L2 acquisition of Turkish vowel harmony and knowledge of the universal 'No Crossing' Constraint

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Abstract: Despite the poverty of the stimulus and potentially misleading classroom instruction, English-Turkish L2ers exhibit sensitivity to the "No Crossing Constraint" of Universal Grammar when calculating noncanonical vowel harmony in the context of underlyingly pre-specified non-velarized laterals (i.e. "light" [l]).

1. Introduction

Although there is a significant published literature documenting a range effects of principles of Universal Grammar (UG) in the domain of morphosyntax and semantics on (adult) nonnative (L2) language acquisition, there has been very little research on the role that UG principles might play in the L2 acquisition of phonology. This paper reports on an empirical study showing that despite a strong poverty of the stimulus, English-Turkish learners exhibit an emerging sensitivity to the "No Crossing Constraint" in their calculation of (non-canonical) Turkish vowel harmony, especially when potentially misleading standard orthography is removed from the stimuli. This effect is mysterious if phonological acquisition is purely based on frequency effects and/or instruction, but receives a natural explanation if adult L2 phonological acquisition is guided by the principles of UG.

2. Theoretical motivation

There is a rich literature showing that principles of UG constrain (adult) L2 morpho-syntactic and syntactico-semantic development. Some examples include studies on the interpretation of overt vs. null pronouns in null-subject languages (Kanno 1997; Pérez-Leroux & Glass 1997), the acceptability of remnant scrambling vs. remnant topicalization (Hopp 2005; Schreiber & Sprouse 1997), process vs. result interpretation of double genitives (Dekydtspotter, Sprouse & Anderson 1997), the multiple event requirement with certain floated quantifiers (Dekydtspotter, Sprouse & Thyre 1999/2000), scope asymmetries with pied piping vs. in situ restrictions on interrogative quantifiers (Dekydtspotter & Sprouse 2001; Dekydtspotter, Sprouse & Swanson 2001), weak vs. strong movement violations (Martohardjono 1993), and distributive interpretation of quantifiers and target landing sites (Marsden 2009). These studies examine a range of native languages (L1s) and target languages (TLs) and employ various tasks, they all rely on a three-fold poverty of the stimulus in L2 acquisition: (1) the crucial TL generalization is underdetermined by primary linguistic data; (2) the generalization is not instantiated in the learner's L1; and (3) the generalization is not the object of explicit instruction.

Furthermore, the studies do not rely on learners' performance to be statistically indistinguishable from the performance of native speakers to make their point. Rather, what is crucial is that there is evidence of the effect of the relevant principle of UG, once learners have received a significant exposure to TL input. This effect cannot be expected to emerge instantaneously, because the learners' L1s differ from the TL in such a way as to not provide the same domain for the relevant UG principle to manifest itself as it does in the TL.

In sharp contrast, there is very little research on whether principles of UG constrain (adult) L2 phonological development.[1] The goal of the current paper is to address this very question by an investigation of knowledge of the No Crossing Constraint (Hammond 1988) in the acquisition of non-canonical Turkish vowel harmony by English-speaking learners.

3. L1-TL background

Consider the Turkish vowel system, as shown in (1).

(1) Turkish vowel system

	[-back]		[+back]	
	[-round]	[+round]	[-round]	[+round]
[+high]	i	y	ɨ	u
[-high]	e	ø	a	o

The Turkish vowel system includes eight (8) vowels, which readily lend themselves to cross-classification by three (3) binary features: [±back], [±round], and [±high]. Abstracting away from details that do not directly concern us here, vowels in uninflected words ("roots") can exhibit any of the 8 logically possible combinations of the features [±high], [±back], [±round]. However, most vowels in suffixes are specified only for [±high]. Canonical vowel harmony in Turkish can be captured by the three statements in (2)
In non-initial syllables (hence, in all suffixes), the generalization in (2) holds.

(2)   For underspecified vowels,
        a.   the value of [±back] spreads from the immediately preceding vowel.
        b.   the value of [±round] spreads from the immediately preceding vowel, if the suffix vowel is [+high].
        c.   [-high] → [-round]

The generalization in (2a) applies to the vowel underlyingly specified as [+high] in the 3s possessive suffix, illustrated in (3).

