# Does a truly symmetrically transparent orthography exist? Spelling is more difficult than reading even in an orthography considered highly transparent for both reading and spelling

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## Abstract

Although we know that spelling develops more slowly than reading in asymmetrically transparent orthographies, such as Italian, we do not know whether spelling lags behind reading in orthographies considered symmetrically transparent for both spelling and reading. This is because reading and spelling skills are rarely tested on the same lexical items, which impedes their direct comparison. This study aimed to address this issue by comparing children's reading and spelling accuracy on the same lexical items in Turkish, which is highly transparent for both reading and spelling. The study also examined an exceptional case, namely letter Ğ, which can cause phonemic ambiguity and potentially complicate spelling but not reading accuracy in Turkish. Through two experiments, children's reading and spelling accuracy rates were tested on the same nonword and real word items at grade 1 (Experiment 1, $N=40$, $M_{age}=80.93$ months, $SD=2.79$ months; Experiment 2, $N=39$; $M_{age}=80.97$ months, $SD=2.80$ months). The consistent findings from nonwords and words (with Ğ or without Ğ) confirmed that spelling development lagged behind reading development in Turkish and that Ğ reduced spelling accuracy but had no effect on reading accuracy. These findings raise questions about the notion of symmetrical transparency: spelling is less transparent and cognitively more demanding than reading even in orthographies considered highly transparent for both reading and spelling. The case of Ğ highlights that even the most transparent orthographies may have exceptional cases that can differentially affect reading and spelling accuracy and therefore the developmental trajectories of reading and spelling skills. Clearly, spelling words as they are heard may not always result in accurate spellings even in Turkish and children should be explicitly taught about the phonemic ambiguity that Ğ may cause.

**Keywords** Turkish · Spelling · Reading · Ğ · Soft G · Orthographic transparency

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It is well established that children's reading and spelling accuracy develops very fast in highly transparent orthographies with 'simple one-to-one relations between letters and sounds' (Aro & Wimmer, 2003; Caravolas, 2004). However, in reality, very few orthographies fit this general definition of orthographic transparency. Most transparent orthographies, such as German, Greek, Italian or Dutch, are more transparent for reading (letter-to-sound mappings) but less so for spelling (sound-to-letter mappings). The lesser transparency of spelling relative to reading has been proposed as the main reason why spelling is more difficult to acquire and develops more slowly than reading in asymmetrically transparent orthographies, such as German (Wimmer & Mayringer, 2002) and Italian (Pinto et al., 2015).

However, spelling is cognitively and linguistically more demanding than reading (Bosman & van Orden, 1997; Perfetti, 1997). Spelling requires recall and construction of precise orthographic representations from memory despite variations in speaker, whereas reading is essentially a recognition of graphemic patterns. Therefore, it is difficult to ascertain whether the asymmetrical transparency and/or the inherent cognitive-linguistic demands of spelling underlie the observed developmental lag between reading and spelling in orthographies, such as German and Italian. It also remains unclear whether spelling develops more slowly than reading in orthographies considered symmetrically transparent for reading and spelling, such as Turkish and Finnish. This is because researchers use different lexical lists to assess reading and spelling skills, which impedes a direct comparison of reading with spelling accuracy in these orthographies. Further, previous studies have rarely taken into account orthographic-specific features that may differentially affect reading and spelling development even in highly transparent orthographies such as Turkish and Finnish.

To sum up, symmetrical transparency refers to bi-directional consistency of letter-sound mappings and by definition it suggests that reading and spelling are equally easy in orthographies such as Turkish and Finnish. The primary purpose of this study was to provide an empirical test of this assumption by testing children's reading and spelling accuracy on the same lexical items in Turkish, which is highly transparent for both reading and spelling (Durgunoğlu, 2006). The present study also went a step further to examine the effect of an exceptional orthographic case, namely the letter Ğ on reading and spelling accuracy in Turkish. The phonemic perception of Ğ in spoken words is influenced by its phonemic context (Kılıç & Erdem, 2013) and therefore may create ambiguity for spelling or sound-to-letter mappings. This is not observed with any other letter or sound in Turkish. Yet, to date no study has systematically examined whether Ğ, which is a very common letter in Turkish words, may complicate early spelling development and therefore, should be taken into account when comparing children's reading and spelling development.

## Turkish orthography

There are 29 graphemes (8 vowels and 21 consonants) and 41 corresponding phonemes in modern standard Turkish (Hengirmen, 1998; Underhill, 1986) (Table A, online resource). Every grapheme corresponds to a single letter and there are no digraphs, diphthongs or homographs. The vowel sounds directly correspond to their

letter names. The long vowel sounds are rarely marked in modern standard Turkish, as they rarely change the meaning of a word. Irrespective of place of articulation (i.e., back or front) all consonantal sounds are denoted by their corresponding letters in writing. The back and front vowel sounds are further classified as rounded/unrounded and open/close (Table B, online resource). The most common syllable structures in Turkish are CV and CVC but double consonant clusters (CVCC) are allowed at word final position (Hengirmen, 1998). The stress is generally on the last syllable of two-syllable words but there are exceptions to this rule for proper nouns and words with three or more syllables (Demircan, 2001).

It is difficult to precisely quantify the degree of transparency of individual writing systems. This is largely because of the challenges of statistical analysis of comparable orthographic units between the writing systems. Nonetheless, broadly, along with Finnish and Czech, Turkish is positioned at the far end of the continuum of transparency (Babayiğit & Stainthorp, 2007; Caravolas, 2006) and these three writing systems are considered relatively symmetrically transparent for both reading and spelling (see Babayiğit & Stainthorp, 2007; Caravolas, 2006; Torppa et al., 2013). In contrast, English is positioned at the opposite end of the continuum of transparency and is considered among the least transparent orthographies with many complex grapheme-phoneme correspondence rules for both reading and spelling (Seymour et al., 2003). Asymmetrically transparent orthographies such as German, Dutch, Greek and Italian are positioned in the middle and are more transparent for reading than for spelling (Georgiou et al., 2012; Moll et al., 2014; Seymour et al., 2003).

