CHAPTER 2

Decreasing dependence on orthography in phonological development

Evidence from vowel harmony in English-Turkish interlanguage

Öner Özçelik and Rex A. Sprouse
Indiana University

Despite the general transparency of standard Turkish orthography, it fails to distinguish the (not fully predictable) contrast between coronal vs. dorsal laterals following back vowels in certain loanwords: the laterals in /koł/ <kol> and /rol/ <rol> are both represented as <l>. This contrast results in non-canonical vowel harmony, where the backness of a suffix vowel is determined by the lateral, rather than by the preceding vowel (e.g. /koł-a/ <kola>, but /rol-e/ <role>). While early English-Turkish learners performed at a significantly higher level of accuracy on selecting the target suffix vowel in these contexts with auditory-only presentation of the stimulus than with auditory and written presentation, intermediate and advanced learners come to rely more on auditory stimuli and less on orthography.

Keywords: Turkish, L2 acquisition, phonology, orthography, vowel harmony

1. Introduction

This paper seeks to contribute to the growing literature on the role of Target Language (TL) orthography on phonological development in (adult) second language (L2) acquisition. While most research in this area has focused on issues such as category formation, phoneme discrimination in perception and production, or lexical retrieval (Erdener & Burnham 2005; Escudero & Wanrooij 2010; Hayes-Harb, Nicol & Barker 2010 among many others), we concentrate on the relationship between orthography and a complex phonological rule, one which is not taught in Turkish language courses, and we consider the role of orthography over the course of L2 phonological development. More specifically, typical classroom

learners of Turkish receive extensive instruction on rules of Turkish vowel harmony. These rules yield TL-congruent results in most cases. Typical classroom learners quickly become adept at applying these rules successfully (e.g. *ev-e* /ev-e/ 'home.DAT' vs. *av-a* /av-a/ 'hunting.DAT', where the backness feature of the dative suffix is determined by the backness feature of the immediately preceding vowel). However, there are special cases where the standardly taught rules yield TL-deviant results because of the effect of an 'exceptional' consonant (whose backness feature is not marked orthographically) intervening between the trigger vowel (whose backness feature is marked orthographically) and the target vowel. In this paper, we report the results of an empirical study designed to tease apart English-Turkish L2 learners' (L2ers) reliance, at three different proficiency levels, on orthography in the computation of Turkish vowel harmony rules by comparing trials with both orthographic and auditory stimuli against trials with auditory stimuli alone. Our results suggest that classroom learners come to rely less on orthographic stimuli and more on auditory stimuli over time.

This paper is structured in the following way. In Section 2, we first situate the issue above within the broader context of what accounts for both similarities and differences between typical child native language (L1) and adult L2 acquisition outcomes. We then state two competing hypotheses about the role of orthography in the developing interlanguage phonology of typical classroom learners: The Decreasing Dependence on Orthography Hypothesis and the Increasing Dependence on Orthography Hypothesis.

In Section 3, we review a range of facts about vowel harmony in Turkish, including a class of cases where vowel harmony in suffixes is governed not by the features of the vowel in the immediately preceding syllable, but rather by a feature of an intervening lateral consonant. The crucial cases, illustrated by *rol-e* /rol-e/[1] 'role.DAT', involve a back vowel followed by a non-velarized (i.e. "light") /l/; in such cases, the suffix vowel harmonizes with the [−back] (or Coronal) feature of the lateral, rather than with the [+back] feature of the vowel in the preceding syllable. Despite its generally transparent nature, Turkish orthography fails to mark the crucial feature contrast on the intervening lateral that governs vowel harmony in these cases. However, an auditory presentation of unsuffixed forms of relevant words (e.g. *rol* /rol/ 'role') and pseudowords would (in principle)[2] suffice to determine the value of the relevant feature of the lateral and thus to enable the listener to calculate the appropriate feature(s) of the vowel in an attached suffix (here -/e/

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1.   As noted earlier, non-velarized /l/ contrasts with the velarized /ł/ attested in Turkish words such as *yola* /yoła/ 'road.DAT'.

2.   We explain, in Section 3, the additional phonological principle required to ensure the TL-congruent computation of vowel harmony.

'DAT', rather than the -/a/ allomorph of the suffix that the preceding vowel /o/ would lead one to expect). We show experimentally that English-Turkish L2ers who have acquired the basics of Turkish vowel harmony but are still in relatively early stages of their acquisition of Turkish are 'misled' by Turkish orthography when presented with bimodal (orthographic and auditory) stimuli and asked to add harmonizing suffixes. The Decreasing Dependence on Orthography Hypothesis predicts that as development continues, such learners will come to rely more on auditory stimulus. On the other hand, the Increasing Dependence on Orthography Hypothesis predicts that learners will not only rely on (potentially misleading) orthographic stimuli in early stages of acquisition, but will come to rely more heavily on orthography as they progress in their acquisition of Turkish.

Section 4 describes the design of the experiment we employed to test the predictions of the two hypotheses and the participants who took part in our experiment.

The results presented in Section 5 show that the English-Turkish L2ers are significantly more likely to provide the TL-like allomorph of the requested suffix containing a [−back] vowel after the sequence [+back] vowel followed by "light" /l/ when the stimulus is exclusively auditory than when the stimulus is both auditory and orthographic. This is consistent with the Decreasing Dependence on Orthography Hypothesis, but unexpected on the Increasing Dependence on Orthography Hypothesis.

In Section 6, we will summarize our findings and briefly discuss potential pedagogical implications.