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[1] One such investigation is the research on L2 knowledge of the UG ban on weight-insensitive iambic languages reported in Özçelik's (2012).

(3)   3s possessive suffix /-I/[2]

				root vowel	suffix vowel
a. ün-ü	/yny/	'(his) fame'	{[+high] **[-back] [+round]**}	{[+high] **[-back] [+round]**}
b. iş-i	/iʃi/	'(his) work'	{[+high] **[-back]** **[-round]**}	{[+high] **[-back]** **[-round]**}
c. kuş-u	/kuʃu/	'(his) bird'	{[+high] **[+back] [+round]**}	{[+high] **[+back] [+round]**}
d. kız-ı	/kɨzɨ/	'(his) girl'	{[+high] **[+back] [-round]**}	{[+high] **[+back] [-round]**}
e. göz-ü	/gøzy/	'(his) eye'	{[-high] **[-back] [+round]**}	{[+high] **[-back] [+round]**}
f. ders-i	/dersi/	'(his) lesson'	{[-high] **[-back] [-round]**}	{[+high] **[-back] [-round]**}
g. dost-u	/dostu/	'(his) friend'	{[-high] **[+back] [+round]**}	{[+high] **[+back] [+round]**}
h. at-ı	/atɨ/	'(his) horse'	{[-high] **[+back] [-round]**}	{[+high] **[+back] [-round]**}

Because the values of both [±back] and [±round] in the vowel of the suffix are copied from the immediately preceding vowel, this suffix displays four (4) allomorphs: /-y/, /-i/, /-u/, and /-ɨ/.

The generalizations in (2b) and (2c) are illustrated in the vowel underlyingly specified as [-high] in the dative suffix, shown in (4).

(4)   dative suffix /-E/[3]

				root vowel	suffix vowel
a. ün-e	/yne/	'fame.DAT'	{[+high] **[-back]** [+round]}	{[-high] **[-back]** [-round]}
b. iş-e	/iʃe/	'work.DAT'	{[+high] **[-back]** [-round]}	{[-high] **[-back]** [-round]}
c. kuş-a	/kuʃa/	'bird.DAT'	{[+high] **[+back]** [+round]}	{[-high] **[+back]** [-round]}
d. kız-a	/kɨza/	'girl.DAT'	{[+high] **[+back]** [-round]}	{[-high] **[+back]** [-round]}
e. göz-e	/gøze/	'eye. DAT'	{[-high] **[-back]** [+round]}	{[-high] **[-back]** [-round]}
f. ders-e	/derse/	'class.DAT'	{[-high] **[-back]** [-round]}	{[-high] **[-back]** [-round]}
g. dost-a	/dosta/	'friend.DAT'	{[-high] **[+back]** [+round]}	{[-high] **[+back]** [-round]}
h. at-a	/ata/	'horse.DAT'	{[-high] **[+back]** [-round]}	{[-high] **[+back]** [-round]}

Here there are only two (2) allomorphs: /-e/ and /-a/, because only the feature [±back] is copied from the immediately preceding vowel. As stated in (2c), with underlyingly underspecified suffix vowels, if the suffix is pre-specified as [-high], then it must surface as [-round].

We turn now to the canonical distribution of the phoneme /l/ in Turkish. This phoneme has two allophones: non-velarized ("light") [l], which generally occurs in the context of [-back] vowels, and velarized ("dark") [ɫ], which generally occurs in the context of [+back] vowels. Consider root-final /l/ in inflected words, that is, the configuration sketched in (5).

(5)   … V   /l/   +   C*   V … (+ a morpheme boundary)

It follows from canonical vowel harmony that both Vs will be either [-back] or [+back]. In the environment of [-back] V, /l/ is realized as "light" [l], while in the environment of [-back] V, /l/ is realized as "dark" [ɫ]. This is indeed the pattern found in native Turkic words, as illustrated in (6).

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[2] We follow the standard Turkological practice of representing the underlying [+high] vowel of such suffixes as /I/. The gloss 'his' should be understood as 'his or her.'

[3] Again, we follow standard Turkological practice by representing the underlying [-high] vowel of such suffixes as /E/.

