Assessment of Dyslexia in the Urdu Language

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from their significantly poorer and slower performance on reading/decoding tasks comprising words with diacritics and pseudowords compared to typical readers. Although the struggling readers in our study were not formally diagnosed with dyslexia, our results do add to an existing body of evidence favouring the phonological deficit being at the core of reading-related issues (Snowling, 2000). We accordingly suggest that formal Urdu reading instruction should include the teaching of adequate strategies that enable children to build letter-to-sound associations from an early age, which is currently not a common practice in Pakistan.

Acknowledgement

We would like to thank all the children, their parents, teachers and schools who participated in our study.

CHAPTER 4

Letter-Position Effects in Typical and Struggling Readers of Urdu

Abstract

Background: Urdu has approximately 100 million native speakers in Pakistan. Its orthography is cursive in nature and letters change shape depending on their position in a word. But how are letters processed in Urdu by the orthographic visual-analysis component of the reading system that is responsible for the determination of the position of letters? And does a change in shape cause difficulties in ordering letters within words, the so-called letter-position effect?

Aims: The shape, frequency and position of letters within Urdu words were manipulated, while the effects of these manipulations on letter processing in typical and struggling readers are compared.

Method: Based on their teachers' and parents' judgments, 295 7-to-11-year-olds (150 boys) recruited from schools in Karachi, Pakistan, were assigned to a typical-readers (n=167) or a struggling-readers group (n=128) and asked to read two lists of 25 words each in which letters varied in shape, frequency and position.

Results: Compared to same-shape migrated-letter cognates, reading accuracy was superior for migrated-letter cognates that changed shape due to their new position, as well as for high-frequency words (having low-frequency cognates) compared to low-frequency words (having high-frequency cognates). All children were also better at reading word pairs containing letters that changed initial and final positions compared to word pairs where letters changed medial positions. Reading accuracy in the struggling readers was, however, always significantly poorer to that of the typical readers.

Conclusion: Position-dependent letter forms facilitate letter-position processing in both typical and struggling readers of Urdu.

Keywords: letter-position effects, migration errors, frequency effect, Urdu, typical and struggling readers

4.1 Introduction

Teachers commonly report that some children read 'two' as 'tow' and 'who' as 'how' or vice versa. This is the so-called letter-position effect where children swap the initial, medial and/or final position of letters in a word while reading. Children who consistently show these errors have been described as having a specific form of dyslexia known as developmental letter-position dyslexia (LPD) (Friedmann & Rahamim, 2007). Letter-position swapping or migration errors have been reported for a number of different orthographies, including English (Kohnen & Castles, 2013; Kohnen, Nickels, Castles, Friedmann & McArthur, 2012), Hebrew (Friedmann & Rahamim, 2007) and Arabic (Friedmann & Haddad-Hanna, 2012). In the present study, we are the first to explore letter-position processing in the Urdu orthography.

We based our study on the dual-route model (DRM) of reading (Coltheart et al., 2001; Ellis & Young, 1988), which proposes that the first component in the reading process is orthographic-visual analysis (see Figure 4.1), which has three separate functions: (1) identification of letters, (2) encoding of letter positions within a word, and (3) letter-to-word binding (allocation of letters to the word they belong to). There is evidence to suggest that these three functions can be selectively impaired, leading to three distinct types of reading errors, i.e. identification errors (e.g. form as farm or fork), migration errors (e.g. form as from) and letter-to-word binding errors (e.g. dark part as park dart) (Kohnen et al., 2012).

The orthographic lexicon and the phonemic buffer, two other components of the DRM, could, theoretically, also be responsible for migration errors. However, Friedmann and Rahamim (2007) argue that the orthographic-visual analysis stage is the most likely cause as in their study Hebrew-speaking participants diagnosed with developmental LPD made many more letter-migration errors (e.g. smile-slime) than identification errors, leading to orthographically similar words (e.g. blows-brows), which would not be predicted by a deficit in the orthographic lexicon. Also, the participants were not impaired on a word and non-word repetition task and a task gauging phonemic awareness. These findings are incongruent with a deficient phonemic buffer. In their study with three English-speaking children with LPD, Kezilas et al. (2014) also ruled out the role of the phonemic buffer and the orthographic lexicon. Like Friedmann and Rahamim, they strongly argue that the orthographic-visual analyser is most likely responsible for, or at least plays a key role in, letter-migration errors.