## Reading and spelling development in transparent orthographies

Theoretical models of early reading and spelling development all emphasise that consistent letter-to-sound mappings not challenged by complex rules or irregularities facilitate reading and spelling acquisition (Ehri, 2005; Share, 1995, 2004). In line with this account, cross-linguistics studies have shown that as the orthographic transparency increases, the time it takes to be an accurate reader decreases. For example, Aro and Wimmer (2003) compared the pseudoword reading accuracy of children from grades 1–4 in English, French, German, Spanish, Dutch, Swedish and Finnish. They found that reading development was the slowest in English. By the end of grade 1, the mean reading accuracy of children in English was 50%, whereas in the rest of the orthographies it was 85% or higher. It took three more years (at grade 4) for children learning English to reach above 80% reading accuracy levels in this study. The findings from studies in Turkish are also aligned with these cross-linguistic reports: within about 8 months of formal reading instruction, children's reading accuracy level reaches ceiling levels (over 90%) (Babayiğit & Stainthorp, 2007; Öney & Durgunoğlu, 1997). A similar facilitating effect of orthographic transparency on spelling development has been reported by Caravolas (2004) who compared Czech with French and English.

Surprisingly, very few studies compared the reading and spelling accuracy skills on the same lexical items in transparent orthographies. In one exceptional study on beginner readers in Italian, Cossu et al., (1995) found that spelling accuracy lagged

behind reading accuracy on the same set of words and nonwords at grades 1 and 2. As spelling in Italian is not as transparent as reading, these results were associated with the asymmetrical transparency of Italian (cf. Cossu et al., 1995; Pinto et al., 2015). No study to date has compared reading accuracy with spelling accuracy on the same lexical items in symmetrically transparent orthographies. Though, there is suggestive evidence from a few studies in Turkish for an out of step development between reading and spelling similar to those reported in Italian (Babayiğit & Stainthorp, 2007; 2010). For example, in a longitudinal study, Babayiğit and Stainthorp (2007) found the mean spelling accuracy to be 45% at grade 1, which increased to 74% at grade 2, yet children's mean reading accuracy was above 90% at both testing times. However, once again the use different lexical lists for reading and spelling tasks means that these reports from Turkish remain inconclusive. We do not know whether spelling develops more slowly than reading in orthographies considered highly transparent for both reading and spelling.

There are also orthographic-specific features that can differentially affect reading and spelling accuracy even in highly transparent orthographies, but these are rarely acknowledged or investigated in this area of research. For example, although Finnish has a relatively transparent spelling system, young spellers make more spelling errors on words with long phonemes, which is indicated by double letters in Finnish (Lehtonen & Bryant, 2004; Kulju & Mäkinen, 2017). That is, long phonemes potentially make spelling more difficult than reading in Finnish but its implications for the relative development of spelling and reading skills is yet to be investigated. In Turkish, phoneme length is not marked and does not change the meaning of a word except in a few loan words. However, the letter Ğ, which is a very common letter in Turkish words, can potentially complicate spelling but not reading in several ways that remain to be clarified.

## The exceptional case of Ğ in Turkish

Without doubt, the phonemic realisation of the letter Ğ, which is also referred to as soft G, remains the most disputed subject in Turkish linguistics (Kılıç, 2017; Kılıç & Erdem, 2013). In fact, the letter name 'soft G' is misleading as the pronunciation of Ğ is not a softer pronunciation of the letter G (/g/) in Turkish. Note that Ğ never appears at the beginning of a word and is always preceded by a vowel but can be followed by a vowel or a consonant. Ğ is a weak consonantal sound which is highly affected by its position and phonemic context in a given word and there is a lack of consensus on its phonemic transcription. Some have posited that Ğ has no phonemic value or it merely serves to lengthen the preceding vowel sound (for a review, see Kılıç & Erdem, 2013). Therefore, Ğ is sometimes transcribed as /:/, which signifies length in International Phonetic Alphabet (IPA; e.g. <yağ> (oil) → /ja:/) (Eker, 2006). However, others highlighted the effect of phonemic context on the perceived salience of Ğ. For example, Ğ is very salient in minimal contrasts and at the end of a syllable or word, such as <çağ> (era) →/ʧaɯ/ and <çay> (tea) →/ʧaj/ (Kılıç & Erdem, 2013). Demircan (2001) also stressed the importance of syllabic position of Ğ and posited that Ğ loses its salience and serves to lengthen the preceding vowel when it is at the

end of the first syllable in mid-word positions, such as CVǦ.CV. Yet, when Ǧ is at the beginning of the second syllable of a word, such as CV.ǦVC, it is more salient and does not have the same effect on the preceding vowel length (Demircan, 2001). It is beyond the scope of the present study to detail the linguistic literature on Ǧ. There seems to be some consensus that depending on its context Ǧ can be transcribed as /ː/ (lengthening), /ɣ/ (voiced velar fricative), /ɰ/ (voiced velar approximant), or /j/ (voiced palatal glide) (see Kılıç, 2017; Konrot, 1981; Underhill, 1986; Zimmer & Orgun, 1999). However, this is not an exhaustive list. Depending on its phonemic context Ǧ may also sound like /v/, /h/ or other weak consonantal sounds (see Lewis, 1967). It is important to note that when Ǧ /ɰ/ sounds like /j/ in certain phonemic contexts, it remains unclear whether the two sounds are the same or whether there are subtle formant differences between the two sounds given that the place of articulation of /ɰ/ and /j/ is different. Therefore, there is a distinction between how Ǧ is *pronounced* by the speaker and how it is *perceived* by the listener, as the two may not be the same depending on the phonemic context of Ǧ. Hence, when Ǧ is pronounced in isolation, there are similar disagreements about its transcription: Some prefer to use a non-IPA symbol /ğ/ to denote its context-dependent nature or transcribe it as /ɰ/ or /ɣ/ (see Kılıç, 2017). Note that /ɣ/ is considered an allophone and the subtle distinction between /ɣ/ or /ɰ/ do not change the perceived meaning of the words with Ǧ (Kılıç, 2017).

