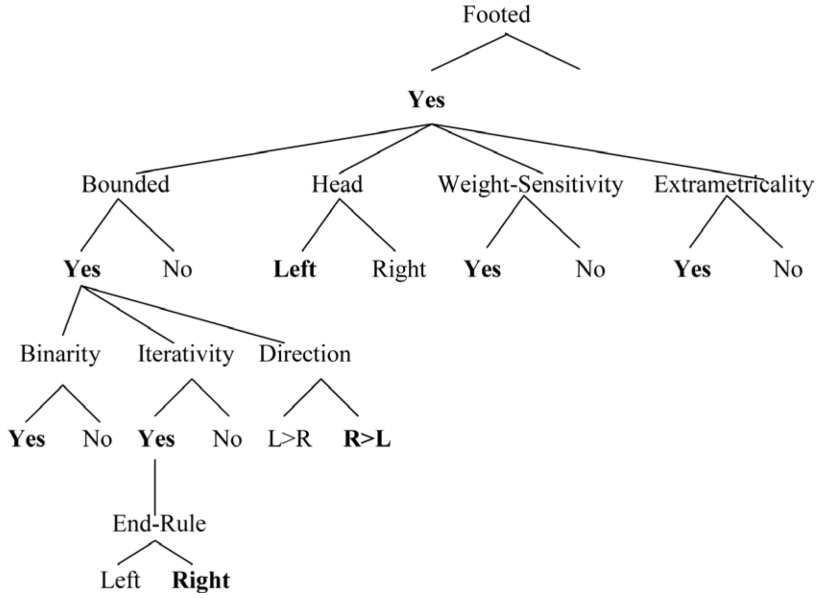
Given the linguistic properties of English and Turkish (see Section 2.1. and 2.2.), and given the Prosodic Acquisition Path Hypothesis (PAPH) proposed in Section 2.3., for which we have presented evidence in this section, certain predictions follow for L1 English-speaking learners of L2 Turkish. Before moving on to the predictions, a summary of the representations for the two languages that are under investigation here is provided below.

3.3.1 L1 representations of the two languages

The trees in (26) and (27), below, provide a schematic representation of the parameter settings for each of the two languages that are under focus in this paper. The specific options chosen by a given grammar are provided in boldface; for example, in (26) below, the option *Yes* is bolded under Footed, for this is the option taken by English, a language with foot structure.

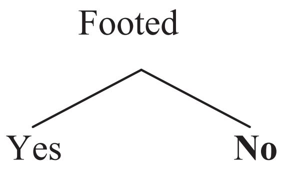
We start with English. As was explained in Section 2, feet in English are weight-sensitive, binary and left-headed (moraic trochees). Foot construction is right-to-left, but the rightmost syllable is extrametrical; it is, therefore, ignored for the purposes of foot construction, and Extrametricality is, thus, set to *Yes*. Feet are iterative in English; as long as a word is long enough, there will be multiple binary feet, out of which the rightmost will be the head of the PWd, since End-Rule is set to *Right*, and the head of this foot will, thus, bear primary stress.

(26) English stress



Turkish, on the other hand, does not require words to have feet (Özçelik 2014; to appear). As discussed in Section 2, Turkish only has demarcative cues to the edges of words, rather than "stress." As such, I analyze Turkish as footless, as represented in (27) (see Section 2.2 for a more detailed analysis). And since Footed = *No* in Turkish, all other parameters under Footed = *Yes* (see (26) above) are open.

(27) Turkish stress



3.3.2 Hypotheses

The universal predictions of the PAPH, predictions that are expected to hold true for all L1-L2 pairings, were presented in Section 2.3 above (see the summary in (25)), along with an in-depth examination of the proposal and formal and empirical evidence to support it. The current section covers more specific predictions, in the context of L1 English learners of L2 Turkish, the two population tested in this paper.

The acquisition task for the learners of Turkish will be difficult, as this involves resetting a top-level parameter in the tree, one whose being reset has consequences for all parameters underneath (one with the most embeddings), as well as resulting in ridding the grammar of a prosodic constituent, the Foot. Thus, the Foot will perhaps never be expunged from the grammar. Note that this prediction of the PAPH does not align with a pre-theoretical 'common sense' view that acquisition of Turkish stress should be easy, since it's very simple to state (especially in comparison to languages like English): stress the word-final syllable. Further, note that given the Subset Principle, too, expunging the Foot should be difficult or perhaps impossible, since there is a subset-superset relationship between languages that do not have feet (subset) and those that have it (superset), as the null set (footless) is the subset of every set. However, it should also be noted that this is different from a classical subset-superset problem in L2 acquisition (see White 1989a; b) in that positive evidence is available in both directions in the form of phonetic cues, since intensity and/or duration are correlates of foot structure, and these are always absent from a footless representation (see Section 2.2. above). Traditionally, moving from a superset to a subset value is considered to be difficult/impossible precisely because there is no positive evidence in such cases to indicate to the learner that the extra option allowed in the L1 is disallowed in the L2 (White 1989a; Slabakova 2006).

Nevertheless, based on the input, the learners will restructure their grammar by going through a number of stages, first resetting parameters that are expected to be easier to reset, i.e. terminal parameters, and only in later stages, resetting parameters with embeddings. This will make their interlanguage sound, on the surface, more and more target-like (though not necessarily structurally target-like).

That is, the hypothesis that English-speaking learners of Turkish will perhaps not be able to expunge the Foot from their grammar and thus not be able to reach target-like representations of Turkish regular stress does not mean that they will always use their L1 representations: As per (25b), they are expected to consider a variety of UG-constrained options, and in doing so, they should initially resort to easier options rather than more difficult ones (see (25b.i) through (25b.iii)). For example, in learning Turkish regular stress, English-speaking learners should first reset a terminal parameter like Extrametricality or Headedness, rather than a parameter with embedding like Iterativity.

4 Methodology

In order to test the PAPH, a production experiment was designed with English-speaking learners of Turkish. The section below presents information on the subjects (Section 4.1), materials and stimuli (Section 4.2), procedures (Section 4.3), as well as data analysis (Section 4.4).

4.1 Subjects

A total of 46 English-speaking learners of Turkish participated in the experiments. According to self-report, all subjects were near-monolingual and had normal or corrected-to-normal vision and had no hearing problems. In order to independently determine their proficiency level, two proficiency tests were used, a cloze test measuring their syntactic and morphological skills and a read-aloud test assessing their global phonological proficiency. The readings obtained as a result of the read-aloud test were, then, rated, on a scale of 1 to 7, by three native speakers of standard Turkish, 1 being least, and 7 being most native-like in terms of global accent (see e.g. Akita 2006; 2007 for a similar procedure with the read-aloud task). Also included among the L2 learners' readings were readings by 3 Turkish native speakers, as well as readings by 3 learners of Turkish who were not subjects in the current study, totaling 50 readings to be rated (44 learners + 3 native speakers + 3 non-native non-subjects). The ratings were done in a pseudo-random order. The inclusion of native speaker readings and non-native non-subjects was done in order to help define the upper and lower bounds, thereby leading to more accurate ratings (see White & Genessee 1996), as well as to control the potential confounding effects of just having started the rating process.

By adding together the subjects' scores on the two proficiency tests, the cloze test and the read-aloud task, overall proficiency scores were calculated, and this was done in percentage terms. In doing so, each of the two tests contributed equally. Based on these overall proficiency scores, the subjects were assigned into different proficiency groups, beginner (n = 14), intermediate (n = 21) and advanced (n = 11).

Finally, regarding their background, the subjects ranged in age from 17 to 41 years old at the time of testing. All of them started learning the target language after age 16, with most starting in college around age 21. All of them had at least 1 to 2 years of formal instruction in Turkish, with the exception of two beginners and one intermediate learner who had no formal instruction (other than self-study) in the target language. All of the subjects had some regular naturalistic input in the target language. Most had native-speaking partners or friends (or roommates) with whom they communicated regularly in Turkish. None of the subjects was a heritage learner of the target language.

4.2 Materials and stimuli

The stimuli were composed of a total of 70 words, all of which were concrete nouns that could be depicted via a picture and could be known even by low proficiency learners. These included 20 bisyllabic and 40 trisyllabic words, all of which were controlled for the weight profiles of each syllable they contained. In addition, 5 four-syllable and 5 five-syllable words were also used (not controlled for weight), although these were not included in the analysis in the end, first because these were found to be abstract or recently borrowed words (reflective of the general situation with longer uninflected nouns in Turkish) and because many learners produced them with an internal pause (due to their length), which would have confounded the results.

The 60 bisyllabic and trisyllabic words embodied all possible combinations of open vs. closed syllables, i.e. LL, LH, HL, and HH for bisyllabic words, and LLL, LLH, LHL, HLL, HHL, HLH, LHH, and HHH for trisyllabic words, leading to 12 different conditions, each of which had 5 words.[11] Examples of bisyllabic and trisyllabic stimuli are presented below in Tables 1 and 2 respectively. For each stimulus, the phonetic transcription is given in the first row, followed by their written form in Turkish and English gloss.