Our study also focuses on the factors influencing the second function of the orthographic-visual analyser but now in beginning readers of Urdu. We were curious to know whether and, if so, why typical and struggling readers of Urdu make frequent letter-migration errors when assigning positions to letters within words. Studies on Hebrew, Arabic (Friedmann, Dotan & Rahamim, 2010; Friedmann & Gvion, 2001, 2005; Friedmann & Haddad-Hanna, 2012; Friedmann & Rahamim, 2007), and English (Kohnen & Castles, 2013) have shown that migration errors mostly occur when the output produces another similar-looking word (e.g. form being read as from). These studies also reported that most migration errors occur due to medial migrations (e.g., spot–stop versus male-lame;

Friedmann & Rahamim, 2007; Khentov-Kraus & Friedmann, 2011). Moreover, migration errors were shown to be more common for adjacent (e.g., form-from) than for non-adjacent (e.g. smile–slime) letters (Friedmann & Gvion, 2001; Friedmann & Rahamim, 2007).

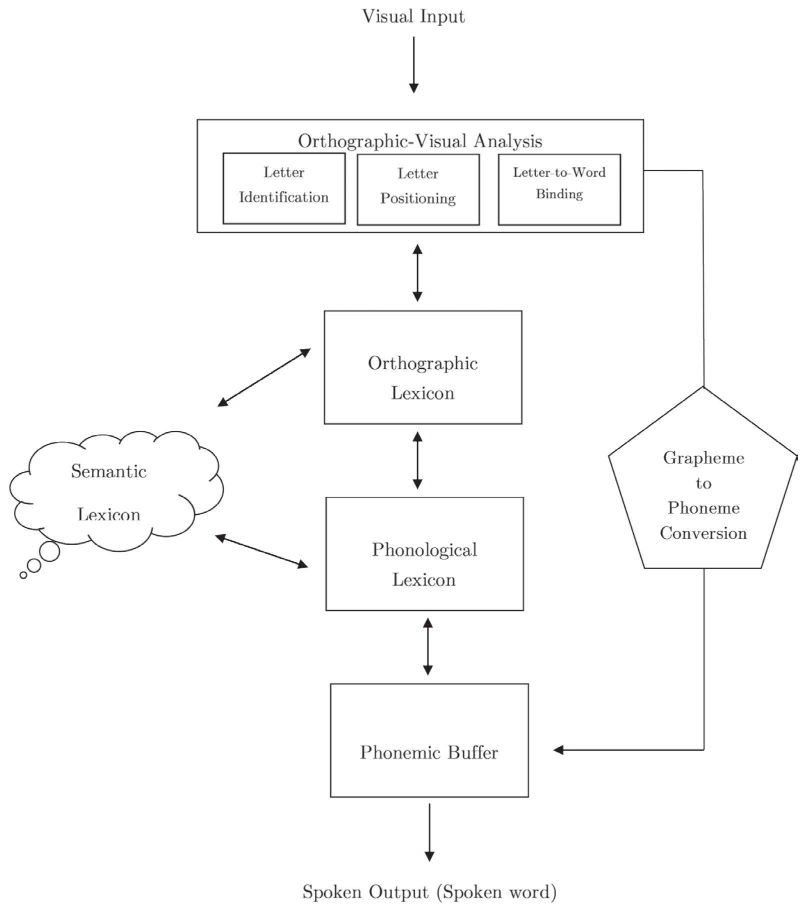

Figure 4.1: The components of the dual-route model of reading aloud (DRC Model - Coltheart, Rastle, Perry, Langdon and Ziegler, 2001. Figure 6, page 213; Friedmann & Rahamim, 2007; Kezilas et al., 2014; Kohnen et al., 2012)

Friedman and Haddad-Hanna (2012) studied developmental LPD in Arabic, which is an interesting orthography in this respect as letters take a different form depending on their position in the word. Comparing migrations errors made when letters did not change shape and when letters did, the authors found that changes in letter shapes had a significant effect on error rates. The children with LPD made fewer errors when letters changed shape than when their shapes remained the same.