2. Theoretical motivation

There can be little doubt that the typical outcome of adult L2 acquisition is strikingly different from the typical outcome of child L1 acquisition. The L2 acquisition research literature presents several hypotheses regarding the reason for such differences including the Monitor Model (Krashen 1981), the Competing Cognitive Systems Hypothesis (Felix 1985), the Fundamental Difference Hypothesis (Bley-Vroman 1990), the Full Transfer/Full Access Hypothesis (Schwartz & Sprouse 1996), the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou 2007), and many others.[3] One potentially crucial source of differences between child L1ers and adult L2ers lies in the typical input for child L1ers and that for

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3. The various models extant in the literature make empirically distinct predictions about the precise nature and extent of the outcome differences between child L1 and adult L2 acquisition. Further discussion would exceed the bounds of this paper.

adult L2ers, at least in the contemporary world because of the role of literacy.[4] Unlike most L2ers, normally developing children have acquired most of the phonology and morphosyntax of their L1s at the point where literacy development begins. If their L1 has an alphabetic writing system, then their new learning challenge is to add graphemic representations for elements of a language that they already know through the medium of sounds. Over the years, it is, of course, possible that a given native speaker might come to know any number of new lexical items first through the written word, but taken as a whole, native speakers acquire spoken language before they acquire written language. Bassetti (2009) cogently discusses ways in which the experience of a (potentially highly) literate adult acquiring a new language in a typical classroom setting is very different. Such a learner not only begins the L2 acquisition process already accustomed to the written representation of language, but also brings the expectation (and has this expectation reinforced by the structure of classroom instruction) that all acquisition of the new language necessarily entails the acquisition of written representations. Particularly when instruction occurs in a traditional academic context, reading and writing assignments will be given from the very first day of instruction, and examinations will be based primarily on accuracy on written tasks. Such a learner is likely to first encounter the majority of new vocabulary items and morphosyntactic patterns in written form (or through both written and auditory input). In sum, with respect to the role of literacy, adult L2 acquisition in the instructed context is different from L1 acquisition in two major ways: (i) L2ers usually bring a fully developed orthographic system (in addition to a fully acquired L1) to the acquisition task and (ii) they start learning the L2 orthography from the very beginning of the L2 acquisition process, unlike what happens in L1 acquisition.

The standard orthographies of languages with alphabetic writing systems vary with respect to their phonetic/phonemic transparency (closeness of fit between graphemic representations, on the one hand, and, phonemic representations and/or phonetic realizations[5] on the other). This can have an impact on the

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4.   In this paper, we consider only (L1 and L2) learners in contemporary societies, where school-based literacy is overwhelmingly the norm.

5.   In developing the "classical" theory of the phoneme, linguists of the American Structuralist School of the first half of the Twentieth Century pointed out that alphabetic writing systems tend to originate as phonemic representations of a particular language, because this is the level of analysis most directly accessible to native speakers without phonetic training, and this level best serves the needs of differentiating meaningful linguistic elements. Alphabetic writing systems acquire degrees of opacity for a variety of reasons: the long-term stability of written representations despite sound changes affecting the spoken language; borrowing both the pronunciation and the written representation of new lexemes from languages with a different lexeme-phoneme correspondences; orthographic reform designed to highlight etymology or

expectations that literate speakers of those languages bring to the task of interpreting a new orthographic system. For example, noting that Turkish orthography is generally very transparent, while English orthography is rather opaque, Erdener and Burnham (2005) found that the phonetic transparency of Spanish orthography gave Turkish speakers an advantage over English speakers in repeating Spanish words, while the relative phonetic opacity of Irish orthography reversed the outcome, placing English speakers at an advantage over Turkish speakers in repeating Irish words.

There is the added complication that the L1 and the TL might employ straightforwardly different alphabets (e.g. Latin vs. Cyrillic) or that both might appear to employ the same "basic alphabet" (perhaps with different sets of diacritics), but any number of the graphemes might be typically associated with quite distinct sound values (as for example with <c>, <j>, <u>, <y>, and <z> across the languages using the Latin alphabet). Hayes-Harb et al. (2010) tested English speakers on their ability to learn the pronunciation of pseudowords on the basis of auditory presentation plus (1) no written presentation, (2) a written presentation consistent with conventional English orthography, or (3) a written presentation inconsistent with conventional English orthography. They found that the third group's pronunciation of the pseudowords exhibited significant interference from the English-deviant written presentation. Clearly, instructors and textbooks typically inform learners about certain differences between the orthographic systems of their L1 and the TL; however, textbook presentations generally focus on major differences and omit many details. In any case, it is far from clear what type of experience with the new system is typically necessary for learners to fully adjust. In fact, it appears to be an under-investigated empirical question whether the ultimate attainment of highly proficient near-native L2ers is psycholinguistically indistinguishable from native speakers in the domain of orthography.[6]

In her review of recent studies on the effect of orthography on phonological acquisition, Bassetti (2009) concludes that the currently available evidence

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distinguish homophones, etc. Since the English orthographic system is older than one millennium and the current Turkish orthographic system originated approximately one century ago, it is not at all surprising that Turkish orthography is much more transparent than English orthography.

6. This may prove a rather vexed question for empirical research because of the problem of establishing the orthographic competence of "typical" or "average" native writers of languages like English, where the orthography is quite opaque, and there appears to be a wide range of orthographic proficiency among native writers across and within levels of educational achievement. In this paper, we leave to future research the exploration of the acquisition of L2 orthography as an active skill. Here we focus on the effect of reliance on Turkish orthography for the computation of vowel harmony.

implicates TL orthography in the acquisition of TL phonology. To our knowledge, most of the extant research focuses on the mapping from orthography directly to surface phonetic realization of individual words or pseudowords. Rather little is known at this point about the impact of (potentially "misleading") TL orthography on the application of TL phonological rules. Nor is it clear whether typical classroom learners, whose literacy development begins virtually on the first day of their exposure to the TL, come to rely more heavily or less heavily on written language as the phonological acquisition process continues into intermediate or advanced stages. In this study, we will compare two broadly stated hypotheses regarding the relative importance of orthography in developing interlanguage systems over time, as stated in (1):

(1) a. The Decreasing Dependence on Orthography Hypothesis:
         When oracy and literacy are developed in tandem, typical classroom learn-
         ers come to rely increasingly on auditory input and less on orthographic
         input as their interlanguage phonological systems develop over time.
     b. The Increasing Dependence on Orthography Hypothesis:
         When oracy and literacy are developed in tandem, typical classroom
         learners come to rely increasingly on orthographic input as their inter-
         language phonological systems develop over time.