Most light syllables started with an onset consonant followed by a nucleus vowel, whereas some were onsetless in that they only contained a nucleus. That is, onset profiles were not controlled, for onsets are not usually considered to contribute weight to a syllable (see e.g. Hayes 1995). As for ‘heavy’ syllables (heavy from the perspective of English), all of these contained a single nucleus vowel followed by a coda consonant. Although Turkish has a number of words with long vowels, since there are very few of them (all of which are borrowed words), syllables with long vowels were not included in the stimuli. Further, including heavy syllables that are composed of a nucleus and a coda consonant were considered to be sufficient for the purposes of the current study, since, English (the L1) is weight-sensitive regarding both codas and long vowels (and Turkish is for neither).

Coda + onset sequences were also controlled for their sonority profiles, as this could impact the way a sequence of two syllables is syllabified thereby altering the weight profiles of the relevant syllables. As such, all coda plus onset sequences in the stimuli were either sonorant + obstruent, sonorant + sonorant, or obstruent + obstruent. Crucially, obstruent + sonorant sequences were not employed, as these would be syllabified as complex onsets in English, even though they are coda + onset sequences in Turkish, since Turkish has no complex onsets (Kornfilt 1997; Kabak 2011), and transfer of L1 syllabification strategies to the target language could confound assumptions about syllable weight profiles. To give an example, if a word-medial coda + onset sequence in a Turkish word such as *as.lan* “lion” (an obstruent + sonorant sequence) were analyzed as a complex onset by the subjects, and were accordingly syllabified as *a.slan*, the initial heavy syllable would turn into light, changing an HH word into LH, which can then impact location of stress/prominence.

4.3 Experimental procedure

Each subject was tested individually in the following order: First, they were asked to fill in the background questionnaire. Then, they took the production experiment, followed by the read-aloud task, both of which were completed on computer in a sound-attenuated

Trisyllabic:

LLL	LLH	LHL	HLL	HHL	HLH	LHH	HHH
araba	tebeʃir	jumurta	hemʃire	dondurma	portakal	ørymdʒɛk	defterler
araba	*tebeşir*	*yumurta*	*hemşire*	*dondurma*	*portakal*	örümcek	*defterler*
car	chalk	egg	nurse	ice-cream	orange	spider	notebooks

Table 1: Example stimuli: trisyllabic.

Bisyllabic:

LL	LH	HL	HH
para	køpɛk	silgi	armut
para	*köpek*	*silgi*	*armut*
money	dog	eraser	pear

Table 2: Example stimuli: bisyllabic.

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[11] Closed syllables in Turkish are not heavy, but I simply use ‘H’ vs. ‘L’ to denote the difference, which reflects English representation of closed vs. open syllables, as closed syllables, along with syllables that contain long vowels, are heavy in English, and thus, attract stress (see Section 2.1 above).

booth. Finally, the cloze test followed, which, as with the background questionnaire, was taken in a paper-and-pencil format.

In order to control for a possible order effect, the experimental stimuli were pseudo-randomized. In addition, half of the subjects completed the experiments with one order (1 to 70), and the other half with the reverted order, i.e. 70 to 1, ensuring randomization between subjects. Each of the stimuli was first uttered in isolation, and then, once again, in a carrier sentence. The following carrier sentence was used:

(28) *Bu resim-de* ____*X*____ *var*
this picture-LOC ____*X*____ exist(ent)
"There is ____*X*____ in this picture."

For the purposes of data analysis, only the words contained in the carrier sentence were transcribed and later analyzed (see below).

Before the subjects started the production experiment, they were presented with a practice session composed of two words in order to ensure that they fully understood the task. The experimenter, who was not made aware of the purpose of the task, made sure not to utter the target words during the practice session in an effort to avoid influencing subjects' pronunciation. The practice session was followed by two words that were not included in the data analysis, as the purpose of including these was to avoid possible effects of having just started the experiment.

For all the experimental stimuli, each subject first saw a picture of the target word on the computer screen (as a Powerpoint slide), which was accompanied with the first letter of the word (see Figure 1). At this stage, their task was to name the object depicted in the picture. The reason for providing the first letter of the object was to help them retrieve the target word from the memory, especially in cases where there could be synonyms or where the picture can be interpreted as two different things. In the example below, for example, the presence of the first letter serves to help them identify the object as *portakal* 'orange', instead of, for example, *mandalina* 'tangerine':

At the next step, the subjects saw the picture again (see Figure 2), but this time, with the carrier phrase, and their task was to utter the word within the carrier phrase.

Once they produced the word within the frame sentence, the subjects, then, moved on to the next experimental item by clicking on the slide. The particular frame sentence was chosen based on several reasons. First, it is simple and rather short, and as such, there isn't much processing load involved on the part of the subjects, thereby decreasing chances of producing utterances with word- or sentence-internal pauses. Second, and perhaps even more importantly, the target stimulus within the frame sentence is located

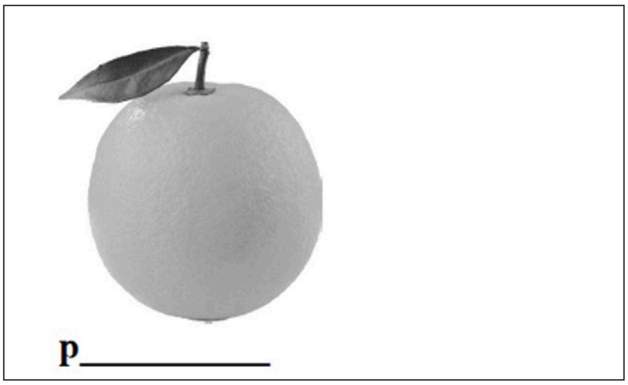

Figure 1: Example test item: Step 1.

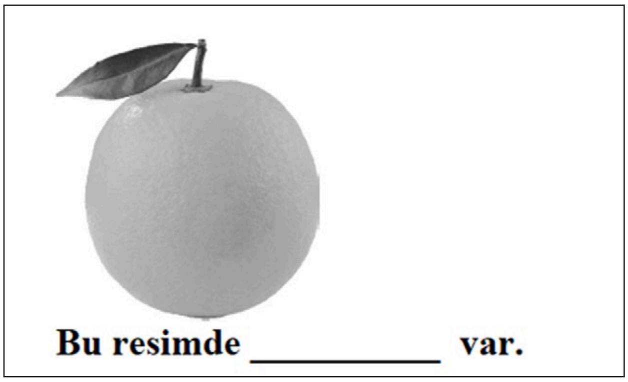

Figure 2: Example test item: Step 2.

in the prosodically strongest position of the sentence, i.e. the position that heads both the Phonological Phrase (PPh) and the Intonational Phrase (I) in Turkish, i.e. the leftmost prosodic word (PWd) within the rightmost PPh in the I (Özçelik & Nagai 2011), *as in*: [[[Bu]PWd [resimde]PWd]PPh [[**X**]PWd [var]PWd]PPh]I. In other words, no accent/prominence reduction is expected in this environment.

4.4 *Data analysis*

As mentioned above, only words uttered in a carrier sentence were transcribed and later analyzed. This was done to avoid certain confounding variables that could arise from words being produced in isolation, such as utterance-final lengthening and pitch fall, which could, in turn, signal greater final prominence than a given subject might produce. Further, the fact that these words were first produced in isolation before being produced in a carrier sentence helped remove any effects that could be caused by 'guessing'; words that are guessed are uttered with an intonation pattern that is usually associated with questions, and are, therefore, accordingly produced with a rising pitch and are lengthened on their final syllables.

The words produced in the carrier sentence were analyzed using an auditory measure for stress/prominence placement by two trained Turkish-speaking phonologists with background in Turkish phonology and teaching Turkish language. In cases of disagreement, the relevant item was discarded. The two listeners also used the Praat acoustic analysis software (Boersma & Weenink 2011) to back up the auditory data in determining prominence location, referring to vowel and syllable duration (in ms), average and peak intensity (in dB), average fundamental frequency (F0, in Hz), and time of F0 peak.

Sentences in which the target word was produced with a pause between its individual syllables were excluded from the analysis. Since four- and five-syllable words involved a particularly high number of pauses, especially for certain low-proficiency learners, these stimuli were completely excluded (see above), and thus, only bisyllabic and trisyllabic stimuli were analyzed.

5 Results

5.1 *General results*

Table 3 below summarizes overall results, indicating which syllable, for both bisyllabic and trisyllabic stimuli, bore primary stress in the utterances of the subjects.[12] The first number in each cell indicates percentage of words stressed on the corresponding syllable, while the second number (in parenthesis) is the standard deviation.

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[12] Overall, only 1.84% of all stimuli were excluded from the analysis for reasons such as the presence of a word-internal pause or disagreement between the two raters.