(6)   Canonical distribution of /l/

			V	realization of /l/
a. kül-e	[kyle]	'ash.DAT'	[-back]	**"light" [l]**
b. il-e	[ile]	'city.DAT'	[-back]	**"light" [l]**
c. kul-a	[kuła]	'servant.DAT'	[+back]	**"dark" [ł]**
d. kıl-a	[kiła]	'hair.DAT'	[+back]	**"dark" [ł]**
e. göl-e	[gøle]	'lake. DAT'	[-back]	**"light" [l]**
f. bel-e	[bele]	'back.DAT'	[-back]	**"light" [l]**
g. kol-a	[koła]	'arm.DAT'	[+back]	**"dark" [ł]**
h. bal-a	[bała]	'honey.DAT'	[+back]	**"dark" [ł]**

This appears to be a straightforward case of allophones of a phoneme in (a phonetically natural) complementary distribution, and it is hardly surprising that the standard system of Turkish orthography employs a single grapheme to represent both allophones.

However, the modern Turkish lexicon includes a set of exceptions to the canonical distribution of /l/, where (in certain loanwords) "light" [l] occurs in the environment of a [+back] vowel. Some examples are given in (7).

(7)   Non-canonical distribution of /l/

			V	realization of /l/
a. rol	[rol]	'role'	[+back] V	"light" [l]
b. petrol	[petrol]	'gasoline'	[+back] V	"light" [l]
c. hal	[hal]	'situation'	[+back] V	"light" [l]

Since this represents a relatively small class of exceptional words, we assume that in just such cases, the lateral is underlyingly specified as non-velarized ("light") [l].

The non-canonical distribution of /l/ gives rise to non-canonical vowel harmony.[4] Consider the environment root-final /l/ in inflected words in the configuration in (8).

(8)   … V[+back] "light" [l] + underspecified V … (+ a morpheme boundary)

The vowel immediately preceding underspecified V is [+back], but the adjacent [l] is [-back] (Coronal). In this case, the No Crossing Constraint of Universal Grammar (Hammond 1988) blocks the spreading of [+back] from the root vowel to the suffix vowel, because there is a closer segment that can provide the relevant specification, in this case the "light" [l]. This is illustrated by the examples in (9).

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[4] There are also instances where dorsal plosives exhibit a non-canonical allophonic distribution, also giving rise to non-canonical vowel harmony. Their behavior in both L1 and L2 Turkish goes beyond the limits of the current study.

(9)   Examples of the No Crossing Constraint
        a. rol-e   [role]   'role.DAT'   [+back]   "light" [l]   **[-back]**
        b. petrol-e   [petrole]   'gasoline.DAT'   [+back]   "light" [l]   **[-back]**
        c. hal-e   [hale]   'situation.DAT' [+back]   "light" [l]   **[-back]**

In the examples in (10), the dative suffix /-E/ is realized with the [-back] vowel /e/, instead of the [+back] vowel /a/, despite the [+back] specification of the root vowel. This is because of the [coronal] feature of the intervening lateral. This phenomenon is illustrated in a condensed Feature Geometric representation in (10) (see Levi 2001 for a similar approach):

(10)   r   o   l   e

        C-place   C-place   C-place   C-place

                       V-place   V-place   V-place
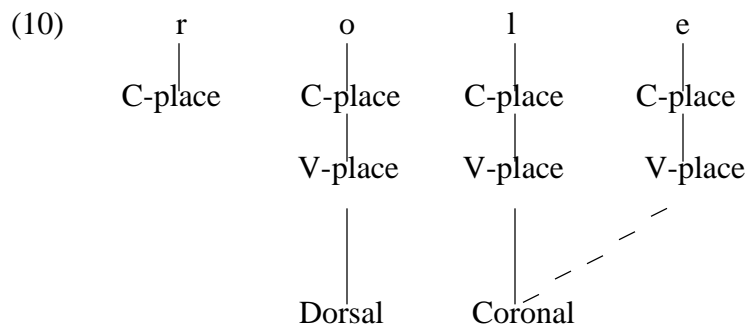
                       Dorsal   Coronal

Normally, we would expect [±back] (Dorsal vs. Coronal for [+back] and [-back], respectively) to spread from one vowel to another (i.e. from [o] in this example), as it is, in the general case, only vowels that have the node Vowel-place (V-place), where spreading of vowel features occurs, ensuring that vowel harmony satisfies locality, despite intervening consonants. The No Crossing Constraint explicitly blocks a representation in which the V-place node of the second vowel is associated with the Dorsal node of the first vowel, crossing the direct line from the V-place of the intervening /l/ associated with Coronal.