Earlier, Friedmann and Rahamim (2007) argued that letter-position errors occur due to an *imprecise specification* rather than to the *incorrect coding* of medial letters in a word. When reading 'slime' as 'smile', the position of the 'l' could be anywhere between positions two and four rather than that the 'l' is coded in fourth position instead of the second. The authors supported their claim with evidence of a frequency effect. Reasoning that if it were just a matter of incorrect coding, the incorrect word activated in the lexicon as a result of incorrect coding would be produced regardless of word frequency, the authors found more migration errors when low-frequency words were being read (e.g. slime) than when their high-frequency cognates (e.g. smile) were being read. This appears to suggest that, due to imprecise specification, a number of alternative words are activated in the lexicon, where the most frequent word is then more likely to be selected.

Factors affecting letter position processing have never been studied for Urdu, which is an Indo-European language spoken in Pakistan and various parts of India, as well as in the South Asian diaspora (Middle East, UK, USA, Canada, etc.). Having around 588 million speakers, Urdu-Hindi is the second most widely spoken language in the world after Chinese (Rahman, 2004; Ulrich, 2015). Its alphabetic system has around 40 single letters, is cursive in nature and written from right to left. Its orthography is derived from Persian (which itself was derived from Arabic). While sharing similarities and differences with other languages like Persian and Arabic, Urdu has unique linguistic properties that make it highly suitable to study the letter-position effect. Similar to Arabic, its orthography consists of multiple letter forms where each letter changes shape according to its position in a word. For example, the shapes of the letter 'غ /ɣ/' in Urdu change from 'غ' in isolation, غـ in initial, ـغـ in medial and to ـغ in final position. Urdu might hence seem more difficult to read compared to English, for instance. Arguably though, different letter forms may facilitate letter-position processing and even possibly reduce specific reading impairments such as LPD (Friedmann & Haddad-Hanna, 2012). Indeed, if letters do not change shape when swapped, they form a visually very similar word. But if letters do change shape when swapped, words take on visually very different forms. We accordingly hypothesised that the higher the similarities in visual word form between a word and its cognate with a different letter sequence, the greater the chance of migration errors. Urdu is an interesting orthography to test our hypothesis, as it allows two shape-related letter migrations. The first is when swapping '*same-shape'* letters results in an orthographically similar and legitimate output (i.e. an existing correctly spelled word) as is shown in Table 4.1.

Table 4.1: Letters retaining their shape after swapping (visually similar cognates)

Words	Roman	IPA	English meaning	Same-shape cognates	Roman	IPA	English meaning
جواب	Jawaab	/j ə v aː b/	Answer	واجب	Waajib	/v aː j ɪ b /	Obligatory
ماتھا	Maatha	/m ɑː t̪ʰ ə /	Forehead	تھاما	Thaama	/ t̪ʰ ɑː m ə /	Hold
اور	Aur	/ ɔ r/	And	وار	Waar	/v aː r/	Attack

Note: IPA=International Phonetic Alphabet

The second is when swapping '*changed-shape'* letters result in words that are visually different from the target word (see Table 4.2). Here, if the original shapes of the letters are retained, this will result in an illegitimate string of letters.

Table 4.2: Letters changing shape after swapping (visually dissimilar cognates)

Words	Roman	IPA	English meaning	Changed-shape cognates	Roman	IPA	English meaning
لات	Laat	/l aː t̪ /	Kick	تال	Taal	/ t̪ aː l/	Rhythm
سڑک	Sarak	/ s ə ɽ ə k /	Road	سکڑ	Sukar/d	/ s ʊ k ə ɽ /	Shrink
بادل	Baadal	/b aː d ə l/	Cloud	بدلا	Badla	/b ə d l ə /	Revenge

Note: IPA=International Phonetic Alphabet

We manipulated three factors likely to be implicated in the letter-position effect in Urdu. First, we compared reading accuracy of words where letter migration involves letters changing shape, with words where letter shapes remain unchanged. Second, we compared the reading speed for high-frequency words (having low-frequency cognates), with low-frequency words (having high-frequency cognates). Third, we contrasted cognates where the initial and final letters migrated with cognates where medial letters changed position.