	Bisyllabic		Trisyllabic		
L1 Eng. (n=46)	**Penult**	**Final**	**Antepenult**	**Penult**	**Final**
Beginner	76.79	23.21	39.32	39.07	21.08
(n=14)	(27.91)	(27.91)	(28.35)	(20.04)	(22.43)
Intermediate	34.19	65.81	18.80	20.32	60.86
(n=21)	(30.34)	(30.34)	(25.58)	(15.42)	(29.50)
Advanced	17.37	82.63	11.75	11.45	76.80
(n=11)	(24.82)	(24.24)	(21.36)	(8.79)	(25.09)

Table 3: Results: percentage stressed.

As seen, the proportion of subjects' finally prominent syllables increases as they become more proficient in the target language. Whereas beginners stress word-final syllables about 23% of the time for bisyllabic and 21% of the time for trisyllabic Turkish words, these numbers rise to about 66% and 61% for the intermediates and 83% and 77% for the advanced learners. The results of a one-way ANOVA confirm that the difference between the three groups was statistically significant, for both bisyllabic ($F = (2, 43) = 15.515$, $p < 0.001$) and trisyllabic words ($F = (2, 43) = 15.482$, $p < 0.001$). Further, the results of a Tukey paired HSD demonstrate that this difference was due to the fact that both the intermediate and the advanced learner groups differed significantly from the beginner group ($p < 0.001$ for both pairs, for both bisyllabic and trisyllabic stimuli). The intermediate and the advanced groups did not however differ from each other significantly ($p = 0.258$ for bisyllabic and 0.251 for trisyllabic stimuli).

Clearly, then, there was a substantial amount of individual variation in the intermediate and the advanced groups, with some intermediate learners performing similarly to the advanced learners and some advanced learners performing similarly to the intermediates.

The general results as presented here are informative in the sense that they reveal the significant differences between the beginner group and the intermediate and advanced groups, but they do not, as it stands, indicate what exactly is going on in the individual grammars of these learners, especially since different learners at the same proficiency level are lumped together. As seen from the very high standard deviations, these percentages are not very informative; a 60% success level on the surface (as with the intermediates' performance on trisyllabic stimuli) can, for example, be due to two very different grammars being lumped together, one of which gives 20% final stress the other 100%. To put it another way, in order to have a clear understanding of individual learner grammars, one needs to distinguish not only between these two hypothetical cases, but also know what, in particular, is responsible for the 20% (or 100%) success rate. In other words, one needs to pinpoint whether the 20% is random or is indicative of something more subtle, such as certain stimuli shapes being stressed on final syllables by such a learner, as opposed to other shapes of stimuli.

With these considerations in mind, the following scatterplot (see Figure 3), which details each subject's percentage of finally stressed bisyllabic words, is quite informative and presents interesting insight into individual learner grammars:

At a first look, what this scatterplot shows is total chaos, with learners' performance all over the place, regardless of proficiency level. A more detailed look, however, suggests that, based on the percentage of finally stressed syllables they had, there were in general four types of learners: The first were learners who had almost no finally stressed syllables, as with L1 English, which we will call, for the purpose of this paper, Stage 0 learners.

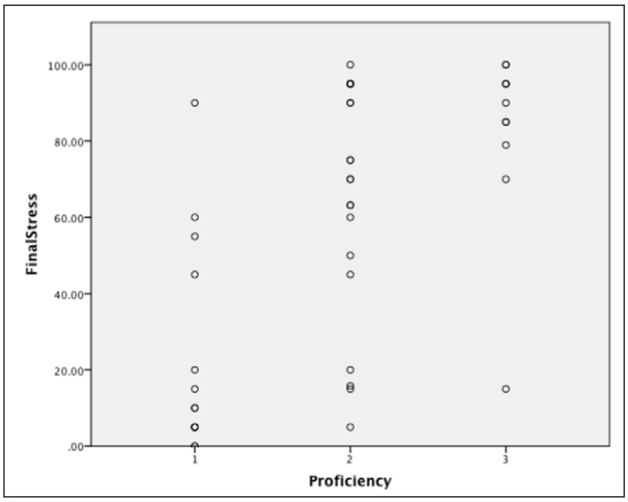

Figure 3: Percentage of subjects' finally stressed bisyllabic words based on proficiency (1=beginner; 2=intermediate; 3=advanced).

Interestingly, there were no learners who had about 25-40% final stress; there was a gap in the relevant area, with the next level starting with learners who had about 50% final stress (Stage 1). These were then followed by learners who had about 75% and 90-100% finally stressed words, with again not much in between.

This figure suggests that something is going on in individual grammars which suddenly results in leaps in the number of finally stressed syllables, much like 'parameter resetting' would. In fact, as I will illustrate in the following section, further analysis of individual grammars demonstrates that these leaps were indicative of different 'stages', stages which were characterized by different parameter settings employed by the learners.

5.2 Individual learner grammars

In this section, I illustrate individual learner grammars. In doing so, I concentrate on four trisyllabic words as examples (taken from the actual test items), which will help demonstrate learners' outputs under each stage: These words include (i) /a.ra.ba/ *araba* 'car', (ii) /ju.mur.ta/ *yumurta* 'egg', (iii) /por.ta.kal/ *portakal* "orange", and (iv) /te.be.ʃir/ *tebeşir* "chalk." These respectively represent sequences of LLL, LHL, HLH and LLH syllable structure profiles, based on the weight these syllables would be assigned by the English grammar (since Turkish is not weight-sensitive).[13]

When individual learner grammars were analyzed, i.e. when learners were categorized not according to proficiency level (as is usually done in L2 research), but in terms of their behaviour, a stage-like pattern of development emerged.[14] We describe this stage-like behaviour below, illustrating the surface effects of changes in parameter settings. We start with Stage Ø, which was composed of learners who treated Turkish as if it were English, the L1.

5.2.1 Stage Ø / Full Transfer: Use L1 values of all parameters

Assuming that the initial state of L2 acquisition is the L1 grammar (White 1989b; Schwartz & Sprouse 1996), beginning level English-speaking learners of Turkish should transfer L1 settings of *all* the parameters in (26), and thus, construct right to left, iterative, left-headed,

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[13] Note that these four word types are used in this section only for expository purposes; as was mentioned before, the experiment included all possible L and H combinations with two- and three-syllable words (i.e. totalling 12 possibilities). The point about the sections to follow is only to show, for a subset of words, what kind of effects one got with different parameter settings for various parameters.

[14] All but 2 of the 46 learners tested belonged clearly to one stage or another, defined based on the parameter settings employed, as will be illustrated here.

bounded, binary feet with End-Rule set to *Right* and Extrametricality to *Yes*. It was found that this was indeed the case with a total of 9 subjects, all of whom were beginners. In particular, 9 of the 14 beginners tested in the experiments (see Table 3 above) belonged to this stage, with no learners from intermediate or advanced levels. Note that since, at this stage, the final syllable is always extrametrical, it never gets stressed, and the learners should never be successful[15] at stressing the final syllables of Turkish words. As is demonstrated by Figure 4, a binary moraic trochee is constructed at this stage starting from the right edge of the PWd (excluding the final syllable, as it is extrametrical), meaning that stress is assigned to the penultimate syllable if it is heavy (e.g. *yu.múr.ta*), otherwise to the antepenult (e.g. *pór.ta.kal, á.ra.ba, té.be.ʃir*). Heavy syllables can form a foot by themselves, as they are binary at the moraic level, as with [(pór).ta.<kal>] and [yu.(múr).ta] (unless they are extrametrical as with the final syllable in (c) and (d)).

As Table 4 below illustrates, however, due to what I assume to be performance-related factors, these learners produced final stress 6.67% (SD: 6.12) of the time for bisyllabic and 8.54% (SD: 4.37) for trisyllabic stimuli. Further, for trisyllabic utterances, they stressed the first (antepenultimate) and the second (penultimate) syllable in equal amounts, which is reflective of the fact that half of the stimuli had a heavy second syllable (see Table 2), which is stressed since English is weight-sensitive (e.g. [L(H́)<L>]), and End-Rule is set to *Right* (e.g. [(H̀)(H́)<H>]). This is further evidenced by the fact that a heavy syllable, when available (and when not extrametrical), was indeed stressed. Accordingly, for trisyllabic stimuli, 94.89% of the heavy initial syllables and 98.34% of heavy penultimate syllables (i.e. those that were not extrametrical) received either primary or secondary stress. Table 4 below summarizes the results by syllable location, in terms of percentage stressed:

	Bisyllabic		**Trisyllabic**		
	Penult	**Final**	**Antepenult**	**Penult**	**Final**
n=9 **(9 beginners)**	93.33 (6.12)	6.67 (6.12)	48.18 (22.00)	42.76 (21.25)	8.54 (4.37)

Table 4: Stage 0 learners.