If L2ers come to rely less on orthography over time (decreasing dependence on orthography), we might expect that the effect of "misleading" orthographic representations would weaken when such learners are required to apply TL-congruent phonological rules whose triggers are not transparently encoded in TL orthography. Conversely, if L2ers become increasingly reliant on orthography over time (increasing dependence on orthography), we might expect that the effect of "misleading" orthographic representations would become even stronger when such learners are required to apply TL-congruent phonological rules whose triggers are obscured by TL orthography.

   We believe that it is not the case that one of these hypotheses is obviously true *a priori*. On the reasonable assumption that most English-speaking classroom learners of Turkish come to the acquisition of Turkish as true *ab initio* learners[7]

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7. This is certainly true in the context of the current study, which was conducted in the United States. We are unaware of the existence of any pre-university Turkish language instructional programs in the entire country. The population of heritage learners of Turkish at US universities approaches zero. Almost every student enrolled in Introductory Turkish I at Indiana University is a genuine *ab initio* learner. Thus, we recognize that the "typical classroom learner" to whom we refer in our two hypotheses has an experience unlike that, for example, of many students enrolled in Spanish language instruction in the United States, where there are indeed

(particularly learners in the traditional academic context where listening, speaking, reading, and writing skills are developed in tandem and much stress is laid on literacy), it is far from obvious whether learners will come to rely more on auditory or more on written input over time. Because of the heterogeneous nature of the experience that learners have with the Turkish language after the first year of instruction, it is not practical to attempt to assess the precise number of hours of spoken Turkish they have heard or the precise number of words of written Turkish they have read. Nevertheless, we believe that it is reasonable to ask the question of whether orthographic or auditory input comes to have priority over time. It is possible to address this question most directly by studying the acquisition of a corner of the TL where these two might provide contradictory evidence for the learner.

3.   The L1 English-TL Turkish comparison: A note on Turkish vowel harmony and laterals in the two languages

The application of Turkish vowel harmony by English-Turkish L2ers offers an ideal test of the Decreasing Dependence on Orthography Hypothesis and the Increasing Dependence on Orthography Hypothesis. In this section, we first provide a basic description of Turkish vowel harmony and its interaction with the distribution of laterals, in both canonical and non-canonical cases. We compare the relevant aspects of Turkish orthography with English orthography and with the most plausible interpretation of Turkish orthography on the part of English-Turkish L2ers and explain how this state of affairs provides a clear test of our two competing hypotheses.

The vowel inventory of Turkish includes eight vowels, which can be straightforwardly classified with three binary features, [±high], [±back], and [±round], leading to a perfectly symmetric system.[8] This is illustrated in (2), with a list of phonemes and corresponding orthographic representations.

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many heritage language learners and many other learners come to the task with significant exposure to both spoken and written Spanish from the ambient cultural context.

8.   We note that this symmetry holds at the phonological level and not, strictly speaking, at the phonetic level. For example, /e/ and /a/ share the features [–high] and [–round], but the phoneme /e/ exhibits allophonic variation ranging from mid [e] to low-mid [ɛ] to low [æ], while the phoneme /a/ is phonetically realized as the low vowel /a/. In the interest of concreteness, we will take the {[+high], [–round], [+back]} feature matrix to correspond to the phoneme we will label /ɨ/, because it is generally realized phonetically as the high, unrounded, central vowel [ɨ] and not the high, unrounded, back vowel [ɯ]. For reasons of space, we cannot review here

(2)   Turkish vowels[9]

	Front vowels		Back vowels	
	Unrounded	**Round**	**Unrounded**	**Round**
High	/i/ \<i\>	/y/ \<ü\>	/ɨ/ \<ı\>	/u/ \<u\>
Non-High	/e/ \<e\>	/ø/ \<ö\>	/a/ \<a\>	/o/ \<o\>

Turkish is typologically an agglutinating language with heavy use of suffixes for both inflectional and derivational morphology (e.g. Kornfilt 1997; Underhill 1976). All of the vowels in Turkish suffixes are specified for [±high], but most are underspecified for [±back] (and [±round]) with the latter features filled in through a process of vowel harmony. More precisely, [+high] vowel harmony targets are underspecified for both [±back] and [±round] and the specifications for both these features almost always spread from the vowel in the immediately preceding syllable. On the other hand, unless underlyingly specified for all features and not subject to vowel harmony at all, [–high] vowels of Turkish suffixes can only be [–round] due to the presence of a separate (more general) constraint in Turkish grammar against the presence of [–high] rounded vowels in non-initial syllables. Therefore, in these cases it is only the specification for [±back] that spreads from the vowel in the immediately preceding syllable. Consider the examples in (3) and (4), which illustrate the basic paradigm of Turkish vowel harmony using simple monosyllabic roots.

(3)   Suffix vowel underlyingly specified as [+high]: 3rd person possessive

	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**]}

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all of the competing accounts of the precise phonetics of Turkish vowels, and this would not be relevant to the research questions investigated here. In any case, as will become clear below, this basic phonological analysis allows for an elegant account of vowel harmony in Turkish and is generally adopted by all linguists investigating the language, as well as all pedagogical materials for Turkish with which we are familiar.

9.   Throughout this paper, we will abstract away from the allophonic variation associated with Turkish vowels, representing, for example, all instances of non-high front unrounded vowels as /e/ and [e] (although /e/ appears as its allophones [ɛ] and [æ] in certain closed syllables).