Letter-position errors are found in children with LPD (Arabic and Hebrew; Friedmann & Haddad-Hanna, 2012; Friedmann & Rahamim, 2007) as well as in typical readers (English; Kohnen & Castle , 2013), suggesting that imprecise letter-position processing is not specific to impaired reading. We therefore compared the reading performance of typical and struggling readers of Urdu in a large sample of 7-to-11-year olds.

4.2 Method

This research was approved by the Macquarie University Human Research Ethics Committee (Australia, Reference No. 5201300826) and by the Research Ethics Committee (CETO) of the Faculty of Arts of the University of Groningen (The Netherlands).

4.2.1 Participants

The same 295 children (150 boys), aged 7-to-11 years, attending grades three to seven of three private middle-income schools in Karachi (Pakistan) reported on in our earlier chapters (two and three) participated in the current study. The students were subdivided into typical readers (TR=167) and struggling readers (SR=128). Since with our successive study we were in the process of developing and testing a dyslexia test for Urdu, for this study struggling readers were identified by their teachers and parents based on the children's reading and spelling performance. All children had received at least two years of formal reading instruction in Urdu and spoke Urdu as one of their primary languages both at school and in the home.

4.2.2 Materials

At the start of our research, 300 words were selected from grade 3-7 school Urdu textbooks, excluding compound words (mostly derived from Persian), words with heavy Arabic influence and commonly mispronounced words. The frequency of the words was rated by the participating teachers on a 3-point scale (1 denoting a low and 3 a high frequency) and by a group of 10 female and 10 male volunteers (18-80 years) with a minimum of 12 years education. The correlation between the two ratings was high (Spearman $\varrho = 0.81$). We subsequently selected 50 words from this pool and divided these into two lists of 25 words each, with list 1 including 25 high-frequency words (rated 3) and list 2, 25 low-frequency cognates (rated 1). Each of the words in list 1 had a cognate in list 2 in which the letters had changed position, of which half were visually similar cognates (letters kept the same shape) and half visually less similar cognates (letters had changed shape). Examples are given in Tables 4.1 and 4.2. Finally, of these 50 words, 10 (5 pairs) had initial-final letter migrations and 10 medial-letter migrations, which we analysed separately.

4.2.3 Procedure

The children read out the two word lists alternately in randomised order during a single individual session. They were instructed to read and verbalise the words as accurately and as fast as possible. Both reading accuracy (the number of correctly read words) and reading speed (the number of seconds used to read a full list of 25 words) were recorded for both lists.

4.2.4 Statistical Analyses

We performed three separate analyses. We first analysed the *accuracy* data for the factors shape, frequency and reading status (TR versus SR) using repeated measures ANOVA. Second, since *reading speed* data were only available for word frequency, we analysed it separately. Third, as the accuracy data for the factor *letter position* concerned 10 word pairs (and not 25 word pairs), we conducted a separate analysis on this dataset.

The ANOVAs conducted with and without outliers elicited the same results, therefore we did not exclude the outliers. Mauchly's test of sphericity indicated that the assumption of equality of variances was met (Field, 2009). Effect sizes are mentioned as partial eta squared (η_{π}^2; small= .01, medium = .06, large = .14).

The reading-speed data for frequency and the accuracy data for letter position had unequal variances and were not normally distributed. Therefore, between-group differences were tested with Mann-Whitney U tests and within-group comparisons with Friedman tests. Results were expressed as effect sizes (ES) using Hedges' g (small = .2, medium = .5, large = .8, very large = 1.3).

4.3 Results

4.3.1 Shape, Frequency and Reading-Status Results

The accuracy results for the factors shape, frequency and reading status are summarised in Table 4.3.