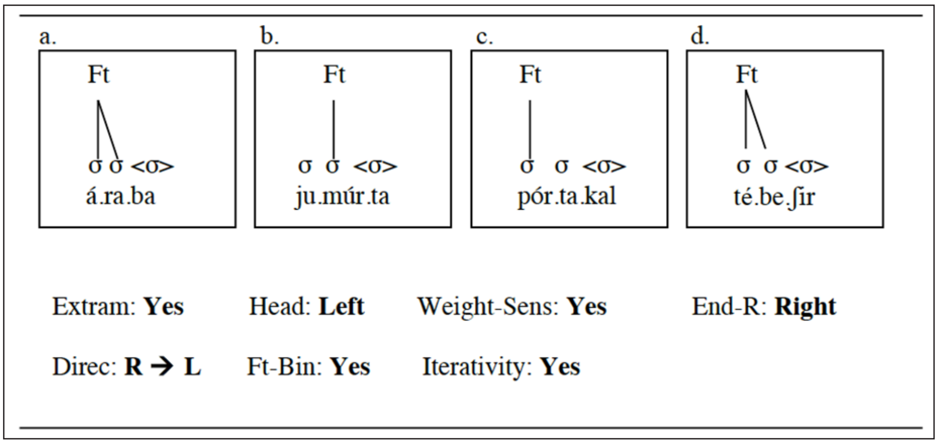

Figure 4: Stage 0.

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[15] This is not actual success; 'success' here means correctly being able to put prominence on the final syllable and only on this syllable. Actual success would necessitate ridding the grammar of the Foot and representing Turkish prominence as intonational instead of as stress.

Again, for trisyllabic stimuli, the results of a one-way ANOVA confirm that there was a statistically significant effect of syllable location (i.e. word-final, penultimate, or antepenultimate) on stress, ($F = (2, 24) = 13.080$, $p < 0.0001$). Furthermore, as would be expected by the representations employed at this stage (see Figure 4), the results of a Tukey paired HSD demonstrate that this difference was due to the fact that both the antepenult and the penult (both stressed around 50% of the time) differed significantly from the final syllable (rarely stressed) regarding stress attraction ($p < 0.001$ for both pairs), whereas the difference between the pair antepenult and the penult was not statistically significant ($p = 0.834$). As for bisyllabic utterances, the difference between the two syllables (93.33% vs. 6.67%) was similarly statistically significant, ($F = (1, 16) = 901.333$, $p < 0.0001$).

Finally, regarding Iterativity, the second surface correlate of non-native-like prosody (in addition to location of main stress), as expected under the PAPH, it was also non-target-like at this stage, for it is set to *Yes* in English, unlike in Turkish, although, for the words in Figure 4, it is vacuously satisfied since none of these words have enough moras to make two binary feet, as the last syllable is treated as extrametrical.

5.2.2 Stage 1: Reset Extrametricality from 'Yes' to 'No'

At the next stage were learners who reset the Extrametricality parameter from *Yes* to *No*, and kept all other English parameter values as they are in the L1, thereby correctly producing *some* forms with final stress, as a result of this single change in the grammar.

At this stage, we would expect the learner to still construct right-to-left, weight-sensitive, binary trochees. And since the learner's trochees will be weight-sensitive, and since final syllables are no longer extrametrical, he or she will stress the final syllable of all words that end in a consonant (representations (c) and (d)), for both codas (and long vowels) are moraic in the L1, employing the following representations:

For final prominence, this would lead to a 50% "success" rate, given that half of the stimuli ended in closed syllables (see Tables 1 and 2). This was partially confirmed, as Table 5 below demonstrates.

The fact that final stress was not observed 50% of the time in the utterances of these subjects is due to two factors: One, three subjects at this stage were still in the process of moving from the previous stage to Stage 1, and as such, produced some words with extrametrical final syllables. Two, surprisingly, and in a way not directly predicted by the PAPH, two subjects at this stage had End-Rule set to Left (having perhaps been influenced by Turkish exceptional stress), and one had a variable End-Rule, meaning that although final closed syllables received (at least secondary) stress, they did not, in the utterances of these subjects, necessarily receive primary stress. When these five subjects were excluded from the analysis, a clearer picture of Stage 1 appeared, as is illustrated in Table 6 below, where the penult and the final syllable are stressed to an equal extent, as would be expected by the representations (see Figure 5) corresponding to this stage:

	Bisyllabic		**Trisyllabic**		
	Penult	**Final**	**Antepenult**	**Penult**	**Final**
n=13 **(4 beg; 8 inter;** **1 advanced)**	64.31 (21.52)	35.69 (21.52)	37.19 (34.33)	31.31 (15.18)	31.31 (20.87)

Table 5: Stage 1 learners.

	Bisyllabic		Trisyllabic		
	Penult	**Final**	**Antepenult**	**Penult**	**Final**
n=8	50.23 (13.88)	49.77 (13.88)	13.24 (9.11)	40.55 (7.28)	45.88 (8.94)

Table 6: Stage 1 learners (clear cases).

As the results of a one-way ANOVA demonstrate, for trisyllabic words, the difference in stress attraction rates between the three syllables was statistically significant, ($F = (2, 21) = 34.068$, $p < 0.0001$). Further, this difference, as indicated by the results of a Tukey HSD test, was, as expected, because the proportion of both the penultimately stressed and the finally stressed words was statistically different from the proportion of words stressed on the antepenult ($p < 0.001$), although the penultimate and the final stress pairs were not statistically different from each other ($p = 0.435$). Likewise, for bisyllabic words, there was no statistically significant difference between penultimate and final stress, ($F = (1, 14) = 0.004$, $p < 0.948$), as both syllables were stressed roughly in equal amounts. Finally, the relation between syllable weight and stress is also evidenced by the fact that heavy syllables, when available, were stressed, receiving either primary or secondary stress (depending on the settings of the other parameters of the said interlanguage). Thus, for trisyllabic stimuli, 99.42% of final heavy syllables, 96.32% of penultimate heavy syllables and 95.71% of antepenultimate heavy syllables were stressed (primary or secondary) for these 8 learners.

Remember at this point that a learner at this stage could possibly also reset a parameter like Iterativity from *Yes* to *No*, and attain full success in that domain, but as predicted by the PAPH, this does not happen until much later: On the PAPH, resetting Iterativity would be quite costly, given (25), since the parameters dependent on Iterativity (i.e. those below it in (23)) would also be affected by such a change.[16]

Finally, note that this is a stage where the interlanguage grammar is neither like the L1 nor like the L2, neither in terms of the parameter settings employed nor in terms of the surface location of stressed syllables. For example, a word like /a.ra.ba/, which was stressed on its initial syllable in the previous stage (as with the L1), is stressed on its penultimate syllable at this stage (i.e. /a.rá.ba/). However, the penultimate syllable is not

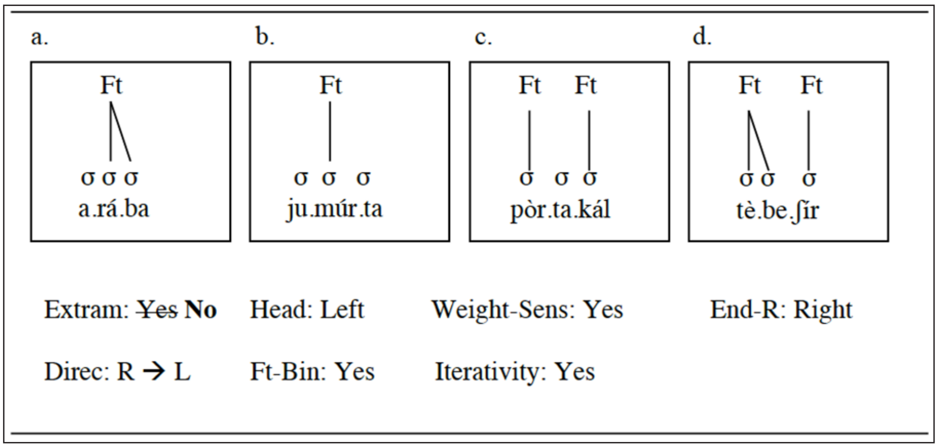

Figure 5: Stage 1.

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[16] One might argue that such a learner can, instead, reset End-Rule to *No*, which is a terminal parameter under Iterativity, and, thus, have no Iterativity. This is not possible for two reasons. First, since End-Rule is a Left/Right parameter, one cannot simply reset it to *No*; its effect cannot be removed unless it is deactivated, which is hypothesized to be impossible, given (25a). Second, even if deactivation of End-Rule turned out to be possible, since there are iterative systems with no End-Rule, e.g. Tübatülabal (e.g. Hayes 1981; Prince 1983), even if End-Rule was, somehow, deactivated, Iterativity would still not be irrelevant.

the most prominent syllable in the L1 or the L2; just like the L1 would stress the initial syllable in such a word, the L2 would place prominence on the final syllable (see Section 2). The fact that these subjects are stressing the penultimate syllable is, thus, clear evidence that they make changes to their grammar *on a parameter-by-parameter basis*, instead of randomly increasing the number of finally stressed/prominent words in their outputs in light of the input they receive in the L2 (i.e. finally prominent words). That is, this knowledge could not have been acquired via language transfer alone or L2 input alone (see Finer & Broselow 1986 for the same argument from syntax; see also Eckman 1991; Archibald 1992; 1993; 1995; Eckman & Iverson 1994; Carlisle 1997; 1998, for similar arguments from phonology).