An English-speaking classroom learner of Turkish is faced with a four-fold poverty-of-the-stimulus in acquiring non-canonical vowel harmony: (1) Non-canonical vowel harmony is underdetermined by Turkish primary linguistic data. (2) English does not instantiate vowel harmony, canonical or otherwise. (3) Learners receive explicit instruction on canonical vowel harmony, but not on non-canonical vowel harmony. (4) Turkish orthography, which is generally a reliable representation of Turkish at the phonemic level, does not represent the difference between "light" [l] and "dark" [ɫ]. Given the robust nature of the canonical distribution of /l/, orthographic representations like <rol> for [rol] are misleading. If such learners nevertheless exhibit a developmental path away from reliance on the rules of Turkish canonical vowel harmony alone and begin to exhibit knowledge of non-canonical vowel harmony as well, this would point to the conclusion that the No Crossing Constraint of UG is guiding their phonological development.

4. Participants, methods, and materials

Participants were 16 adult English-speaking L2 learners of Turkish, as well as a comparison group of 8 native Turkish speakers. The L2ers were attending a major midwestern university in the USA. Their average age was 25 years (range 19-36 years), whereas the average age of native Turkish speakers was 30 (range 28-33). L2ers' knowledge of Turkish was based on a combination of instruction in Turkish as a foreign language at the university (starting from at least 6 months of instruction to 4 years of instruction) and naturalistic exposure through study abroad in Turkey (one month to 2 years), as well as through Turkish-speaking partners, friends, or relatives. In total, 8 out of 16 participants had some type of regular naturalistic input in Turkish, in addition to the classroom input (naturalistic or formal) from native speaking teachers and teaching assistants. On the basis of a multiple-choice cloze test, participants were divided into three proficiency levels: beginner (n=6), intermediate (n=5) and advanced (n=5). These proficiency levels closely matched with participants' reported proficiency levels and the Turkish-language classes they were placed in at the university.

On the experimental task, participants were presented with a Turkish word or pseudoword (presented as a root), and asked to choose the correct variant of a suffix, from among four or two options depending on whether the suffix contained a [+high] vowel (four allomorphs) (half of the items or a [-high] vowel (two allomorphs) (the other half of the items). The task consisted of 256 semi-randomized items, half of which (i.e. 128) were experimental (i.e. ending in a lateral) and the other half fillers (i.e. ending in a variety of consonants other than a lateral), all presented on a computer screen. Both real Turkish words and pseudowords were used as experimental items, with approximately equal numbers (more on this below). All of the words were nouns and all the suffixes were inflectional suffixes that attach to nouns (see below). For half of the stimuli (both experimental and fillers), words were presented auditorily only, and participants had to choose the correct suffix to be attached from among those presented on a computer screen by clicking on the correct option. For the other half, words were presented both auditorily and visually; for these items, participants were instructed to also read the stimuli, in addition to listening to them, before choosing the correct option. Hence, of both experimental items and fillers (128 each), 64 of the items were presented only auditorily and 64 both auditorily and visually.

The following suffixes were used:

(11)   a. Suffixes with an underlying high vowel (128 in total; 64 experimental, 64 filler):
             i.   {/-im/, /-üm/, /-ım/, /-um/} 'first person possessive marker'
             ii.   {/-siz/, /-süz/, /-sız/, /-suz/} 'without'

        b. Suffixes with an underlying low vowel (128 in total; 64 experimental, 64 filler):
             i.   {/-ler/, /-lar/} 'plural'
             ii.   {/-de/, /-da} 'locative'

We tested every logically possible combination of stem vowel + suffix vowel. This is illustrated in Figure 1 below. For example, the sequences ü-ü and ö-ü under ü means that the suffix vowel is