Although the current linguistic research evidence for the proposed phonemic effects of Ǧ is highly limited and far from conclusive, there is no question that Ǧ can complicate sound-to-letter mappings in Turkish. That is why Ǧ presents an exceptional case in Turkish: it requires children to go beyond phonemic information and develop orthographic knowledge to spell words with Ǧ accurately. In contrast, pronunciation of <ğ> as either /ɣ/ or /ɰ/ when reading words with Ǧ provides an accurate reading irrespective of the phonemic context of <ğ>.

For example, phonetic spelling of Ǧ can lead to spelling errors such as spelling <soğan> (onion) as <sovan> (nonword; consonant substitution error) because Ǧ may sound similar to /v/ in this word (Lewis, 1967). Likewise, if children do not perceive Ǧ as a salient phoneme when it lengthens the preceding vowel, they may simply omit Ǧ in their spellings (omission of Ǧ error). Recall that vowel length is not marked in Turkish. Children learning to read and spell in Turkish are taught to write words as they hear or say. Yet, application of this strictly phonetic strategy to words that contain Ǧ may lead to spelling errors even if a child speaks modern standard Turkish. In support of this assertion, several studies noted that spelling words that contain Ǧ can be particularly challenging for young learners in Turkish (Babayiğit, 1999; Sönmez et al., 2015; Terziyan & Demirel, 2020). For example, Babayiğit (1999) reported that first graders made more than twice as many spelling errors than reading errors on words that contained Ǧ (61% versus 27%). However, none of these studies tested reading and spelling of Ǧ on the same lexical items whilst taking into account its syllabic position or phonemic context in a word.

In contrast to the ongoing linguistic debate on Ǧ, there is a conspicuous absence of Ǧ in instructional practices in Turkish (Babayiğit & Konedralı, 2009). Children learning to read and spell in Turkish are taught to pronounce Ǧ as /ɰ/ or /ɣ/ (see Kılıç, 2017). It is not clear if teachers are aware of the subtle distinction between these two

sounds when they introduce the letter Ǧ to children. Further, in our review of text-books and survey of teachers, there was no recognition of the phonemic ambiguity that Ǧ can cause in spelling or sound-to-letter mappings (Babayiğit & Konedralı, 2009). This is concerning as Ǧ is a late acquired phoneme in Turkish (Topaş, 2004), which suggests that phonological processing of Ǧ is particularly difficult for young Turkish speakers.

To sum up, even the highly transparent spelling systems of Finnish and Turkish can be complicated by orthographic-specific features (i.e., long phonemes in Finnish and Ǧ in Turkish). Therefore, a comparison of the reading and spelling development in highly transparent orthographies would be incomplete without considering the exceptional features that can differentially affect early reading and spelling accuracy in these orthographies.

## Present study

The current study involved two experiments designed to clarify whether children's spelling lagged behind their reading in Turkish which is considered highly trans-parent for both reading and spelling. The most important novel contribution of the current study was that it systematically compared reading and spelling accuracy on the same lexical items while at the same time taking into account an orthographic-specific feature, namely Ǧ, that can differentially affect reading and spelling accuracy in Turkish.

Experiment 1 examined whether young learners made more spelling errors than reading errors on the same nonword items in Turkish. The use of nonwords allowed to control for prior experience and to match nonwords with and without Ǧ on all letters (except Ǧ) and syllable structure. For a naturalistic replication of the results of experiment 1, a second experiment with real words was conducted. Specifically, experiment 2 examined: (a) whether children made more spelling errors than read-ing errors on high frequency words that they had encountered before in writing and speech, and (b) whether the anticipated impact of Ǧ on spelling accuracy rate disap-pears for high frequency words. Finally, a spelling error analysis was conducted to explore children's typical spelling errors on lexical items with Ǧ in order to inform instructional practices in Turkish. Children's spelling errors have long been consid-ered a window into their developing phonological and orthographic knowledge of words and therefore have specific pedagogic importance (Bahr et al., 2012; Cassar & Treiman, 2004).

It was anticipated that spelling would be more difficult than reading for young learners despite the high levels of transparency of Turkish spelling system because spelling is cognitively more demanding than reading and it is more likely to be affected by phonetic events, which makes spelling more error-prone than reading (Babayiğit & Stainthorp, 2007; Sönmez et al., 2015). Primarily due to the phonemic ambiguity that Ǧ causes in spoken words, it was predicted that children would make more spelling errors on lexical items with Ǧ than on items without Ǧ. In contrast, Ǧ was not expected to impact reading error rate, as its default pronunciation as either /ɯ/ or /ɣ/ is sufficient for accurate reading of words. Finally, following the previous

report stating that Ğ becomes less salient when it is at the end of a syllable (Demircan, 2001), it was anticipated that omission of Ğ in writing would be higher when Ğ is at the end of a syllable rather than at the beginning of a syllable in mid-word positions.

## Method

All tasks were implemented by the author who is Turkish Cypriot and a native speaker of Turkish. Consent was obtained from parents, schools, and children's assent was sought at each testing session.