  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) class'
      {[−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**]}

(4) Suffix vowel underlyingly specified as [−high]: dative
          root vowel   suffix vowel
  a. ün-e [yne] '(to the) fame'
      {[+high] [**−back**] [+round]} {[−high] [**−back**] [−round]}
  b. iş-e [iʃe] '(to the) work'
      {[+high] [**−back**] [−round]} {[−high] [**−back**] [−round]}
  c. kuş-a [kuʃa] '(to the) bird'
      {[+high] [**+back**] [+round]} {[−high] [**+back**] [−round]}
  d. kız-a [kɨza] '(to the) girl'
      {[+high] [**+back**] [−round]} {[−high] [**+back**] [−round]}
  e. göz-e [gøze] '(to the) eye'
      {[−high] [**−back**] [+round]} {[−high] [**−back**] [−round]}
  f. ders-e [derse] '(to the) class'
      {[−high] [**−back**] [−round]} {[−high] [**−back**] [−round]}
  g. dost-a [dosta] '(to the) friend'
      {[−high] [**+back**] [+round]} {[−high] [**+back**] [−round]}
  h. at-a [ata] '(to the) horse'
      {[−high] [**+back**] [−round]} {[−high] [**+back**] [−round]}

The examples in (3) illustrate vowel harmony with a suffix consisting of a vowel pre-specified as simply [+high], the third person singular possessive suffix -I. The root vowels in the eight examples illustrate all eight logically possible combinations of the three binary features. In each instance, the vowel of the suffix is [+high], but the specifications for the features [±back] and [±round] are simply copied from the root vowel, as indicated by boldface type. For example, the word [gøz] (see (3e)) contains (and ends in) the vowel [ø], which has the features {[−high] [−back] [+round]}. Since the suffix vowel is specified as [+high], it can undergo both front/back and rounding harmony, resulting in a high vowel that is front and rounded, as with [ø], which leads to the vowel [y]. Because the suffix vowel here has four possible realizations, this vowel harmony pattern is often called "four-way vowel harmony" in Turkish textbooks.

The examples in (4) illustrate vowel harmony with a suffix with a vowel pre-specified for [−high], the dative case suffix. In these examples, the vowel of the suffix is [−high] and [−round], and as the vowel is [−high], only the specification for the feature [±back] is copied from the root vowel.[10] Using the same example, [gøz], which ends in a vowel with the specifications {[−high] [−back] [+round]}, since the suffix vowel -A is [−high], only the backness feature is copied from the root, and roundness is not, resulting in a suffix vowel that is not only [−high] (which is underlyingly specified) but also [−back] as with the root vowel, but, un-like the root vowel, it is [−round]. Because the suffix vowel here has two possible realizations, this vowel harmony pattern is often called "two-way vowel harmony" in Turkish textbooks.

These surface alternations are extremely robust in the auditory input and are transparently represented in the Turkish writing system. Furthermore, English-speaking classroom learners of Turkish receive early and extensive instruction on these two primary patterns of vowel harmony.

The feature [±back], furthermore, plays a central role in the distribution of the surface variants of the underlyingly underspecified lateral /l/ in Turkish. Consider the examples of typical uninflected native Turkish words in (5).

(5) a. [baɫ]   bal   'honey'   dark [ɫ]
    b. [buɫ]   bul   'to find'   dark [ɫ]
    c. [soɫgun]   solgun   'pale'   dark [ɫ]
    d. [ɫaf][11]   laf   'statement'   dark [ɫ]
    e. [leke]   leke   'dirt'   light [l]
    f. [bel]   bel   'back'   light [l]
    g. [kyl]   kül   'ash'   light [l]
    h. [jelken]   yelken   'sail'   light [l]

When the lateral occurs in the immediate environment of a [+back] vowel, the lateral is realized as a velarized [ɫ], generally known as the "dark" [ɫ], as illustrated in (5a)–(5d). When the lateral occurs in the immediate environment of a [−back] vowel, the lateral is realized as a non-velarized [l], generally known as the "light" [l], as illustrated in (5e)–(5h). This pattern holds regardless of whether the lateral immediately proceeds or immediately follows the [+back] or [−back] vowel.

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10. We leave aside here discussion of whether the non-occurrence of suffix vowels that are {[−back] [+round]} is better stated in the specification of individual suffixes or in a general rule of Turkish phonology.

11. As one reviewer points out, laterals in word-initial position are almost never obligatorily velarized in Turkish (e.g. Demircan 1996). Thus [ɫaf] is in free variation with [laf] in certain varieties of Turkish. In fact, word-initial laterals will not be relevant for the present study.

Consider now the lexemes that end in a lateral in their uninflected forms. When a suffix with an underspecified vowel is added, this pattern is further enforced, as shown in the examples in (6).

(6) a. bal-a   [baɫa]   'honey.DAT'   dark [ɫ]
    b. kul-a   [kuɫa]   'servant.DAT'   dark [ɫ]
    c. kol-a   [koɫa]   'arm.DAT'   dark [ɫ]
    d. kıl-a   [kɨɫa]   'hair.DAT'   dark [ɫ]
    e. kül-e   [kyle]   'ash.DAT'   light [l]
    f. il-e   [ile]   'city.DAT'   light [l]
    g. göl-e   [gøle]   'lake. DAT'   light [l]
    h. bel-e   [bele]   'back.DAT'   light [l]

In the examples in (6), the dative suffix, which is underlyingly underspecified for the feature [±back] has been attached to nouns ending in a lateral. Canonical vowel harmony results in dark [ɫ] preceded and followed by a [+back] vowels in (6a)–(6d), and in light [l] preceded and followed by [–back] vowels in (6e)–(6h).

The examples of Turkish laterals discussed thus far give the appearance of a standard example of allophones of a single phoneme in complementary distribution. They are representative of the vast majority of Turkish lexemes containing a lateral, and this distribution may be thought of as the canonical distribution of laterals in Turkish.

There is, however, a class of exceptional cases. Due to borrowing from Arabic, Persian, and some European languages,[12] there are instances of light [l] in the environment of [+back] vowels (Kabak 2011; Levi 2001). Some of the most common examples are listed in (7).[13]

(7) a. rol   [rol]   'role'   "light" [l]
    b. petrol   [petrol] 'petroleum'   "light" [l]
    c. hal   [hal]   'situation'   "light" [l]

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12. Of course, from the perspective of Contemporary Turkish, the origin of these lexemes is merely an historical fact, not directly relevant to their synchronic representation. Furthermore, many English-Turkish classroom learners are not aware of the origins of the relevant Turkish lexemes, in any case.