5.2.3 Stage 2: Reset Extrametricality (Stage 1) and Head from 'Left' to 'Right'

The word types that were problematic for learners at Stage 1 were *all* of those ending in a final light (CV) syllable (see e.g. representations (a) and (b) in Figure 5). In addition to resetting Extrametricality as in Stage 1, some learners reset Foot-Head Direction from *Left* to *Right* (i.e. from Trochaic to Iambic). This single additional change resulted in final stress not only in cases with final closed syllables, but also in half of the cases where words end in an open/light syllable, i.e. those where a final open syllable is immediately preceded by another open syllable.

In other words, a learner at this stage will be able to stress not only word-final syllables that end in a coda consonant (as in Stage 1 above – see representations (c) and (d)), but also those ending in a vowel and not preceded by a closed syllable (as in representation (a) – see Figure 6), resulting in final stress roughly about 75% of the time. This analysis is one that is relatively easy to arrive at under the PAPH: The learner must reset *two* existing terminal parameters (Extrametricality and Head, see 23), but he or she does not have to make any previously set parameters (de facto) inactive:

Since, in this grammar, all final closed syllables (50% of the stimuli, see Tables 1–2), as well as all final open syllables preceded by open syllables (25% of all stimuli), will be stressed, we would expect learners at this stage to have final stress roughly 75% of the time, with the remaining stimuli stressed on the penult (as with (b) in Figure 6), and with no stimuli stressed on the antepenult. As Table 7 below indicates, this prediction was borne out, as the percentage of finally stressed words was very close to 75%. In addition, as expected, very few trisyllabic words bore primary stress on their initial (antepenultimate) syllable, because of the two-syllable stress window expected to exist at the right edge at this stage.

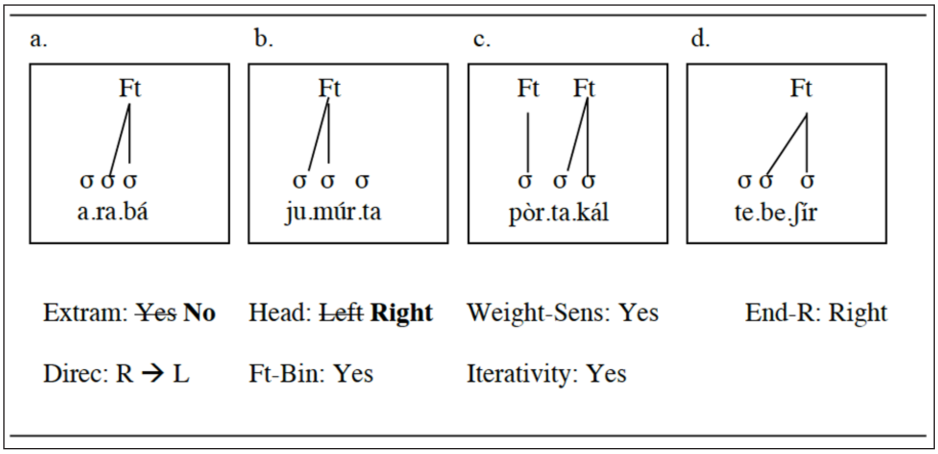

Figure 6: Stage 2.

	Bisyllabic		Trisyllabic		
	Penult	Final	Antepenult	Penult	Final
n=7 **(5 inter; 2 adv)**	28.27 (5.1)	71.73 (5.1)	8.11 (5.51)	27.04 (6.55)	64.85 (11.38)

Table 7: Stage 2 learners.

A one-way ANOVA was conducted to test or statistical significance. For trisyllabic words, the difference between the three syllable locations' stress attraction rates was significant, (F = (2, 18) = 86.347, $p < 0.0001$). In addition, and as was expected, this difference, as indicated by the results of a Tukey HSD test, was because the proportion of syllables with final, penultimate and antepenultimate stress were all statistically different from each other ($p < 0.001$ for each of the three pairs, i.e. antepenult-penult, antepenult-final, penult-final). Similarly, regarding bisyllabic stimuli, the differences in terms of stress attraction rates between the two syllables (penult and final) were statistically significant, (F = (1, 12) = 156.141, $p < 0.0001$).

As mentioned above, at this stage, words ending in a light syllable immediately preceded by a heavy/closed syllable (e.g. *yumurta*) still bear non-final (primary) stress. This is due to the fact that Weight-Sensitivity is still set to *Yes* in the grammars of these learners; as such, a heavy syllable, when available, must be stressed. (Thus, 98.60% of final, 95.65% of penultimate, and 96.40% of initial heavy syllables received primary or secondary stress in trisyllabic stimuli.) To put it another way, Weight-Sensitivity, which helped learners achieve *some* finally stressed words in the previous stage when the grammar was trochaic, prevents them from having final stress in *all* of the cases at this stage.

The 'logical' next step, for a cognitively driven grammar, would therefore be to reset Weight-Sensitivity also from *Yes* to *No*, and have final stress for all word types. No such learners were however found to exist in this study; none of the subjects had a weight-insensitive iambic grammar, which, I believe, is because such grammars are not permitted by the universal inventory of foot types, as was discussed in much previous formal phonological literature (see e.g. McCarthy & Prince 1986; Hayes 1995, among others). Instead, as will be seen in the next section, some learners lengthened word final open syllables, thereby turning them into heavy syllables, which could be stressed on a weight-sensitive grammar.

5.2.4 Stage 3: Reset Extrametricality and Head (Stage 3) plus word-final open syllable lengthening

The problem with the previous stage was with final Heavy-Light (HL) sequences (25% of the stimuli) since, given Weight-Sensitivity, these are stressed on the H, even in an iambic grammar. As mentioned above, however, there were no learners who reset Weight-Sensitivity to *No*. Instead, some learners lengthened word-final open syllables, much like resorting to 'iambic lengthening' (Hayes 1995) thereby changing word-final light syllables into heavy, which meant that these syllables could be stressed on a weight-sensitive iambic grammar:

As expected, almost all of these learners' utterances were stressed on the final syllable, with nearly no words stressed on the penult or the antepenult, as is indicated in Table 8.

A one-way ANOVA was conducted to test for statistical significance. For trisyllabic stimuli, the results confirmed that the difference regarding stress attraction between the three syllables was statistically significant, (F = (2, 36) = 818.208, $p < 0.0001$). Further, this difference, as indicated by the results of a Tukey HSD pair test, was, as expected, because the proportion of the finally stressed words was different (much greater) from the proportion of words stressed on the antepenult or penult ($p < 0.0001$ for both pairs), although the pairs 'penultimate' and 'antepenultimate' were not statistically different from each

	Bisyllabic		**Trisyllabic**		
	Penult	**Final**	**Antepenult**	**Penult**	**Final**
n=13	6.92	93.08	5.93	4.72	89.34
(7 inter; 6 adv)	(4.80)	(4.80)	(5.92)	(3.42)	(8.09)

Table 8: Stage 3 learners.

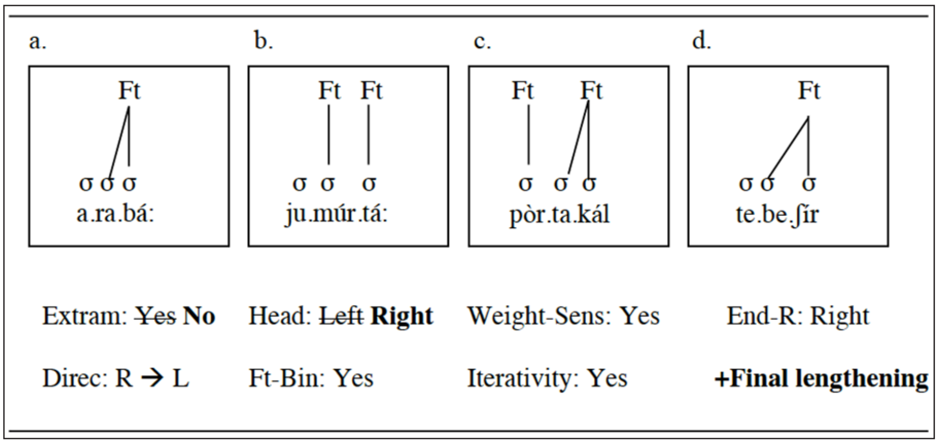

Figure 7: Stage 3.

other (p = 0.868). Similarly, for bisyllabic stimuli, the difference between finally stressed words and words with penultimate stress was statistically significant, (F = (1, 24) = 2090.667, p < 0.0001).

In sum, learners at this stage were able to consistently place stress on the final syllable of Turkish words, unlike those at previous stages, but were still unable produce Turkish words with only one prominent syllable (see e.g. (b) and (c) in Figure 7), as Iterativity was still set to *Yes* in their grammars.