### Experiment 1

### Participants

The study was conducted in Northern Cyprus (Turkish Republic of Northern Cyprus) where children are taught to read and spell in modern standard Turkish in primary schools. The reading instruction was a mix of whole word and phonics approaches, and children were taught to write using print handwriting. All schools used the same books and followed the same national curriculum. Babayiğit and Konedralı (2009) provide a detailed account of reading instruction practices in Northern Cyprus. Forty children (19 male and 21 female) from two different public primary schools were tested at grade 1 after about 7–8 months of formal reading and spelling instruction. The mean age was 80.93 months ($SD = 2.79$ months). All children were monolingual native speakers of Turkish and none of them had any speech, language, learning or motor coordination difficulties. The parental occupational background was reflective of the general population: 43.6% of mothers reported to be unemployed/housewife, 2.6% partially skilled manual worker, 41.0% non-manual skilled worker, 10.3% self-employed and 2.6% professional. As for fathers, 2.6% reported to be unemployed, 7.7% skilled manual worker, 43.6% non-manual skilled worker, 10.3% intermediate managerial, 28.2% self-employed and 7.7% professional.

### Development of nonwords with and without Ğ

Children's reading and spelling was assessed on the same 48 nonwords (Table D, online resource). The use of nonwords allowed to control for prior exposure and to make a precise match between lexical items with and without Ğ. The 24 nonwords with Ğ were matched with 24 nonwords without Ğ on letters and syllable structure and differed only in terms of the presence or absence of the letter Ğ. For example, the nonword item with Ğ, <ko.ğal> (CV.CVC) →/kouɑal/ was matched to the nonword item without Ğ <ko.fal> (CV.CVC) →/kofal/. All nonwords were pronounceable and developed in line with the phonotactic rules of Turkish (see Lewis, 1967).

Following Demircan's (2001) report about the syllable position effect on the perceptual salience of Ğ, half of the nonwords with Ğ (12 items) included Ğ at the beginning of the second syllable and in intervocalic position, CV.ĞVC (e.g., <to.ğun>). In the remaining half of the nonwords with Ğ (12 items), Ğ was at the end

of the first syllable and between a vowel and a consonant, CVĞ.CV (e.g., <toğ. nu>). So, CV.ĞVC and CVĞ.CV items contained the same letters just the position of the last two letters were swapped to obtain a different syllable structure (e.g., <to. ğun> versus <toğ.nu>). In this way it was possible to examine the effect of Ğ on reading and spelling accuracy as a function of its syllable position. Finally, because the vowel context can influence phonemic perception of Ğ (Lewis, 1967), nonwords were developed to capture a range of common vowel contexts in Turkish (Table D, online resource).

For the spelling task, children were provided with a lined paper and for the reading task, the nonwords were printed with Century Gothic font (18 font size) on an A4 size card. This font size and type closely matched those in children's reading books at school. During the spelling task, Ğ was pronounced as /ɯ/. So, there was only one possible correct spelling of each nonword. During the reading task, children's pronunciation of Ğ as either ɣ/ or /ɯ/ was correct pronunciation. Also, if the pronunciation of Ğ resulted in the lengthening of the preceding vowel and this was appropriate, it was considered a correct pronunciation. Recall that long vowels are not marked in modern standard Turkish and the vowel lengthening that occurs almost automatically due Ğ provides adequate auditory cue to perceive the presence of Ğ in children's pronunciation of nonwords (see Konrot, 1981). However, replacing Ğ with another sound including similar sounding consonantal sounds such as /j/ is not a correct pronunciation and was scored as inaccurate reading. So, with the exception of these considerations related to Ğ, there was one possible correct pronunciation of each nonword.

## Procedure

All testing was conducted one-to-one at the children's schools in a supervised area over four sessions spread across two different days. The 48 items were presented on two parallel forms (Cards A and B) with 24 items on each (Table D, online resource). The order of the presentation ensured that children never read or spelled the same nonwords consecutively on the same day. For example, children spelled form A and then read form B on the first testing session on day 1, and then about 10 days later they spelled form B and read form A on day 2. Children were evenly allocated to each testing order, which is summarised in Table E (online resource). On average, reading of nonwords on each form took 1 min and spelling took 3.5 min.

The nonwords were printed as a list and children were told to read aloud each nonword as accurately as they could from top to bottom. Prior to testing children were presented with four nonword practice items and they were informed that the words they would read were made-up words with no meaning. As for the spelling task, after articulating each item with normal stress patterns, children were asked to repeat each item after the experimenter and then write it down on a lined paper. Prior to the spelling task, children were told that they would hear a strange word that will not make any sense to them, but that they should repeat aloud the word as well as they could before they wrote it down. If the child could not repeat the nonword accurately, the experimenter articulated it again. Up to three repetitions were allowed to make sure that the child heard the nonword accurately and they could pronounce the

nonword accurately before writing. Following three repetitions, if a child still could not pronounce the nonword accurately, they were asked to write the nonword as well as they could.

## Results

Prior to testing, children's alphabet knowledge on both capital and lowercase letters was tested (max score 58). The alphabet knowledge was high: the mean error count was very low 0.55 (*SD*=0.96) and the number of errors ranged from 0 to 3. Due to limited variance, alphabet knowledge was not related to any of the reading or spelling measures and therefore, it was excluded from the reported analyses. Likewise, gender was dropped from the analysis as there was no difference between the boys and girls on any reading or spelling measures.

Table 1 shows the descriptive statistics for spelling and reading accuracy. The overall mean reading accuracy was higher than mean spelling accuracy on the same nonword items: 43.33 (90%) versus 35.85 (75%), respectively. The mean spelling accuracy was lower on nonwords with Ğ than those without Ğ, 64% versus 85%, respectively. In contrast, the mean reading accuracy on nonwords with and without Ğ were very similar, 91% and 94%, respectively.