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expected to have ü, following a word whose final vowel is ü and following a word whose final vowel is ö respectively, as in kül-üm and çöl-üm. There were 16 stimuli in each of the 16 conditions (e.g. i-i, o-u, ö-ü) presented in Figure 1, of which 8 are experimental (words that ended in /l/) and 8 are fillers. Again, half of these were presented auditorily only and half both auditorily and visually, as was also mentioned above:

Figure 1: Expected stem+suffix vowel sequences in stimuli[5]
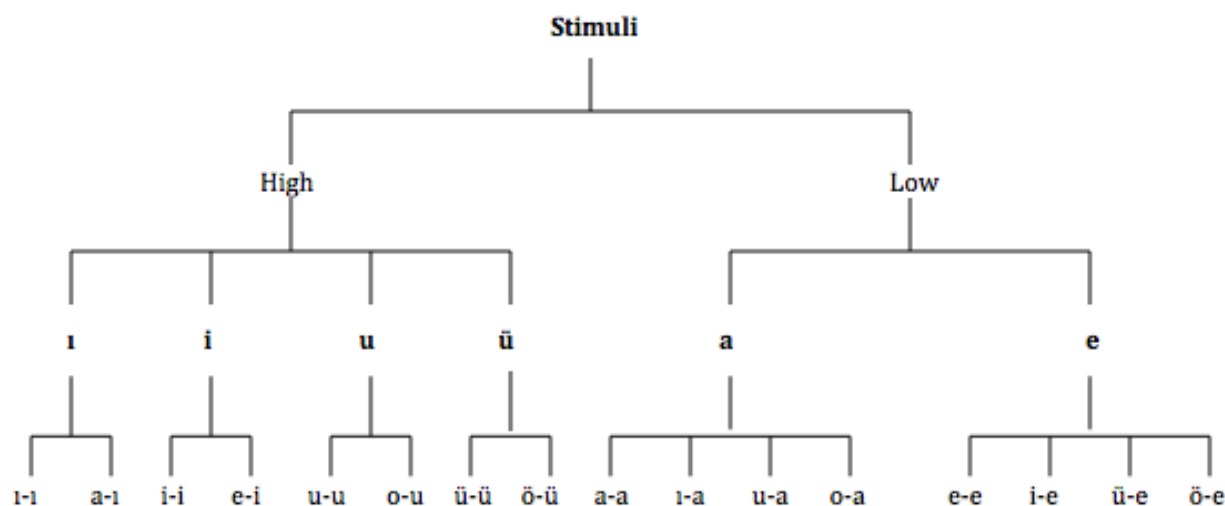
Half of the experimental items in each condition (i.e. 4 out of 8) had a non-contrasting /l/, which means that the /l/ surfaced as a non-velarized ("light") [l] in the environment of front vowels and a dark (velarized) [ł] in the environment of back vowels, e.g. [bał] 'honey' vs. [bɛl] 'back' as in (6). For the other half, the quality of the lateral was underlyingly specified, as with the forms in (7) above, such as [rol] 'role', where a "light" [l] appears in the environment of back vowels. Because of this, back harmony is affected by the presence of this [l] in that the vowel of the following suffix needs to be front, not back, even though the last vowel in this word is a back vowel, i.e. as in [rol-de] and not *[rol-da]. In addition to these forms which have a lateral underlyingly specified as [-back], we also created stimuli that were the mirror image of these cases, words with a lateral underlyingly specified for [+back], i.e. cases leading to a dark /ł/ on the surface immediately following a front vowel, e.g. [tøł] and [reł], even though this particular pattern does not occur in Turkish at all.[6] The focus of this paper is on the former type of

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[5] Note that the tokens represented in Figure 1 are more representative of the distribution of vowel sequences expected under canonical vowel harmony and do not necessarily reflect non-canonical vowel harmony. What matters here is that every possible sequence of vowels has been symmetrically represented among the stimuli selected for the study.