5.2.5 Stage 4: Reset Extrametricality, Head, word-final lengthening (Stage 3) plus Iterativity from 'Yes' to 'No'

At this stage, learners would be making *four* changes in their grammar: Extrametricality from *Yes* to *No*, Foot-Head from *Left* to *Right*, word final lengthening and, crucially, Iterativity, a *non*-terminal parameter, from *Yes* to *No*. Out of the four general grammars covered so far, this last one should be the most difficult to employ on the PAPH, requiring a change that involves a parameter with embedding (see (23)), which is hypothesized on the current proposal to be highly costly.

As such, a change in Iterativity alone was not expected by itself; it is a change that is predicted to come only after some of the easier changes have been made in the grammar; it should, thus, appear together with a set of other changes, as is exemplified in Figure 8.

This grammar should, therefore, be one that is resorted to only after other simpler options are rendered non-optimal by L2 learners in capturing final prominence and lack of secondary stress in Turkish. It was predicted that only advanced or near-native learners should consider this.

These predictions were indeed borne out. Only two advanced learners were able to reset Iterativity from *Yes* to *No*. Both of them were among the most advanced learners tested, and one was in fact the most advanced among all the learners tested who had spent significant time in Turkey. Only 19.17% of the words they produced had secondary stress, although almost all of their outputs, except those in the LL and LH conditions, could have accommodated more than one foot, especially given that they had final lengthening

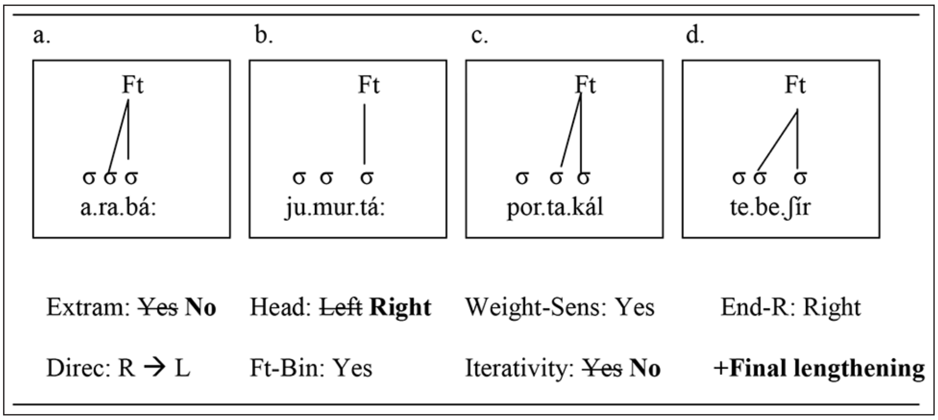

Figure 8: Stage 4.

(as with learners at the previous stage), thereby increasing the number of moras in a word and thus the possibility of multiple stresses. Given the many iterative forms (and many that lack Iterativity), it could also be stated that Iterativity was in the process of being reset from *Yes* to *No* for these learners. In terms of the percentage of syllables stressed, the results are summarized in Table 9:

	Bisyllabic		**Trisyllabic**		
	Penult	**Final**	**Antepenult**	**Penult**	**Final**
n=2	5.00	95.00	0.00	14.21	85.79
(both advanced)	(0.00)	(0.00)	(0.00)	(5.95)	(5.95)

Table 9: Stage 4 learners.

Note that at this stage, unlike stages 0, 1, 2, and 3, learners are finally able to correctly get rid of Iterativity altogether,[17] i.e. even for longer utterances, because there will be a single foot at the right edge for any given word. On the other hand, this may or may not mean that they were able to rid their grammar of the Foot, as their outputs may still be different from the actual Turkish grammar in that the acoustic correlates of final prominence would include duration (and possibly intensity), in addition to F0. In fact, this is what was observed in the current experiments for most of their outputs, but a more detailed account of whether very advanced (or near-native) learners of Turkish can move on to yet another stage and additionally rid their grammar of the Foot is beyond the scope of this paper.

6 Discussion

First and foremost, the results bear out the hypotheses generated by the Prosodic Acquisition Path Hypothesis (PAPH) proposed in this paper (see (25) in Section 3.3). In the most general terms, the English-speaking subjects went through a number of stages, consistent with the path proposed in this paper, making changes towards restructuring their interlanguage grammar on the basis of the L2 input, although the representations they entertained are not explicable on the basis of L2 input alone (see below). Changes resulting from

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[17] Another strategy that gets rid of Iterativity altogether would, of course, be to reset Boundedness from *Yes* to *No*, instead of resetting Iterativity. Such a strategy would, however, be even more difficult to employ, for Boundedness has even more parameters dependent on it than Iterativity does in the tree in (23). Determining, based on an output form, which of the two strategies is being employed by a given learner is nearly impossible, however; nonetheless, structurally speaking, changing Boundedness from *Yes* to *No* (and keeping everything else the same as in Stage 4) would result in Interlanguage representations such as *arabá, tebeşír, yumurtá* (compare these with the Interlanguage forms in Figure 8 that result from a change in Iterativity).

terminal parameters being reset (e.g. Extrametricality and Headedness) were employed first; changes that involved parameters with embeddings, such as Iterativity, were only made at later stages, and by the most advanced learners. Further, as expected, no English-speaking learner seemed to be able to rid their grammar of the Foot, but two learners, those with the highest level of proficiency (the two who reset Iterativity), had some outputs that could be analyzed as footless, presenting partial evidence against the strong form of the proposal that once projected, the Foot will never be expunged from the grammar. Perhaps, the Foot can also be lost, but only at near-native levels of proficiency. Further examination of this possibility will have to wait for future research on near-native speakers, and optimally involve an investigation of the acoustic correlates of stress/prominence, too.

All terminal parameters whose being reset served to make the interlanguage grammar sound more native-like, were, in the end, reset by the English-speaking learners, with the exception of Weight-Sensitivity, which, though terminal, was not reset (more on this below; see also the discussion at the end of Section 5.2.3). We have seen, for example, all English-speaking learners, except for the nine with the lowest level of proficiency, reset Extrametricality (from *Yes* to *No*). We have also seen several learners additionally reset Headedness (from *Left* to *Right*). Both are terminal parameters, and resetting both served to better account for the L2 input, thereby making their grammars sound more native-like. On the other hand, although resetting parameters with embeddings, such as Iterativity and Boundedness, would also have served to make their interlanguage grammar appear more-native like, these strategies were not employed by the vast majority of the English-speaking learners, consistent with the PAPH claim that these parameters should be very difficult to reset from their *Yes* to *No* settings (see (25)). Only two English-speaking subjects, those with the highest level of proficiency in Turkish, were able to reset Iterativity from *Yes* to *No*, and even for them, the parameter had not completely been reset to its *No* setting; there were still several utterances (about 20%, see Section 5.2.5) that were compatible with the *Yes* setting of this parameter. That is, their grammar was most probably still undergoing transition with respect to the “correct” setting of this parameter.

On the face of it, the finding that Weight-Sensitivity was not reset by the English-speaking learners from its *Yes* to *No* setting, seems to be in conflict with the PAPH; after all, all terminal parameters should be easy to reset according to the PAPH, and there seems to be no reason, if one can reset two terminal parameters, as was done by the Stage 2 learners, why resetting a third one, Weight-Sensitivity, should be impossible, at least at a later stage in development. In fact, that would make the grammar more symmetric on the surface, since all words would, then, end in a stressed syllable, no matter what weight the final syllable has, and the ambient input would better be accounted for by this analysis. Thus, there seems to be no obvious reason why some advanced learners would not follow such a path.

One could claim that the reason why no such pattern was observed is simply due to chance, i.e. that it could have arisen if more learners had been tested.[18] I will not follow this line of thinking, however; I will, instead, take a different, stronger, position, and will argue that the PAPH interacts, as any theory of language acquisition should, with other

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[18] One could also argue, as alluded to in Section 3.2, that Weight-Sensitivity is not, in fact, a terminal parameter, but that it has more structure underneath it since, in all weight sensitive languages in which codas are weight-sensitive, long vowels are weight-sensitive, too, but not vice versa. That is, it could be argued that Weight-Sensitivity is, in fact, Weight-Sensitivity-to-Vowels (with the settings of *Yes* and *No*), under the *Yes* setting of which there is Weight-Sensitivity-to-Codas (again with *Yes* or *No* settings). This will capture the implicational relationship between being sensitive to the weight of long vowels vs. codas observed in world languages. For L2 acquisition, then, one could argue that Weight-Sensitivity is difficult to reset because it has embeddings underneath. But this would not explain why Weight-Sensitivity-to-Codas, which would, under this analysis, be a terminal parameter under the maximal parameter of Weight-Sensitivity-to-Vowels, cannot be reset from *Yes* to *No*, either. Clearly, putting more structure under Weight-Sensitivity is not the solution.

factors in determining the level of difficulty for L2 learners, the other factor being language universals in this case.