Table 4.3: Accuracy results for letter shape and frequency for the two study groups

		TR n=167		SR n=128	
Shape Condition	**Frequency**	**M (%)**	***(SD)***	**M (%)**	***(SD)***
Changed-shape	High	94.70	*(15.63)*	69.11	*(26.22)*
	Low	93.60	*(15.65)*	60.82	*(29.17)*
Same-shape	High	93.66	*(15.90)*	64.84	*(25.57)*
	Low	88.42	*(16.71)*	49.87	*(27.92)*

Note: $p < .001$, accuracy = proportion of correctly read words, TR = typical readers, SR = struggling readers

We conducted repeated measures ANOVA to determine the effects of shape (changed/same), frequency (high/low) and reading status (typical readers/struggling readers) on reading accuracy measures (see Table 4.3). We found main effects of shape, frequency and reading status. Changed-shape cognates were read better than same-shape cognates, [Shape, F (1, 293) = 100.47, $p < .001$, $\eta_\pi^2 = .25$]. High frequency words (with low frequency cognate) were read better than low frequency words (with high frequency cognates), F (1, 293) = 148.17, $p < .001$, $\eta_\pi^2 = .34$. Typical readers performed better than struggling readers in all the conditions, F (1,293) = 177.01, $p < .001$, $\eta_\pi^2 = .38$. Moreover, we found significant interactions. Frequency had larger effect in struggling readers than in typical readers, [Frequency x Reading status, F (1, 293) = 48.39, $p < .001$, $\eta_\pi^2 = .14$]. Frequency had less effect in changed-shape than in same-shape cognates [Frequency x Shape, F (1, 293) = 35.86, $p < .001$, $\eta_\pi^2 = .11$]. Shape had a larger effect in struggling readers than in typical readers [Shape x Reading status F (1, 293) = 17.72, $p < .001$, $\eta_\pi^2 = .06$]. All the effect sizes were large except for interactions between shape and frequency, and between shape and reading status.

4.3.2 Reading Speed for High- and Low-Frequency Words

Reading-speed results for the factor frequency are summarised in Table 4.4.

Table 4.4: Reading speed (in seconds) for high- and low-frequency words for the two study groups

	TR n=167		SR n=128		Mean difference
Condition	**M**	***(SD)***	**M**	***(SD)***	**(seconds)**
High-frequency words	36.76	*(26.46)*	122.05	*(90.10)*	85.29
Low-frequency words	44.77	*(31.41)*	133.13	*(85.92)*	88.36

Note: *$p < .001$; reading speed for the two 25-word lists is in seconds, a higher mean indicating longer reading times; TR = typical readers, SR = struggling readers

The non-parametric between-group analyses generated a significant difference for high- and low-frequency words, with the large effect sizes (ES > 1) demonstrating that the struggling readers needed significantly more time to read the lists than their typically reading peers. This was true for the high-frequency words, $U = 1904$, $z = 11.47$, $p = .001$, g =1.30, and the low-frequency words, $U = 1899$, $z = 11.40$, $p = .001$, $g = 1.40$. The non-parametric within-group comparisons showed that both groups read the list of high-frequency words faster than they did the list of low-frequency words, with the difference being significant for both groups: TR, $\chi 2$ (1) = 48.21, $p < .00$, $g = .27$; SR, $\chi 2$ (1) = 34.71 $p < .001$, g = .12. However, effect sizes for both groups were small (ES < .3). We also found a significant interaction between reading speed and reading status as difference between the reading speed of high and low frequency words was significantly larger for struggling readers than for typical readers, TR *Mean difference* = 8.01, $SD = 19.39$; SR *Mean difference* = 11.09, $SD = 47.69$; $U = 8864$, $z = 2.51$, $p = .012$, $g = .08$. The effect size was small, $g = .08$.

4.3.3 Outcomes for Medial and Initial-Final Letter Migrations

Accuracy results for the factor letter position are summarised in Table 4.5.

Table 4.5: Reading accuracy for words with medial or initial-final letter migrations for the two study groups

	TR n=167		SR n=128		
Condition	**M(%)**	***(SD)***	**M(%)**	***(SD)***	**Mean difference**
Medial-letter migrations	86.59	*(17.72)*	48.12	*(25.18)*	38.47
Initial-final letter migrations	97.12	*(15.45)*	77.73	*(27.58)*	19.39

Note. * $p < 0.01$, accuracy is percentage of correctly read words, total number of words is 10 for each category of letter-migrations, TR = typical readers, SR = struggling readers