Due to statistically significant negative skews specifically on reading accuracy measures (skewness index ranged from −2.48 to 14.86), the nonparametric test of Wilcoxon signed rank test was conducted to compare the reading and spelling accuracy scores. Table 2 summarises these results. The difference between the reading accuracy for nonwords with and without Ğ was not statistically significant but the rest of the comparisons were all statistically significant, and the effect sizes ranged between medium and large. So, the mean spelling accuracy was lower than mean reading accuracy on nonwords with Ğ and as well as on nonwords without Ğ. Further, whereas the presence of Ğ reduced spelling accuracy rate, it did not have any effect on reading accuracy rate. For an item-based comparison of spelling and reading accuracy rates, see Table I and Figures A and B in online resource.

**Table 1** Experiment 1: Descriptive results for reading and spelling accuracy of nonwords with and without Ğ

| Nonword Items | Reading accuracy | | | | Spelling accuracy | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Mean (*SD)* | Median | % | Min-Max | Mean (*SD)* | Median | % | Min-Max |
| With Ğ (24 items) | 21.88 (3.01) | 23 | 91 | 11–24 | 15.45 (5.33) | 16.5 | 64 | 0–24 |
| Without Ğ (24 items) | 22.45 (2.14) | 23 | 94 | 14–24 | 20.40 (3.27) | 21 | 85 | 10–24 |
| Total (48 items) | 43.33 (4.42) | 46.5 | 90 | 30–48 | 35.85 (7.60) | 37 | 75 | 10–47 |

*N*=40

**Table 2** Experiment 1: Summary of Wilcoxon signed rank test on nonwords with or without Ğ

| Nonword items | Z | p | r |
|---|---|---|---|
| Reading nonwords with Ğ vs. without Ğ | −0.514 | 0.607 | −0.057 |
| Spelling nonwords with Ğ vs. without Ğ | −4.869 | <0.001 | −0.545 |
| Spelling nonwords with Ğ vs. reading nonwords with Ğ | −5.19 | <0.001 | −0.581 |
| Spelling nonwords without Ğ vs. reading nonwords without Ğ | −3.739 | <0.001 | −0.418 |
| Total spelling accuracy vs. total reading accuracy (nonwords with and without Ğ combined) | −5.386 | <0.001 | −0.602 |

## Experiment 2

### Participants

Participants were the same as those for experiment 1, except that the total sample size was reduced to 39 due to one child (male and aged 79 months) being absent on the day of testing. The mean age was 80.97 months ($SD$=2.80 months).

### Selection of high and low frequency real words with and without Ğ

There was no formal word frequency information for this age group in Turkish. Therefore, children's school books were examined to select appropriate real words. Five teachers rated each selected word from 1 to 5 in terms of frequency that children of this age were likely to come across in written and spoken form (1=never to 5=often). The final list consisted of 14 high (rated 4 or 5; sometimes or often) and 14 low (rated below 3; never or very rarely) frequency words. In this final list of 28 words, there were 14 words with Ğ and 14 words without Ğ (Table F, online resource). Eight words with Ğ were of high frequency and six were of low frequency. Six words without Ğ were of high frequency and eight were of low frequency. Ğ was at the end of syllable position in eight words and at the beginning of syllable position in the remaining six (Table F). Finally, Ğ was pronounced as /ɯ/ during the spelling task and scoring of reading accuracy was based on the same criteria as described in experiment 1.

**Table 3** Experiment 2: Descriptive results for spelling and reading accuracy of real words with and without Ğ

| Words | Reading accuracy | | | | Spelling accuracy | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean (SD) | Median | % | Min-Max | Mean (SD) | Median | % | Min-Max |
| With Ğ (14 items) | 13.90 (0.50) | 14 | 99 | 11–14 | 10.13 (2.89) | 11 | 72 | 1–13 |
| Without Ğ (14 items) | 13.92 (0.35) | 14 | 99 | 12–14 | 12.64 (1.48) | 13 | 90 | 7–14 |
| Total (28 items) | 27.82 (0.82) | 28 | 99 | 23–28 | 22.77 (3.72) | 23 | 81 | 8–27 |

$N$=39

## Procedure

Children read and spelled the same set of 28 words (Table F, online resource). Half of the sample completed the spelling task first, then about a week later they completed the reading task. The remaining half completed the reading task first followed by the spelling task. There was at least a week between the two testing sessions. On average, it took children about 1 min to complete the reading task and 3.5 min to complete the spelling task.

## Results

Table 3 presents the descriptive statistics for spelling and reading accuracy for real words. The spelling accuracy rate was lower than reading accuracy rate on real words with and without Ğ. The reading accuracy rate for words with and without Ğ was the same, 99%. In contrast, children made more spelling errors on words with Ğ: The spelling accuracy rate was 72% on words with Ğ and 90% on words without Ğ. The Wilcoxon signed rank tests showed that all these comparisons were statistically

**Table 4** Experiment 2: Summary of Wilcoxon Signed Rank Test on Real Words with and without Ğ

| Words | $Z$ | $p$ | $r$ |
|---|---|---|---|
| Reading words with Ğ vs. without Ğ | −0.577 | 0.564 | −0.065 |
| Spelling words with Ğ vs. without Ğ | −4.38 | <0.001 | −0.496 |
| Spelling words with Ğ vs. reading words with Ğ | −5.462 | <0.001 | −0.619 |
| Spelling words without Ğ vs. reading words without Ğ | −4.533 | <0.001 | −0.513 |
| Total spelling vs. total reading (words with and without Ğ combined) | −5.454 | <0.001 | −0.618 |