13. Although most commonly observed with laterals, this phenomenon targets a larger inventory of consonants than just laterals, most notably alveolar and velar stops, as in [saat] – [saat-i] and [dikkat] – [dikkat-i]. We keep the focus of this paper restricted to laterals for experimental feasibility. We refer the reader to Clements & Sezer (1982) and Kabak (2011) for a more detailed coverage of these cases.

Examples like (7) suggest that in some instances, Turkish laterals are in fact underlyingly specified for a feature like [Coronal].[14] We may think of this phenomenon as the non-canonical distribution of /l/. When a suffix with a vowel that is underlyingly underspecified for the feature [±back] is attached, the suffix vowel surfaces as [–back], as illustrated in (8).

(8) a. rol-e   [role]   'role.DAT'   "light" [l] [–back] V
     b. petrol-e   [petrole]   'petrolium.DAT'   "light" [l] [–back] V
     c. hal-e   [hale]   'situation.DAT'   "light" [l] [–back] V

In the examples in (8), an underlyingly underspecified vowel is realized as a [–back] vowel, despite the presence of a [+back] vowel in the immediately preceding syllable. This obtains because of the intervening underlyingly specified [Coronal] lateral. We may say that the non-canonical distribution of /l/ leads to non-canonical vowel harmony in Turkish.

Following Clements and Sezer (1982) (and in the spirit of Nevins 2010),[15] we assume that examples of this kind indicate that in certain lexical items Turkish laterals are pre-specified for the feature [–back] and that locality conditions on feature spreading dictate that this feature specification spreads rightward to the vowels that follow. In the presence of this pre-specified feature, general constraints on feature spreading block the spreading of the specification [+back] from the root vowel to the suffix vowel. Hence, the forms in (9) (compare with (8) above) are not possible:

(9) a. *rol-a   [rola]   'role.DAT'   "light" [l] [+back] V
     b. *petrol-a   [petrola]   'petroleum.DAT'   "light" [l] [+back] V
     c. *hal-a   [hala]   'situation.DAT'   "light" [l] [+back] V

This phenomenon is illustrated in a condensed Feature Geometric representation in (10) below (see Levi 2001 for a similar approach):

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14. There are a few (but very few) examples of near-minimal pairs. A good example for a near-minimal pair is [koł] "arm" vs. [gol] "goal." In some dialects, as "arm" is [goł], these are minimal pairs.

15. Recently, Kabak (2011) has challenged the standard analysis assumed here. Kabak (2011) claims that all the relevant vowels in Turkish have full underlying specifications and that vowel harmony is the result of feature-changing rules. However, the autosegmental "spreading" analysis we employ here continues to receive support in modern phonological analyses of vowel harmony (see a review by Hyman 2014). It would go beyond the natural limits of this paper to offer a detailed critical discussion of this recent debate, particularly because it is not obvious that the plausible differences between the two approaches would materially affect the outcome of the L2 acquisitional question under investigation here.

(10)   r   o   l   e

   | | | |

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

   | | |

V-place   V-place   V-place

   | |
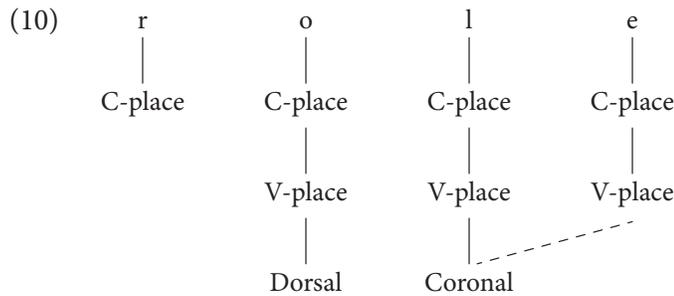
Dorsal   Coronal

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). This is because, in general, only vowels have the node Vowel-place (V-place), where spreading of vowel features occurs, ensuring that vowel harmony satisfies locality despite intervening consonants. In this case, however, we assume, as with Levi (2001) and in the sense of Clements and Hume (1995), that the lateral has a V-place, pre-specified with Coronal (i.e. [−back]). This means that the final vowel, which is underspecified for [±back], will obtain this feature from the nearest feature-bearing element with the same node (i.e. the lateral).[16] In other words, even though the vowel feature [±back] normally spreads through vowels, and also consonants are transparent to this (vowel harmony) process (as only vowels have the V-Place node), the lateral consonant here is special in that it is underlyingly specified for the spreading feature (as [−back]). This means that spreading from the vowel is blocked, and further spreading occurs from this consonant. Such blocking effects are common in Feature Geometry; whenever a segment is underlyingly specified for a value of the spreading feature, blocking occurs, and spreading (re)starts from this underlyingly specified segment (see Clements 1985; Clements & Hume 1995).

It is precisely in examples of this type where Turkish orthography presents the L2er with potentially misleading input. This is because the Turkish writing system does not mark the unpredictable (hence, necessarily pre-specified) [−back] feature (Coronal) for the lateral in words like *rol*. To put it another way, the phonemic status of /l/ in examples like this one is not reflected in Turkish orthography, although Turkish orthography is otherwise a prime example of a phonemic

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16. What makes these cases formally different from the cases involving the regular /l/ is that the regular /l/ is not prespecified for the Coronal node. Therefore, it appears as [+back] following a [+back] vowel, and [−back] following a [−back] vowel, inheriting these features from the preceding vowel through spreading. Thus if the lateral in this example were not prespecified for [−back]/Coronal, the features of the preceding vowel would spread both to the lateral and to the following vowel.

script.[17] Auditory input alone ([rol]) calls for [−back] vowels when suffixes with under-specified vowels are added; orthographic input alone (<rol>) strongly suggests [+back] vowels. Similar examples exist for other consonants, such as for the palatalized velar plosive /c/ as well, although we will not discuss these in this paper (see Note 5 above).