The between-group non-parametric comparisons for reading accuracy produced significant differences for both types of word pairs (medial and initial-final letter migrations). Effect sizes were large (ES > 0.8), signifying that the SR group had made significantly more errors than the TR group in reading word pairs with medial migrations, $U = 2207$, $z = 11.82$, $p = .001$, $g = 1.80$, and word pairs with initial-final migrations, $U =$ 4834, $z = 9.93$, $p = .001$, $g = 0.90$. The non-parametric within-group comparisons showed that initial-final letter migrations were read better than medial letter migrations. The differences between conditions were significant for both groups: TR, $\chi 2$ (1) = 93.12, p < .001, $g = .63$; SR, $\chi 2$ (1) = 89.69 $p < .001$, $g = 1.11$, with medium ES for the TR group, $g = .63$ but large ES for the SR group, $g = 1.11$. We also found a significant interaction between migration position and reading status as the difference between the accuracy of medial and initial-final migrations was significantly larger for struggling readers than for typical readers, TR *Mean difference* = 10.54, $SD = 11.52$, SR *Mean difference* = 29.61, $SD = 22.14$, $U = 16551.50$, $z = 8.22$, $p = .001$, $g = 1.12$. Effect size for interaction was large, $g = 1.12$.

In summary, as to reading accuracy, all the children performed significantly better in reading changed-shape cognates compared to same-shape cognates (large ES: $\eta_\pi^2 = .60$), as well as reading high-frequency words (having low-frequency cognates) compared to low-frequency words (having high-frequency cognates) (large ES: $\eta_\pi^2 = .33$). Overall, typical readers performed better than struggling readers, again showing a large ES ($\eta_\pi^2 = .37$). Within-group differences for high- and low-frequency cognates were larger for the struggling readers than for typical readers, with a large ES ($\eta_\pi^2 = .14$). Frequency also affected the reading of same-shape cognates more than the changed-shape cognates, with a close-to-large ES ($\eta_\pi^2 = .09$). Struggling readers showed greater difference between changed- and same-shaped cognates compared to typical readers exhibiting medium effect size ($\eta_\pi^2 = .06$).

Results also showed that initial-final letter migrations were read better than medial letter migrations, with a medium ES for typical readers ($g = .63$) and a large ES for struggling readers ($g = 1.11$). Moreover, struggling readers made significantly more errors than typical readers when reading word pairs with medial as well as initial-final letter migrations, both with large ES ($g > .8$). The ES for significant interaction between migrated-letter position and reading status was large ($g = 1.12$).

High-frequency cognates were read faster than low-frequency cognates by both groups but with small ES ($< .3$). The struggling readers needed significantly more time to read both high- and low-frequency cognates than the typical readers, which was demonstrated by large ES (> 1). The ES for significant interaction between reading speed and reading status was low ($g = .08$).

4.4 Discussion

As Urdu letters may change shape according to their position in a word, we explored letter-position effects in 7-to-11-year-old typical and struggling readers of Urdu. We compared the influence of word frequency and various letter positions (initial, medial, final), two factors assumed to play a role in letter-position errors. Below, we will discuss our findings for each of these factors.

4.4.1 Letter shape

We found a main effect of shape with a very large effect size ($\eta_\pi^2 = .60$): reading accuracy was significantly higher for words in which letters changed shape than it was for cognates where the letters kept the same shape. This implies that a change in the shape of letters across the various positions in words facilitates word recognition and hence reading. One might expect that letters with multiple position-dependent letter forms complicate the reading process, but our results showed that the opposite is true for Urdu, which is consistent with previous findings in Arabic-speaking individuals with LPD (Friedmann & Haddad-Hanna, 2012). In Arabic, all the letters may change form contingent upon their position within a word and the authors found that their participants made almost no letter-position errors when this was the case. By comparison, in Hebrew only

five letters change form, and one bilingual participant made more errors reading Hebrew than was the case for Arabic. In same-shape migrations error rates were similar for the two languages. Friedmann and Haddad-Hanna accordingly postulated that the reading advantage of position-dependent letter-form changes is due to the fact that erroneous migrations in cognates where a form change is required would result in orthographically illegitimate words. Although our struggling readers read significantly less accurately than their unimpaired peers, the effects for letter migrations with form changes and those without form changes were comparable for both groups.