[6] These items were added in order to test whether learners (and native speakers) would attach a suffix with a back vowel after a lateral underlyingly specified as [+back], mirroring what happens with forms like [rol-de], where a suffix with a front vowel is attached after a word

underlyingly specified laterals, i.e. those that actually occur in Turkish. In sum, whereas half of the experimental items (i.e. 64) had a non-contrasting /l/ (not pre-specified for [±back]), the other half had a contrasting /l/ (i.e. pre-specified for *[±*back]*)*, half of which (i.e. 32) were pre-specified for (i.e. underlyingly had) a light /l/, and the other half (i.e. 32) were pre-specified for a dark /ł/, the form that does not exist in Turkish. These were equally distributed to the two different modalities of presentation. The main focus of this paper, as mentioned above, is cases where there is an underlying light /l/.

There were also 128 fillers, which ended in a variety of Turkish consonants. The fillers, unlike experimental stimuli, did not contain consonants affecting vowel harmony or any other type of exceptionality. Their inclusion helped us to ascertain if participants knew several linguistic structures involved in the experimental stimuli, such as vowel harmony rules most importantly, including both back and rounding harmonies. Perhaps more importantly, they also ensured that the number of words ending in [l] and [ł] vs. other consonants was somewhat balanced, helping us avoid a situation where all test stimuli ended in a lateral.

Participants were tested individually (on a computer screen, using the Powerpoint software). The order of testing was as follows: (i) a language background questionnaire, (ii) vowel harmony experiment, and (iii) cloze test. Responses were recorded and subsequently downloaded into Excel for analysis. For all the results reported below, we conducted a two-way ANOVA, followed by a post hoc test, i.e. a Tukey HSD test.

5. Results

We used the proportion of participants' correct suffix choices as our dependent variable. Our independent variables were (i) modality of presentation, i.e. whether the stimulus was presented auditorily only or both auditorily and visually, as well as (ii) proficiency level. Figure 2 below summarizes these results, in terms of percentage of correct responses, for (i) stimuli ending in laterals underlyingly specified as Coronal (i.e. [-back]) following a [+back] vowel (row 1), (ii) for laterals that are underlyingly unspecified and thus appear as light-l in the environment of front vowels and dark-ł in the environment of back vowels (row 2) and (iii) fillers, words that end in consonants other than a lateral (row 3).

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whose final vowel is a back vowel, because of the underlyingly specified "light"/l/. We will return to this issue in future research.

Figure 2. Results

	Beginner (n=6)	Intermediate (n=5)	Advanced (n=5)	Native (n=8)
Back V + light /l/				
Auditory only	44.17%	55.00%	55.00%	81.88%
Auditory + visual	2.50%	21.00%	32.00%	73.18%
Regular /l/				
Auditory only	77.09%	90.63%	96.25%	99.61%
Auditory + visual	96.67%	98.40%	99.20%	99.50%
Fillers				
Auditory only	84.11%	93.75%	96.56%	98.83%
Auditory + visual	98.43%	99.06%	95.90%	98.04%

The results suggest that on test items, i.e. words that end in a palatal [l] after a back vowel (as in [rol]), hearing stimuli only auditorily lead to a higher percentage of correct responses than being presented with stimuli both auditorily and visually; that is, 'modality of presentation' mattered. As seen, all learner groups, irrespective of their level of proficiency did better in the "Auditory only" condition than in the "Auditory+visual" condition. The results of a two-way ANOVA showed that these differences are statistically significant, $F(1, 26) = 11.024$, $p < .001$, although there was no significant main effect for the 'proficiency' factor, $F(2, 26) = 1.557$, $p > .05$. Further, the interaction between 'modality of presentation' and 'proficiency' was not significant, either, $F(2, 26) = .306$, $p > .05$.

In contrast, for all other stimuli, such as (regular) /l/ that is underlyingly not specified as coronal or dorsal (row 2), as well as all the fillers (row 3), presenting stimuli visually in addition to auditorily *increased* the percentage of correct responses, as opposed to what happened in the case of experimental stimuli. First, for stimuli ending in a regular /l/, the two factor analysis of variance showed a significant main effect for the 'modality of presentation', $F(1, 26) = 55.884$, $p < .001$ and, unlike the test items, a significant main effect for 'proficiency' level, $F(2, 26) = 23.878$, $p < .001$. Further, the interaction between 'modality of presentation' and 'proficiency' was also significant, $F(2, 26) = 14.078$, $p < .001$. Further, the results of a Tukey HSD test show that the significant effect of 'proficiency' was due to the difference between the 'Beginner' and 'Advanced' groups ($p < .01$), and that there was no significant difference between the two pairs 'Beginner and Intermediate' and 'Intermediate and Advanced' ($p > 0.5$ for both pairs).