**Table 5** Experiment 2: Descriptive Statistic for Spelling and Reading Accuracy of High and Low Frequency Words

| Words | Reading accuracy | | | | Spelling accuracy | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean (SD) | Mdn | % | Min-Max | Mean (SD) | Mdn | % | Min-Max |
| HF with Ğ (8 items) | 7.92 (0.35) | 8 | 99.0 | 6–8 | 6.15 (1.71) | 7 | 76.9 | 0–8 |
| HF without Ğ (6 items) | 5.95 (0.32) | 6 | 99.2 | 4–6 | 5.72(0.60) | 6 | 95.3 | 3–6 |
| Total HF (14 items) | 13.87(0.66) | 14 | 99.1 | 10–14 | 11.87(2.05) | 12 | 84.8 | 3–14 |
| LF with Ğ (6 items) | 5.97 (0.16) | 6 | 99.5 | 5–6 | 3.97 (1.39) | 4 | 66.1 | 1–6 |
| LF without Ğ (8 items) | 7.97 (0.16) | 8 | 99.6 | 7–8 | 6.92(1.01) | 7 | 86.5 | 4–8 |
| Total LF (14 items) | 13.95(0.22) | 14 | 99.6 | 13–14 | 10.90(1.89) | 11 | 77.9 | 5–14 |

Note. $N=39$; HF=high frequency words; LF=low frequency words

significant with a large effect size (Table 4). The only exception to this was the non-significant effect of Ğ on reading accuracy rate.

Next, the effect of word frequency on reading and spelling accuracy rates was explored. Table 5 presents the descriptive statistics for the reading and spelling accuracy of high and low frequency words and Table 6 summarises the results of the Wilcoxon signed rank test. When reading and spelling accuracy was compared for words matched on frequency (with or without Ğ), children's spelling accuracy remained lower than their reading accuracy with moderate and large effect sizes. Table J and Figures C and D in online resource present the spelling and reading accuracy rates for individual word items.

## Spelling error analyses

A spelling error analysis was conducted to explore the nature of errors children made when spelling nonwords and real words with Ğ. The error categories were informed by previous reports which posited that depending on its syllabic position, Ğ loses its salience (omission errors) or it might be replaced by weak consonants, such as v, h, y. Note that omission errors and grapheme substitution are common spelling errors in Turkish (Erden et al., 2002; Sönmez et al., 2015; Terziyan & Demirel, 2020). The spelling error analysis was expanded and categories were added as needed to account for different error types. As the main focus was on spelling errors that were directly and specifically related to Ğ, only such errors were included in the analyses. For example, spelling <Toğun> as <Togum> involves replacing Ğ with /g/ but also replacing the final phoneme /n/ with /m/, which is unrelated to Ğ, and therefore this error was not included in the Ğ-related spelling error counts.

## Spelling error analyses: Nonwords

The analysis revealed ten spelling error categories directly related to Ğ, which are summarised along with illustrative examples in Table 7. These ten spelling error categories captured 66% of all spelling errors on nonword items with Ğ (for a detailed summary of counts for each spelling error category, see Table G in online resource).

The omission of Ğ in writing was by far the most frequently observed spelling error. Out of total 210 errors specific to Ğ, 134 errors (64%) involved the omission

**Table 6** Experiment 2: Summary of Wilcoxon Signed Rank Test on Reading and Spelling of High and Low Frequency Words

| Words | Z | p | r |
|---|---|---|---|
| Reading HF words with Ğ vs. spelling HF words with Ğ | 5.001 | <0.001 | 0.566 |
| Reading HF words without Ğ vs. spelling HF words without Ğ | 3.000 | <0.003 | 0.340 |
| Reading total HF words vs. spelling total HF words | 4.991 | <0.001 | 0.565 |
| Reading LF words with Ğ vs. spelling LF words with Ğ | 5.131 | <0.001 | 0.699 |
| Reading LF words without Ğ vs. spelling LF words without Ğ | 4.592 | <0.001 | 0.691 |
| Reading total LF words vs. spelling total LF words | 5.333 | <0.001 | 0.604 |

Note. HF=high frequency; LF=low frequency

**Table 7** Spelling error analyses on nonwords with Ğ: Ten error categories and examples

| Spelling error category | Target Nonword with Ğ | | | | | |
|---|---|---|---|---|---|---|
| | Toğnu | Çöğme | Suğam | Kuğal | Süğer | Soğum |
| 1. Omission of Ğ | Tonu | Çöme | | Kual | Süer | |
| 2. Omission of Ğ and the following vowel sound | | | | | | Som |
| 3. Omission of vowel sound after Ğ | | | | Kuğl | | Soğm |
| 4. Replacing Ğ with Y | | | Suyam | | | |
| 5. Replacing Ğ with H | Tohnu | | Suham | Kuhal | Süher | |
| 6. Replacing Ğ with V | | Çövme | Suvam | Kuval | | |
| 7. Replacing Ğ with L | | Çölme | | | | |
| 8. Replacing Ğ with R | | | | | Sürer | |
| 9. Doubling of Ğ | | | | Kuğğal | | Soğğum |
| 10. Replacing Ğ with G (omission of diacritical marker) | Tognu | | Sugam | | Süger | Sogum |

of Ğ, which at the same time corresponded to 42% of all spelling errors (134/319) (Table G, online resource). Further analysis confirmed the prediction that children would make more omission of Ğ errors when Ğ was at the end of a syllable: there were 116 omission of Ğ errors (87%) when Ğ was at the end of a syllable (CVĞ.CV items) and 18 omission of Ğ errors (13%) when Ğ was at the beginning of the second syllable (CV.ĞVC items) (Table G, online resource). A 2×2 chi-square analysis on collapsed spelling error categories (omission of Ğ versus other errors) and syllable position (CVĞ.CV versus CV.ĞVC) confirmed that children made more omission of Ğ errors when spelling nonword items with CVĞ.CV syllable structure and the effect size was large, chi-squared=68.93, $p < .0001$, phi coefficient=−0.58.