The PAPH is as much a learning theory as it is a UG-based approach aiming to constrain our predictions of what L2 learners will and will not do. Its restrictive power comes both from the learning principles employed *and* the UG constrained principles and parameters assumed to hold of natural languages. It is the learning principles that predict terminal parameters to be easier to reset than parameters with embeddings, for example Iterativity. UG does not, otherwise, preclude a language from setting Iterativity to *No*. Noniterative footing is an option observed in many languages of the world (e.g. Southeastern Tepehuan; Kager 1997; 1999), but is rendered difficult according to the PAPH for learners coming from a language with a *Yes* setting.

On the other hand, once Headedness has been reset from trochaic to iambic (i.e. left- to right-headed), it is UG principles that rule out the option of resetting Weight-Sensitivity from *Yes* to *No*; otherwise, if the PAPH held true by itself, without being limited by language universals, all terminal parameters should be equally easy to reset from their *Yes* to *No* settings, as long as there is positive evidence triggering such a change. And in the case of Weight-Sensitivity, resetting it from *Yes* to *No*, for learners with iambic grammars such as those at Stage 2 and later, would, in fact, lead to higher levels of success with respect to final stress/prominence. That this was not done, neither by the Stage 2 learners nor by any of the subjects at later stages (who instead lengthened final light syllables – compare Figures 6 and 7, for example), despite being predicted by the PAPH and despite being a very reasonable option from a cognitive point of view, is due to UG precluding such an option. That is, a strategy could be predicted to be easy on the PAPH, yet is not chosen since it is not permitted in the inventory of options allowed by UG. This is the inverse of the preceding scenario, that an option could be permitted by UG (e.g. Iterativity-*No*), but is too difficult to adopt given the learning principles integral to the PAPH.

It has long been argued in formal phonological literature that there exist no weight-insensitive iambic languages, i.e. iambic languages in which a heavy syllable is in foot-dependent position, as with [(HĹ)] (see e.g. Hayes 1985; 1987; 1995; McCarthy & Prince 1986; 1993; 1995, among others). Hayes (1985), in fact, goes further, and argues, in proposing the Iambic/Trochaic Law (based on Bolton 1894; see also Woodrow 1909/1951), that there are durational asymmetries between iambic and trochaic systems, and that iambs are typically uneven (e.g. reinforced by vowel lengthening), of the form $[\sigma_{\mu} . \acute{\sigma}_{\mu\mu}]$, while trochees are typically even $[\acute{\sigma}_{\mu} . \sigma_{\mu}]$ or $[\acute{\sigma}_{\mu\mu}]$. Though this certainly seems to be a tendency (and heads of iambs are usually lengthened, as was done by the Stage 3 and 4 learners in this study), many iambic languages that are weight-sensitive but permit even parses, of the type observed in Stage 2 above (see Section 5.2.3), have also been attested (e.g. Ojibwa, and Weri, among others; see Gordon 2002).[19] What is unattested are, as mentioned, iambic parses such as [(H.Ĺ)] and [(H.H́)], parses where a heavy syllable is in foot-dependent position, though their trochaic counterparts, [(Ĺ.H)] and [(H́.H)], are attested, such as in Gooniyandi (see e.g. McGregor 1990; 1993; Kager 1992) and Modern Greek (Malikouti–Drachman & Drachman 1989; Drachman & Malikouti–Drachman 1999; Revithiadou 2004). In other words, weight-insensitive syllabic trochees are attested, whereas weight-insensitive syllabic iambs are not.

Prince (1991) nicely summarizes these facts by proposing a hierarchy of well-formedness for trochaic vs. iambic feet:

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[19] Furthermore, as one reviewer has pointed out, later experimental studies on rhythmic perception were not always in line with those of Bolton and Woodrow, contra Hayes' arguments (see e.g. Bell 1977 and Handel 1989).

(29) a. Trochees: $[\acute{\sigma}_{\mu} . \sigma_{\mu}]$, $[\acute{\sigma}_{\mu\mu}]$ >> $[\acute{\sigma}_{\mu\mu} . \sigma_{\mu}]$ >> $[\acute{\sigma}_{\mu}]$
b. Iambs: $[\sigma_{\mu} . \acute{\sigma}_{\mu\mu}]$ >> $[\sigma_{\mu} . \acute{\sigma}_{\mu}]$, $[\acute{\sigma}_{\mu\mu}]$ >> $[\acute{\sigma}_{\mu}]$

That is, both the uneven trochee $[\acute{\sigma}_{\mu\mu} . \sigma_{\mu}]$ and the even iamb $[\sigma_{\mu} . \acute{\sigma}_{\mu}]$ are allowed, but they are lower on the scale than the even trochee $[\acute{\sigma}_{\mu} . \sigma_{\mu}]$ and the uneven iamb $[\sigma_{\mu} . \acute{\sigma}_{\mu\mu}]$. What is not allowed, once again, is the weight-insensitive iamb of the type $[\sigma_{\mu\mu} . \acute{\sigma}_{\mu}]$ or $[\sigma_{\mu\mu} . \acute{\sigma}_{\mu\mu}]$, where a heavy syllable is in the dependent position of a foot.

If there is a universal foot inventory that excludes quantity-insensitive iambs, it is not surprising that no learner tested in our experiments followed such a path. This is despite the fact that doing so would be pedagogically and cognitively reasonable. All final syllables would, after all, be stressed, and the ambient input would be better accounted for. Therefore, this finding seems to present strong evidence for the view that interlanguages are UG-constrained (see e.g. White 1989b; 2003a).

One might wonder, at this point, why no weight-insensitive trochees were, then, observed in the current study. If resetting Weight-Sensitivity, a terminal parameter, was not allowed in the grammars of the English-speaking subjects with an iambic grammar due to a linguistic universal prohibiting such an option, why is it that it was not done by the English-speaking subjects with a trochaic grammar, either? The answer to this question is rather simple. Though Weight-Sensitivity is a relatively easy parameter to reset, and its being reset is permitted – provided that the language is trochaic – by whatever linguistic universals are responsible for the foot inventory available to speakers, there was no reason for the learners with trochaic grammars to reset it, given the ambient input. In fact, Weight-Sensitivity being reset would result in a decreased success rate among these learners, which were discussed under Stage 1 above; final syllables would, then, never be stressed, even when they ended in an H.

The question remains, however, as to how learners would behave in moving from a weight-sensitive trochaic language like English to a weight-insensitive trochaic language like Gooniyandi or Greek. Given the PAPH, there should be no difficulties in making such a change in the grammar, since Weight-Sensitivity is a terminal parameter (and since UG does not preclude weight-insensitive trochees). However, the prediction remains to be tested.

Just like the results of this study are informative regarding UG in that UG-disallowed options were not employed by the learners, they are also informative in that the options the subjects did entertain all corresponded to what is actually observed in natural languages of the world. For example, just like Stage 0 corresponds to English, Stage 1 corresponds to languages like Tol (Fleming & Dennis 1977) and Bergüner-Romansh (Kamprath 1987), both right-to-left trochaic languages without Extrametricality. It is interesting in this regard how learners' outputs at this stage were more similar *not* to the target language or the native language, but instead a language like Tol in which they never received input, producing outputs like /arába/, with stress on the penult, which is neither like the L1 nor the target language. As such, such outputs are inexplicable unless they are available to the learners as part of UG (see Finer & Broselow 1986 for the same argument from syntax; see also Mairs 1989; Archibald 1992; 1993; 1995 for similar arguments from phonology). The other stages also corresponded to natural languages: Stage 2 was quite like Aklan (Hayes 1981), and Tiberian Hebrew (McCarthy 1979) (see also Hayes 1995). Stage 3 is just like the various dialects of Ojibwa (see e.g. Bloomfield 1939; Piggott 1980; 1983). And Stage 4 is quite like Farsi Persian (Toosarvandani 2004; Hosseini 2014).

All things considered, the results of the current study provide strong evidence for the PAPH. This is particularly true when individual results/learner grammars (Section 5.2) are taken into consideration. Group results (Section 5.1) are informative only to the extent that they illustrate the range of variation observed for final stress among the subjects, implying that different options are being considered, some of which yield final stress more often than others. It is through the individual results that we obtain some insight into the grammars of each English-speaking subject, given that a certain output form with a certain stress pattern could be indicative of different parameter settings for different subjects. For example, it was predicted, and later found, that learners with trochaic and iambic grammars demonstrate the same behaviour on the surface for some conditions in the experiments. For example, LH and LHL words were both stressed on the H, with the former resulting in final and the latter non-final stress, by both trochaic and iambic English-speaking groups, since both groups had Weight-Sensitivity set to *Yes*. The differences between the grammars of the two groups of learners (i.e. trochaic vs. iambic) could have been obscured if each learner had not been analyzed separately based on their overall behaviour and if only a few conditions had been included, instead of testing all 12 possible combinations of open and closed syllables (see Tables 1 and 2).