The English-speaking learner of Turkish will find little assistance here from his or her L1 phonological and orthographic systems. The Turkish vowel system contrasts sharply with that of English, which exhibits neither vowel harmony nor three of the eight vowel phonemes of Turkish (i.e. /y/, /ø/, /ɨ/).[18] It tends to exhibit /ə/ in most suffixes. Furthermore, English suffixes, unlike those in Turkish, tend to be unstressed, as final syllables are extrametrical in English, and the language is trochaic (Hayes 1995). Moreover, although the English lateral phoneme has at least four allophones (Fromkin et al. 2000: 524–525) (including the two that Turkish has), exemplified in (11), their distribution is dissimilar to that of the laterals in Turkish.[19]

(11) a. [ɫ] in syllable-final position   file   [faɪɫ]
      b. [ɫ̪] immediately preceding [θ]   wealth [wɛɫ̪θ]
      c. [l̥l] immediately following [−voice] please [pʰl̥liz]
      d. [l] elsewhere   loose [lu:s]

(based on Fromkin et al. 2000: 525)

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17. It should be noted that as one reviewer has mentioned, Turkish once had a means for indicating irregularity in some cases, by using a circumflex on a (back) vowel grapheme adjacent to a non-canonically "light" /l/, as in the example <hayâl> for [hayal] 'imagination'. This has never been an unambiguous orthographic diacritic, because it is also used for other purposes, such as lengthening of a marked vowel. Furthermore, this use has always been restricted to (some) borrowed words from Arabic and Persian, and was never used for words borrowed from Western languages, such as <rol> and <petrol>. Although the use of the circumflex for vowels adjacent to non-canonical "light" /l/ in certain words is still maintained by some Turkish speakers, it is clearly on the decline in contemporary written Turkish, and typical classroom learners of Turkish receive extremely little (however useful it might be) instruction on this point today.

18. This is not to deny that some varieties of English may include one or more of these sounds as allophones of one or more of its phonemes. The point here is that English orthography is not designed to represent these sounds either phonemically or phonetically.

19. Turkish arguably has additional lateral allomorphy, as described in detail in Demircan (1996). We will not cover these cases. What is crucial here is the fact that dark- and light-l have a different distribution in the two languages.

In English, whether a lateral is velarized depends on its position within the syllable, not on the backness of adjacent vowels (e.g. Yuan & Liberman 2009, 2011).[20]

In essence, Turkish orthography reinforces the auditory input for canonical vowel harmony and provides neither facilitation nor obfuscation for the canonical distribution of /l/. However, given the general pattern of the canonical distribution of /l/, where the phonetic realization of /l/ is linked to adjacent vowels, Turkish orthography obfuscates the non-canonical distribution of /l/. English-speaking classroom learners of Turkish receive extensive instruction on canonical vowel harmony and may receive some instruction on the canonical distribution of /l/, but they receive no systematic instruction on the non-canonical distribution of /l/ and absolutely no instruction on non-canonical vowel harmony. Furthermore, while the English sound system includes both dark [ɫ] and light [l] as allophonic variants, their distribution is governed by their position within the syllable, not by the specification of the feature [±back] of an adjacent vowel. Therefore, the phonetic interpretation of the English grapheme <l> is at best uninformative and at worst misleading for the English-speaking learner of Turkish. Taking all these factors into account, it should hardly be a surprise if early English-Turkish L2ers do not immediately exhibit knowledge of non-canonical vowel harmony. However, the Decreasing Dependence on Orthography Hypothesis predicts that intermediate and advanced English-Turkish L2ers will come to rely less on "misleading" orthographic stimuli and increasingly on auditory input in their computation of vowel harmony. The Increasing Dependence on Orthography Hypothesis, on the other hand, predicts that as L2ers advance in their acquisition of Turkish, the effect of "misleading" orthographic stimuli will not diminish.

4. Methodology

In this section, we describe an experiment designed to test the predictions of the Decreasing Dependence on Orthography Hypothesis and the Increasing Dependence on Orthography Hypothesis. We aim to investigate aspects of unconscious knowledge of vowel harmony in English-speaking learners of Turkish at three different proficiency levels. Participants were asked to select vowel-harmonically correct suffixes on the basis of simultaneous auditory and orthographic stimuli as well as on the basis of auditory stimuli alone.

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20. As one reviewer has suggested, some varieties of American English may only have dark-l (e.g. Oxley, Buckingham, Roussel, Daniloff 2006; Sproat & Fujimura 1993). Nevertheless, these varieties are still different from Turkish because they do not have light-l to begin with, placing an even greater burden on the English-speaking learner of Turkish.

4.1   Participants

Participants were 16 adult English-speaking L2 learners of Turkish, as well as a comparison group of 8 native Turkish speakers. The L2ers were all students at a major US university and they had a mean age of 25 (range 19–36). The mean age of native Turkish speakers was 30 (range 28–33). L2ers' knowledge of Turkish was based on formal Turkish instruction, ranging from 6 months to 4 years, as well as naturalistic L2 Turkish exposure through study abroad in Turkey (for 1 month to 2 years), and 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 speaker teachers and teaching assistants. In order to obtain an independent measure of proficiency level in Turkish, the participants were also asked to complete a proficiency test. In the absence of a commonly available standardized L2 proficiency test for Turkish, we employed a multiple-choice cloze test to determine the L2ers' general proficiency levels. The cloze test was previously used in Montrul (1997) and Özçelik (2011) to categorize learners of Turkish into different proficiency groups. As in Özçelik (2011), a multiple-choice version of the cloze test was used in the current study. On the basis of the cloze test, participants were divided into three proficiency levels: beginner (n = 6), intermediate (n = 5), and advanced (n = 5). These proficiency levels more or less matched with participants' self-reported proficiency levels and the Turkish-language classes they were placed in at the university.