The next most common spelling error categories were replacing Ğ with <v> (26 errors), with <h> (16 errors), and with <g> (15 errors). The former two were phonetic errors and involved replacement of Ğ with another weak consonant which varied depending on its phonemic context. Replacement of Ğ with G is likely to be non-phonetic error and involves the omission of the diacritical marker for Ğ.

### Spelling error analyses: real words

The spelling error analysis on real words revealed seven spelling error categories of Ğ. These seven categories captured 70% of all errors on words with Ğ. Table 8 summarises these spelling error categories along with illustrative examples from the sample and Table H in online resource summarises the counts for each spelling error category.

The omission of Ğ error was the largest category and corresponded to 49% (49/101) of all Ğ related spelling errors and 34% (49/144) of all spelling errors (Table H, online resource). Further, out of 49 'omission of Ğ' errors, 46 (94%) were observed when Ğ was at the end of syllable position. A 2×2 chi-square analysis on error type (omission of Ğ versus other error categories) and syllable position (Ğ at end of syllable versus beginning) confirmed that children made significantly more omission of Ğ errors when Ğ was at the end of a syllable and the effect size was

**Table 8** Spelling error analyses on real words with Ğ: Seven error categories and examples

| Spelling error category | Target Real Word with Ğ | | | | |
|---|---|---|---|---|---|
| | Buğday (Wheat) | Yağar (Rains) | Değerli (Valuable) | Öğrenci (Student) | Dağ (Mountain) |
| 1. Omission of Ğ | Buday | Yaar | | Örenci | Da |
| 2. Omission of Ğ and the following vowel sound | | Yar | Derli | | |
| 3. Omission of vowel sound after Ğ | | Yağr | Değrli | | |
| 4. Replacing Ğ with Y | | | Deyerli | Öyrenci | |
| 5. Replacing Ğ with H | | | Deherli | | |
| 6. Replacing Ğ with L | | | | | Dal |
| 7. Replacing Ğ with G (omission of diacritical marker) | | Yagar | | Ögrenci | |

large, chi-squared=68.32, *p* <.0001, phi coefficient=−0.84. Finally, the next two most common spelling errors were omission of Ğ along with the following vowel sound (18 errors) and the omission of the vowel sound following Ğ (18 errors). All these omission errors were observed in words where Ğ was at the beginning of a syllable (e.g., CV.ĞVC).

## Discussion

The present study sought to clarify whether the development of spelling accuracy lags behind reading accuracy in Turkish; an orthography considered highly transparent for both reading and spelling (symmetrically transparent). Through two experiments children's reading and spelling accuracy rates were compared on the same nonword and real word items. This study also went further and examined an exceptional orthographic-specific feature of Turkish, the letter Ğ, which was expected to complicate spelling accuracy but not reading accuracy due to the phonemic ambiguity it can cause from sound-to-letter mappings. It was particularly important to examine Ğ in this study, as it is a very common letter in Turkish words. The findings from both experiments supported the predictions that spelling would be more difficult than reading and that Ğ would undermine early spelling accuracy but not reading accuracy in Turkish. Finally, as anticipated, syllable position of Ğ was found to be directly related to its perceived salience: children made more omission errors when Ğ was at the end of a syllable in mid-word position.

## Does spelling development lag behing reading development in Turkish?

The consistent findings from the two experiments with nonwords and real words provided strong evidence that spelling development lags behind reading development in Turkish despite the relatively simple Turkish spelling system. The overall mean spelling accuracy was 75% for nonwords and 81% for real words, the mean reading accuracy was higher with 90% for nonwords and 99% for real words. It is noteworthy

that the spelling accuracy rate was lower than reading accuracy rate even on high frequency words with nonambiguous sound-to-letter mappings (i.e. high frequency words without Ğ). There was also much more variability in children's spelling scores than in their reading scores. Together, these findings call into question the notion of symmetrical transparency. It is more accurate to view symmetrical transparency in relative terms, that is, relative to other orthographies rather than in absolute terms: the present findings indicate that spelling is more difficult, error-prone and less transparent than reading even in highly transparent orthographies like Turkish.

## Does Ğ complicate spelling in Turkish?

Another novel contribution of this study was that it systematically compared the effect of Ğ on children's reading and spelling accuracy in Turkish. In experiment 1, children read and spelled the same nonwords with and without Ğ, which were matched on letters and syllable structure. The results supported the prediction that Ğ would complicate spelling but not reading: Children made more mistakes when spelling nonwords with Ğ than those without Ğ. In contrast, but as anticipated, Ğ did not have any effect on children's nonword reading accuracy levels. The findings from experiment 2 further confirmed these results with real words: Reading accuracy rate of words was not affected by the presence or absence of Ğ but spelling accuracy was affected: Children's spelling accuracy was lower for words with Ğ than for words without Ğ and this was the case even with high frequency words.

These parallel findings from the two experiments provided strong empirical support for the prediction that Ğ would complicate spelling but not reading in Turkish primarily due to the phonemic ambiguity it causes in sound-to-letter mappings (Babayiğit, 1999). So, the present findings extended previous linguistic reports (Topbaş, 2004) by showing that the difficulty in phonological processing of Ğ is young Turkish-speakers is also observed in their early spellings. That said, it is important to highlight that whilst children found words with Ğ more difficult to spell relative to words without Ğ, their spelling accuracy levels were impressive on several lexical items with Ğ (Tables I and J, online resource). This suggests a rapid development of orthographic representations of Ğ even during these early stages of spelling development which, undoubtedly, is faciliated by a highly consistent orthography.

## Spelling error analyses

It was quite remarkable that a significant proportion of all spelling errors on non-words and words with Ğ were directly and specifically related to the spelling of the letter Ğ. It is noteworthy that these are conservative estimates due to the exclusion of spelling errors which included Ğ in addition to other spelling errors not directly related to Ğ.