Finally, on fillers, as with cases with regular (non-contrasting) /l/, 'modality of presentation' (auditory only or auditory + visual) made a difference, with stimuli presented with both auditorily and visually leading to higher rates of correct responses than stimuli presented auditorily only. Accordingly, the results of a two factor analysis of variance demonstrated a

significant main effect for 'modality of presentation', $F(1, 26) = 17.712$, $p < .001$; and a significant main effect for the 'proficiency' factor, $F(2, 26) = 5.328$, $p = .012$. The interaction between 'modality of presentation' and 'proficiency' was also significant, $F(2, 26) = 8.771$, $p < .001$. Further, the results of a Tukey HSD test show that the significant effect of 'proficiency' was due to the difference of the 'Beginner' group from both 'Intermediate' and 'Advanced' groups ($p < .05$). There was no significant difference between the pair 'Intermediate' and 'Advanced' ($p > 0.5$), meaning that, for regular cases of vowel harmony, proficiency level mattered only to the extent that it distinguished beginners from intermediate learners; at higher levels, intermediates and advanced learners did similarly.

The contrast in Table 2 between row 1 on one hand and rows 2 and 3 on the other is rather striking: Whereas presenting stimuli visually (in addition to auditorily) negatively influences participants' correct responses in cases where a palatal (light) [l] immediately follows a back vowel (where orthography is opaque), the same factor positively influenced participants' proportion of correct answers in the two other types of stimuli, cases with regular /l/ (where the underlying place of /l/ is not specified) and fillers (i.e. the types of stimuli where word-final vowels only determine the quality of the suffix vowel). It should be noted, however, that in cases with regular /l/ and fillers (forms with regular vowel harmony), none of the participants had any noteworthy difficulties to begin with (except to some extent beginners), suggesting that vowel harmony itself (regular harmony) is not difficult for learners of Turkish, irrespective of level of proficiency and regardless of whether it involves back harmony or rounding harmony.

6. Discussion and conclusion

In our experiment, modality of presentation was a very significant factor. When compared with auditory presentation alone, bimodal presentation (including both auditory and orthographic stimuli) led learners at all three proficiency levels to a higher rate of correct responses on canonical vowel harmony but to a lower rate of correct responses on non-canonical vowel harmony. Bimodal presentation led even native speakers of Turkish to a depressed rate of accuracy on non-canonical vowel harmony, when compared with auditory presentation alone.

The basic outline of development reported here suggests an important role for orthography in the phonological development of instructed learners acquiring a language such as Turkish. It would appear that the (many) aspects of Turkish orthography that more or less transparently encode the phonological system of Turkish (of course, paired with abundant auditory input) can be highly facilitative of phonological acquisition, particularly in early stages of acquisition; however, the less transparent or even obfuscating aspect of the orthographic system (which in our case are relevant for relatively low-frequency phenomena) can (partially) inhibit such acquisition in early learners. As development unfolds, our English-Turkish L2ers came to rely less on potentially misleading orthographic stimuli, performing at a significantly higher rate of accuracy, even when potentially misleading orthographic presentation was included in the stimulus.

The developmental path displayed by the three learner groups points to the acquisition of abstract phonological representations that distinguish between the canonical and non-canonical

distributions of Turkish /l/ and recognize the need for pre-specification of non-canonical /l/. Only on the assumption that an innate principle such as the No Crossing Constraint is (still) active in adult L2ers does it follow that this underlying specification results in the TL-like computation of non-canonical vowel harmony in both (a small set of) actually occurring and nonce forms. It is important here not to be misled by the still far from native-like performance of the Advanced group on non-canonical vowel harmony. Recall that on the basis of classroom instruction on both canonical vowel harmony and the interpretation of Turkish orthography, we would expect accuracy on non-canonical vowel harmony to be the mirror image of accuracy on canonical vowel harmony, i.e. close to 0%. This is far from the case, and it suggests that the difference between the Advanced group and the Native group is quantitative, not qualitative: The performance of both groups is impacted by the No Crossing Constraint.

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