4.2   Task and stimuli

In the experimental task, participants were presented with a Turkish word or pseudoword (i.e. the root), and asked to choose the correct variant of a suffix, from among two or four options depending on whether the suffix was subject to two-way or four-way vowel harmony (see the discussion under (4) in Section 3). Although the term 'vowel harmony' was not mentioned in the instructions, the choices for any particular item were in fact allomorphs of a given suffix. The allomorphy involved was based solely on vowel harmony (and not, for example, on consonantal voicing assimilation). For example, for a given word like [ev] 'home', participants were presented with the options (a) '-de' and (b) '-da', and not '-te' or '-ta'; the latter two are also allomorphs of the same locative morpheme, but are attached after words ending in voiceless consonants. The task consisted of 256 semi-randomized items, half of which (i.e. 128) were experimental items (i.e. ending in a lateral) and the other half, fillers (i.e. ending in a variety of consonants other than a lateral). All items were 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). As real words of the relevant profile were very few, almost all existing such words we were able to think of were used, irrespective of frequency of use in Turkish. Half of the experimental items (i.e. 64) and half of the filler items (i.e. 64) were presented auditorily only. In this condition, participants, upon hearing a stimulus item, chose the correct suffix to be attached from among those presented on a computer screen by clicking on the correct option. The other half of experimental and filler items (i.e. 64 in each) were presented both auditorily and visually. For these items, participants were instructed to both read and listen to the stimuli before choosing the correct option.

Regarding the suffixes that were used, half of the items (i.e. 128 items composed of 64 experimental and 64 filler items) tested suffixes that have an underlying high vowel (see (3) above), whereas the other 128 items (64 experimental; 64 control) targeted suffixes with an underlying low vowel (see (4)). In particular, the following suffixes were used:

(12)   Suffixes used:
    a.   Suffixes with an underlying high vowel (128 in total; 64 experimental, 64 filler):
       i.   {/-im/, /-üm/, /-ım/, /-um/} 'first person possessive'
       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'

The suffixes in (12a) correspond to the so-called four-way vowel harmony (see (3) for an illustration), while those in (12b) correspond to two-way vowel harmony (see (4)). Recall that the suffixes with inherent high vowels exhibit both back and rounding harmony, resulting in four different options, while the suffixes with underlying/inherent low vowels exhibit only back harmony, resulting in two possible options. So half of the items in our test had 4 choices, whereas the other half had only 2, depending on whether a given item tested four-way or two-way vowel harmony.

The quality of the final vowel in every test item was controlled for. This allowed us to test every logically possible combination of stem vowel + suffix vowel. This is illustrated in Figure 1. For example, the sequences *ü-ü* and *ö-ü* under *ü* in Figure 1 means that the suffix vowel is expected to be *ü*, following a word whose final vowel is *ü* and following a word whose final vowel is *ö*, respectively, as in
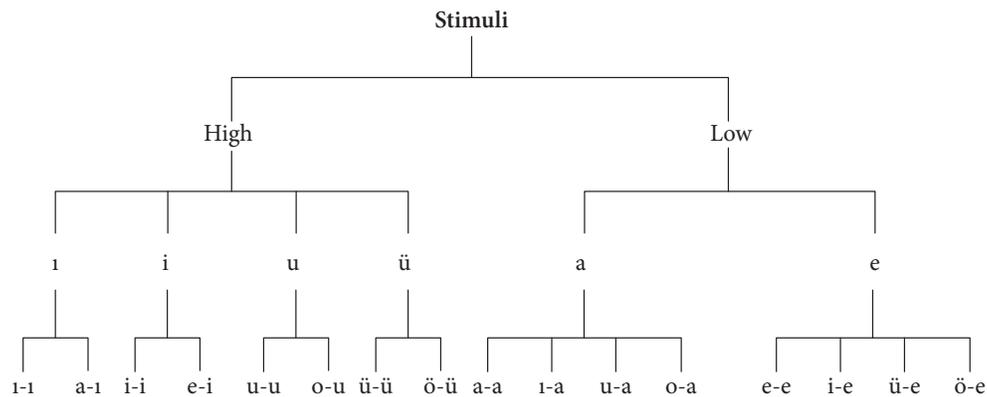
Figure 1. Expected stem+suffix vowel sequences in stimuli

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. Out of these 16 stimuli, 8 were experimental (words that ended in /l/) and 8 were fillers. Again, half of these were presented auditorily only and half both auditorily and visually.

Note, however, that the sequence of vowels illustrated under each class in Figure 1 is more representative of fillers than of experimental items. More specifically, in the experimental item set, a word whose final vowel is a [+back] vowel will not necessarily be followed by a suffix that contains a [+back] vowel because /l/ will have an effect on the quality of the following vowel, at least in cases where it is underlyingly specified as Coronal (or [–back]) as in the example of /rol-e/ (but not */rol-a/) (see examples (7) to (9)). Consequently, it will surface, in these cases, as an *o-e* sequence, instead of *o-a*. Thus, the tokens represented in Figure 1 are more representative of the distribution of vowel sequences expected under the regular rules of Turkish vowel harmony and do not necessarily reflect output forms as affected by the presence of consonants that lead to exceptional cases of vowel harmony. What matters here is that every possible sequence of vowels has been symmetrically represented among the stimuli selected for the study.

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 light (non-velarized) [l] in the environment of front vowels and a dark (velarized) [ł] in the environment of back vowels (e.g. [bel] 'back' vs. [bał] 'honey' as in (6)). For the other half, the quality of the lateral was underlyingly specified, as with the forms in (7), 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 (e.g. [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 [ɫ] on the surface immediately following a front vowel as in [töɫ] and [reɫ]) even though this particular pattern does *not* occur in Turkish at all.[21] The focus of this paper is on the former type of 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]). Out of 64 items pre-specified for [±back], 32 were pre-specified for (i.e. underlyingly had) a light /l/, and the other 32 were pre-specified for a dark /ɫ/, a form that does not exist in Turkish. These were equally distributed in two different presentation modalities. As mentioned earlier, the main focus of this investigation is cases consisting of an underlying light /l/.