7 Conclusion

The focus of previous research in L2 acquisition of stress/prominence has almost exclusively been on English (see e.g. Archibald 1993; Pater 1997; Tremblay 2006). The issue has been whether learners of English-type languages are able to stress the correct syllable or not, and crucially, *not* whether learners of fixed stress languages like Turkish (or French) can manage not to stress any (or many) syllables. Focusing on Turkish, I have presented a general, comprehensive account of the L2 acquisition of word-level prosody in this paper, an account that considers most parameters proposed in the literature that arise from having foot structure, as well as the Foot itself, in an effort to account for the L2 acquisition of stress in natural language. The result is the prediction of a "path," or, rather, several different acquisition paths, depending on the L1 and L2 involved.

In the most general terms, the PAPH can be summarized under two major points, some of which were tested in this paper, with English-speaking learners of Turkish; others require further research with different L1s and/or L2s: (i) It is impossible to deactivate a parameter altogether, but de facto deactivation, by means of resetting a parameter which embeds the relevant parameter from *Yes* to *No*, is possible, though highly difficult; (ii) Some parameters are easier to reset than others, depending on whether they are terminal or not in the parameter tree proposed in (23), or depending on whether the change is from *No* to *Yes*, or *Yes* to *No*. To give an example, English-speaking learners of Turkish were predicted to have greatest difficulties in ridding their grammar of foot structure (as Footedness is the parameter with the greatest number of embeddings in the tree), and they were predicted not to be able to deactivate certain foot-related parameters that are irrelevant in L2 Turkish. They were, on the other hand, hypothesized to be able to reset the values of some of the parameters in their L1, on the basis of positive evidence (some easier than others), and consequently construct several different interlanguage grammars, grammars that are neither like the L1 nor the L2, but are possible grammars attested among the natural languages of the world.

In order to test these predictions, a production experiment was constructed, with various conditions, so as to determine the relevant aspects of learners' prosodic grammars (see Section 4). In particular, all possible Light- and Heavy-syllable combinations were generated in the bisyllabic and trisyllabic stimuli used in the experiment, amounting to in total 4 conditions of bisyllabic and 8 conditions of trisyllabic stimuli. It was shown to be crucial to have as many conditions as possible, as it is nearly impossible to determine the correct setting of a parameter through looking only at a few word shapes, as the same behavior on the surface can be caused by the interaction of several different parameters.

This, to my knowledge, is the first experiment in the literature to consider words of all possible weight profiles.

The results of the experiments presented in Section 5 lend strong support to the PAPH. In particular, no L1 English-speaking learner of L2 Turkish seemed to able to produce footless outputs, or had fully reset the Footedness parameter (except partially for the two most advanced learners who appeared to potentially have some footless outputs); their productions all involved foot structure. This is in contrast to adding the Foot, which does not seem to be nearly as difficult, as is implied by the findings of research with French-speaking learners of English (Pater 1997; Tremblay 2007). Although, similar to Turkish, French is also arguably a footless language (e.g. Özçelik to appear), in which prominence regularly falls on the final syllable of a PPh, French-speaking learners of English are able to not only produce footed utterances, but also have the correct setting of most of the parameters of stress, and thus, produce iterative binary trochees.

Although the learners of Turkish tested in this study were not able to produce footless utterances, they did not, at the same time, use the L1 settings of all foot-related parameters; they reset several parameters, in order to better accommodate the L2 input, and in doing so, they demonstrated stage-like behavior (see Section 5.2), along the lines predicted by the PAPH. A great majority of the subjects were, for example, able to reset Extrametricality, a terminal parameter, from *Yes* to *No*, thereby producing some words with final stress. Words ending in an H were, in particular, stressed on their final syllable by these learners, for Weight-Sensitivity, in their grammar, was still set to *Yes*, as in the L1. Several subjects were also able to reset Foot-Head from trochaic to iambic, in addition to resetting Extrametricality, and were, thus, able to stress a higher number of syllables in word-final position, though this did not result in 100% final stress, given that Weight-Sensitivity was still set to *Yes*, resulting in non-final stress in final HL sequences. At the next stage were learners who not only reset Extrametricality (from *Yes* to *No*) and Foot-Head (from trochaic to iambic) but also lengthened final open syllables, thereby rendering them heavy, and thus achieving final stress at all times. None of the learners with iambic grammars, though, reset Weight-Sensitivity from *Yes* to *No*, although this would also have resulted in all words being stressed on their final syllables, as with final lengthening, and with the additional benefit of not violating Faithfulness to underlying (target) vowel length. Finally, only two subjects, two of the most advanced subjects tested, were able to utter words without secondary stress, providing evidence that Iterativity, a non-terminal parameter, i.e. one with embeddings, is indeed a very difficult parameter to reset, as was predicted by the PAPH.

Note that this research also contributes to our understanding of variability in L2 production, a topic that has generated much debate both in L2 syntax/morphology (see e.g. Lardiere 1998a; b; Ionin & Wexler 2003; White 2003b; Ionin, Ko, & Wexler 2004 for different accounts of variability) and L2 phonology (e.g. L. Dickerson 1975; W. Dickerson 1976; Tarone 1980; 1983; Tropf 1987; Eckman 1991; 2004; Broselow et al. 1998; Hancin-Bhatt 2000; Major 2001; Lombardi 2003; Broselow 2004). Focusing on prosodic variability, the current research suggests that what may look like random phonological variation on the surface can be accounted for via transfer of L1 prosodic representations and a well-defined process of moving away from these representations on a path where options are constrained by UG.

Many predictions can be made based on the PAPH, some of which we were able to test in the L1 English/L2 Turkish setting. Other predictions go beyond those tested in this paper, and could better be tested with different L1/L2 pairs. Take, for example, the prediction that resetting terminal parameters is easier than resetting parameters with embeddings. Though we did find some evidence of this in our experiment (Iterativity was, after all, very difficult to reset, unlike Extrametricality or Foot-Type), it is not clear if *all* terminal parameters are easier to reset than their non-terminal counterparts. In this paper, Weight-Sensitivity was not reset from its *Yes* to *No* setting, despite being a terminal parameter. We have linked this finding to two facts: (i) weight-insensitive iambs are not permitted by UG, so if interlanguages are natural languages, it is expected that the learners with iambic grammars will retain Weight-Sensitivity, and (ii) there was no reason for the learners with trochaic grammars to have a weight-insensitive system, since that accounts for the L2 input less well than the weight-sensitive trochees that are readily available from the L1. In order to further test the predictions based on the PAPH in this regard, it would be optimal to have an experimental setting with two trochaic languages, one with weight sensitivity, another without, and see, among other things, if learners can reset this parameter from *Yes* to *No*. Further, such a study, if bidirectional, could help us see if moving from *No* to *Yes* is indeed easier, as predicted by the PAPH, than vice versa.

One can test, for example, English-speaking learners of Greek, which has weight-insensitive trochees (Malikouti–Drachman & Drachman 1989; Drachman & Malikouti–Drachman 1999; Revithiadou 2004), as well as Greek-speaking learners of English. Both languages are trochaic, while the two differ in that whereas English is weight-sensitive, Greek is not. It should be possible for English-speaking learners of Greek to reset Weight-Sensitivity from *Yes* to *No*, since weight-insensitive trochees, unlike weight-insensitive iambs, are not ruled out by the universal foot inventory allowed by UG. Further, such a change should be rather easy, according to the PAPH, since Weight-Sensitivity is a terminal parameter. Finally, such a bidirectional study would allow us to test another prediction of the PAPH, that moving from *Yes* to *No* is more difficult than moving from *No* to *Yes*. Though both groups of learners should be able to reset the relevant parameter, the task should be easier for Greek-speaking learners of L2 English, for they are going from *No* to *Yes*, whereas English-speaking learners of L2 Greek are moving from *Yes* to *No*.

Finally, it should be noted that much of what was argued in this paper depends on a hierarchical tree representation of metrical parameters presented in (23). Certain parts of the tree could possibly be modified however. For example, it might be better to somehow tie together foot head and weight-sensitivity, for we know that iambic languages are always weight-sensitive, whereas trochaic languages can be weight-sensitive or not (see e.g. Hayes 1995; but see Alshuler 2009). Similarly, some of the parameters could have more structure underneath; Weight-Sensitivity, for example, can be characterized as Weight-Sensitivity-to-Vowels, under which exists Weight-Sensitivity-to-Codas, since all languages that are sensitive to coda weight are also sensitive to the weight of long vowels, but not vice versa. I leave further elaboration of the tree to future research.

In conclusion, the L2 acquisition data investigated in this paper presents evidence for the Prosodic Acquisition Path Hypothesis that was proposed here, as well as for UG-based theories of second language acquisition in general. At the same time, several aspects of this hypothesis, for which I presented formal and L1 acquisition-based arguments, remain to be tested by future experimental research with L2 learners of various language pairings.

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Competing interests

The author declares that he has no competing interests

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