The spelling error analysis revealed that by far the most common error type was the omission of Ğ (Tables G and H, online resource). Moreover, in line with the previous linguistic reports (Demircan, 2001), there was a clear syllable position effect

and the omission of Ğ was observed when Ğ was at the end of the first syllable in mid-word position (e.g. CVĞ.CV). It is notable that these were robust findings supported by the results from both experiments. As vowel length is not marked in Turkish, it is possible that children simply omitted Ğ in their spelling when it lost its salience and lengthened the preceding vowel, as it was not perceived as an individual phoneme. Also, if children say words slowly when spelling, this may in itself have the effect of lengthening the vowel and therefore, children may not notice that the pronunciation of the words, such as <Suğma> and <Suma> are not the same, when they omit Ğ in their spellings (see Treiman & Kessler 2005, for a similar explanation for spelling mistakes on long phonemes in Finnish).

In line with the linguistic reports (Kılıç & Erdem, 2013; Lewis, 1967), there was also a tendency of replacing Ğ with other weak consonantal sounds such as <h> →/h/ and <y> →/j/: 23% of Ğ related errors in nonwords and 12% in real words involved such replacement errors (Tables G and H, online resource). As expected, these phonemic replacement errors tended to vary depending on the vowel context of the lexical items (see Lewis, 1967).

The omission of Ğ along with the following vowel sound or the omission of a vowel sound following Ğ were also noted for both nonwords and words (4% and 36%, respectively, Tables G and H). It is notable that in both experiments these two error types were observed when Ğ was at the beginning of a syllable and in between two vowel sounds (e.g. CV. ĞVC). The omission of a vowel sound after Ğ may suggest the use of letter name strategy. If children articulate Ğ with a vowel then they might omit the vowel sound following Ğ in writing. For example, spelling <bill> as <bll> in English. The writing of Ğ as G, that is the omission of the diacritical marker, was another common spelling error and has been reported before in relation to other letters with diacritical markers in Turkish (Terziyan & Demirel, 2020).

Finally, although nonword and real word items were not matched, there was a substantial overlap in spelling error categories between these two sets of lexical items: the seven spelling error categories in real words were also observed in nonwords and the most common error category was the omission of Ğ in both nonwords and real words. The three spelling error categories in nonwords that did not feature in real words were replacing Ğ with the weak consonantal sounds of <v> and <r> and doubling of Ğ, <ğğ>. The latter two were observed in only a few cases (two and four cases, respectively, see Table G). These differences are likely to reflect the differences in phonemic context of lexical items.

## Study limitations, implications and way forward

There are several caveats that need to be highlighted when evaluating the findings from this study. The nonword and word items were not matched, therefore a direct comparison between the two should not be made. Likewise, the high and low frequency words in experiment 2 were not strictly matched in terms of number, length or syllable structure.

It is possible that different phonemic contexts and syllable position of Ğ in longer multisyllabic words might have yielded a different pattern of results. For example,

during the suffixation process, if a word ends with the letter <k> and takes a suffix beginning with a vowel sound, then <k> becomes <ğ> [e.g. <tabak> /tabak/ (plate) + 1st person possessive suffix <ım> / ɯm/ → <tabağım> /tabaɯɯm/ (my plate)]. Turkish like Italian is a highly inflected writing system (Arfé et al., 2016). The word-final changes due to suffixation processes are very common in Turkish. Therefore, it is important to examine reading and spelling development within the context of long inflected and multisyllabic words. Likewise, the observed spelling error categories might have been affected by the characteristics of lexical items and task effects (Bosman & van Orden, 1997; Sönmez et al., 2015).

The spelling task in this study was very conservative and allowed multiple repetitions and checked that children could pronounce the words correctly before spelling them. This was an important control measure given the phonemic ambiguity Ğ may cause in spoken words but it also meant that the observed gap between spelling accuracy and reading accuracy might have been even larger, if a traditional spelling-to-dictation task were to be used.

Finally, the present study highlighted the importance of further laboratory-based phonetic research on Ğ to elucidate its effect on pronunciation and phonemic perception of spoken words, which can then inform teacher training and spelling instruction practices in Turkish. This study modelled the classroom practices and lexical items were pronounced such that each letter including Ğ was pronounced clearly. Future laboratory-based research is warranted to confirm the present findings while taking into account variations in accents and dialects that may also affect the pronunciation and phonemic perception of Ğ.

Nonetheless, the findings from this study highlighted that children should be explicitly taught about the exceptional nature of Ğ and specifically, the ambiguity it can cause when spelling Turkish words. Further, children's attention should be drawn to Ğ's position in a word and instances when it is likely to lose its salience or sound like other weak consonantal sounds. Hence, there is a clear need for developing both teachers' and children's metalinguistic awareness of Ğ.

## Conclusion

This study provided the first systematic comparison of the development of reading and spelling skills in an orthography considered highly transparent for both reading and spelling. The findings from the two experiments with nonword and real word items revealed a remarkably consistent picture and provided strong evidence that spelling accuracy lags behind reading accuracy even in a writing system considered highly transparent for both reading and spelling. This study also highlighted the importance of considering orthographic-specific features that can differentially affect reading and spelling accuracy even in highly transparent orthographies. The exceptional case of Ğ in Turkish, which undermined spelling accuracy but had no reliable effect on reading accuracy is a case in point in this respect. Together the results from this study raise the question of whether it is ever possible to have a truly symmetrical orthographic transparency: Cognitive differences between reading and spelling and the variability of speech sounds mean that spelling is inherently less transparent and

more error-prone than reading. Finally, the findings underscore the importance of further linguistic research on Ğ and integration of linguistic knowledge into teacher training and instructional practices in Turkish. Even in highly transparent orthographies such as Turkish, children should be taught that spelling words as they hear them may not always result in accurate spellings.

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