As was mentioned above, in addition to the 128 test stimuli containing words ending in variations of /l/, there were 128 fillers, which ended in a variety of Turkish consonants. The fillers, unlike the experimental stimuli, did not contain consonants affecting vowel harmony or any other type of exceptionality. They served a number of purposes. For example, they helped us ascertain if participants knew several linguistic phenomena involved in the experimental stimuli, such as vowel harmony rules particularly those involving backness and rounding harmony. Perhaps more importantly, they also ensured that the number of words ending in [l] and [ɫ] 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 task, and (iii) cloze test. Responses were recorded and subsequently downloaded into Excel for analysis. For all the results reported, we conducted a two-way ANOVA, followed by a post hoc test, i.e. a Tukey HSD test.

5. Results

We took the rate 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); (ii) proficiency level. Table 1 summarizes these results in terms of percentage of correct

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21. 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 whose final vowel is [+back],due to the underlyingly specified front (palatal) /l/.

Table 1. Results: Percentage of correct suffix choices

	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

responses, for (i) stimuli ending in laterals underlyingly specified as Coronal (see row 1); (ii) for laterals that are underlyingly unspecified and thus appearing as light-l in the environment of front vowels, and dark-ł in the environment of back vowels (row 2); (iii) fillers, which end in consonants other than a lateral (row 3).

The results revealed that with respect to words ending in a palatal [l] after a back vowel (as in [roł]), being exposed to stimuli only auditorily lead to a higher percentage of correct responses than being exposed to stimuli both auditorily and visually. In other words, the 'modality of presentation' mattered. 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 were statistically significant, $F(1, 26) = 11.024$, $p < .001$, although there was no significant main effect for the 'proficiency' factor, $F(2, 26) = 1.557$, $p > .05$. Furthermore, the interaction between 'modality of presentation' and 'proficiency' was not significant, either, $F(2, 26) = .306$, $p > .05$.

In contrast, for all other experimental stimuli (row 2) and for the fillers (row 3), presenting stimuli visually and auditorily *increased* the percentage of correct responses. First of all, for stimuli ending in a regular /l/, a 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, $F(2, 26) = 23.878$, $p < .001$. Furthermore, the interaction between 'modality of presentation' and 'proficiency' was also significant, $F(2, 26) = 14.078$, $p < .001$. In addition, the results of a Tukey HSD test showed that the significant effect of 'proficiency' was due to a difference between the 'beginner' and 'advanced' groups ($p < .01$), and that there was no significant difference either between 'beginner and intermediate' or 'intermediate and advanced' groups ($p > 0.5$).

Finally, for the fillers, as with the cases with regular (non-contrasting) /l/, the 'modality of presentation' made a difference; stimuli presented both auditorily and visually lead to higher accuracy rates 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 'proficiency', $F(2, 26) = 5.328$, $p = .012$. The interaction between 'modality of presentation' and 'proficiency' was also significant, $F(2, 26) = 8.771$, $p < .001$. Furthermore, the results of a Tukey HSD test showed that the significant effect of 'proficiency' was due to the fact that the beginner group diverged from both the intermediate and advanced groups ($p < .05$). There was no significant difference between the intermediate and advanced groups ($p > 0.5$). This suggests that for regular cases of vowel harmony, the proficiency level mattered only to the extent that it distinguished beginners from intermediate learners. At higher proficiency levels (i.e. intermediate and advanced) learners behaved similarly.

The contrast in Table 1 between row 1 on one hand and rows 2 and 3 on the other is rather striking: bimodal (visual and auditory) presentation of stimuli negatively influences participants' correct responses in cases where a palatal (light) [l] immediately follows a back vowel (where orthography is opaque). This type of presentation positively influences participants' correct responses in the two other types of stimuli (i.e. cases with regular /l/, where the underlying place of /l/ is not specified, and fillers, 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 (except for some beginners) had any difficulty. This suggests that vowel harmony itself (regular harmony) is not difficult for learners of Turkish, irrespective of level of proficiency and regardless of whether it involves backness harmony or rounding harmony.

6.   Discussion and conclusion

The results of the experiment indicate that the modality of stimulus presentation was a very significant factor in determining participants' accuracy rates. Compared to auditory presentation alone, bimodal presentation has led to a higher rate of correct responses in providing the vowel harmonic version of suffixes in cases involving 'regular' vowel harmony (cases that we termed as 'fillers'). However, in cases involving exceptional vowel harmony (i.e. cases that involve a "light" /l/ immediately following a back vowel), the bimodal stimulus presentation has led to a lower rate of response accuracy. The proficiency level played a significant role

in cases with regular vowel harmony, with advanced learners performing significantly better than intermediate and beginner learners of Turkish. 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 basic outline of development reported here suggests an important but circumscribed 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 is relevant for relatively low-frequency phenomena) can (partially) inhibit such acquisition in early learners. Nevertheless, with increased exposure to auditory input, L2ers seem to be able to overcome the obfuscating aspects of TL orthography and rely more on auditory input, providing evidence for the Decreasing Dependence on Orthography Hypothesis. In our case study, this is particularly striking, in light of the relatively low frequency of Turkish lexemes exhibiting non-canonical distribution of /l/ and hence non-canonical vowel harmony to which learners will be exposed. Particularly intriguing is the result that this cannot have been a simple result of learning specific lexemes of this sort, because learners applied their mentally represented rules of vowel harmony equally to both real Turkish words and nonce words.

The early introduction of literacy development in the L2 acquisition of Turkish appears to yield a highly facilitative effect for the vast majority of lexemes exhibiting canonical distribution of /l/ and canonical vowel harmony. If one accepts the premise that it is acceptable for L2ers to make occasional vowel harmony errors in a small class of items at early stages of acquisition, as long as they will be able to recover from those errors in intermediate and advanced stages of acquisition, these results suggest that the current practice of developing oracy and literacy skills in tandem may in fact be helpful in the long term. At the same time, we would encourage as much auditory input as possible, given that this is crucial for the development of target-like computation of the full range of vowel harmony rules in Turkish. We also encourage Turkish language teachers to be aware of the non-canonical distribution of /l/ and the associated non-canonical vowel harmony patterns so that they can provide a demystifying explanation to linguistically astute learners who notice these exceptional forms and inquire about them.

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