4.4.2 Word Frequency

Both the typical and the struggling readers were more accurate and faster in reading high-frequency words with a low-frequent cognate than vice versa. Thus, if by letter migration a low-frequency word becomes a high-frequency cognate, this increases the risk of migration errors significantly more than it does in the inverse condition. Our results are consistent with the findings of studies assessing Hebrew-speaking children with developmental LPD (Friedman & Nachman-Katz, 2007; Friedmann & Rahamim, 2007) and acquired LPD (Friedmann & Gvion, 2001). In these studies migration errors were also higher for less frequent words than for their more frequent counterparts, with the direction of errors being the same as we observed (from the less frequent to the more frequent cognate).

On a theoretical note, our findings support Friedmann and Rahamim's (2007) suggestion that it is an under-specification of letter positions rather than incorrect coding in the orthographic-visual analyser that lies at the heart of letter-position errors. Arguably, if the input from the orthographic-visual analyser to the lexicon is underspecified, then more than one word will be activated in the lexicon – the correct word and its migration neighbour. As the reader does not know which word is the correct one, s(he) is more likely to select the high-frequency word due to its higher baseline activation level. If the input was simply coded incorrectly, the reader would always choose the wrong word, regardless of its frequency.

Friedmann and Rahamim (2007) further argued that information about letter positions is particularly underspecified with respect to the position of medial letters, which contention we tested and will discuss in more detail in the next section.

4.4.3 Letter-Position

Comparing typical and struggling readers reading words with medial-letter and initial-final letter migrations, we found that reading accuracy was indeed more affected in the medial-letter migrations in both groups but more so in the struggling readers, which is consistent with the previous research on medial letters' higher susceptibility to migrations, both in unimpaired (Pitchford, Ledgeway & Masterson, 2008; Schoonbaert & Grainger, 2004) and impaired readers with LPD (Friedmann & Gvion, 2001; Friedmann & Haddad-Hanna, 2012; Friedmann & Rahamim, 2007).

The previous and our results could be explained with Kohnen and colleagues' (2012) argument that initial and final letters may have a perceptual advantage over medial letters because they are adjacent to one letter only (at one side they have an empty space), thus having fewer closely neighbouring letters to interfere with their processing compared to medial letters. This interference in the perception of letters due to the presence and/or proximity of adjacent letters is known as the crowding effect (Bouma, 1970). Evidence of the facilitating effects of wider letter spacing largely comes from studies on inter-letter spacing; compared to conventional letter spacing, a little increase in the space between letters within a word reduces the negative effects of crowding. It has also been suggested that more appropriately spaced letters could also facilitate letter-position coding (Perea, Panaderó, Moret-Tatay & Góméz, 2012).

The struggling readers in our study made more medial migration errors than initial-final migration errors, compared to typical readers, which is consistent with the literature on young readers who all showed the crowding effect, with the effect being stronger in the impaired readers (Hawelka & Wimmer, 2005; Martelli, Di Filippo, Spinelli & Zoccolotti, 2009; Spinelli, de Luca, Judica & Zoccolotti, 2002).

An alternative explanation of our findings was proposed by Friedmann and Gvion (2001), who attributed the effect to a more differentiated attention to the various letter positions. They stated that attention is generally first directed towards the initial and final letters of a word, and then to all the medial letters at the same time, a process that is vulnerable to incorrect coding, resulting in more errors.

4.4.4 Dual-Route Model and Letter-Position Processing in Urdu

If we attribute the letter-position effect in Urdu to a differentiated attention to initial, final and medial letters at the orthographic-visual analysis stage of the reading process, the process may then progress as follows: there is preferential attention to a word's initial and final letters, only after which the medial letters are processed, where they are not perceived separately but as a whole without attention to their order. Here, the search for the best match in the lexicon already commences, increasing the risk of an incorrect word being retrieved that has the same letters but where the medial letters are ordered differently. Of all the contenders, the word having the closest orthographic similarity and the highest frequency will supersede the other options and thus becomes the most likely to be produced even if it is an erroneous response.

Although the orthographic-visual analyser appears implicated in migration errors, deficits in two other components of the dual-route model might also be involved. Although Kezilas et al. (2014) strongly favoured the involvement of the orthographic-visual analyser and ruled out the role of the orthographic lexicon and phonemic buffer (for word reading in English) in letter-position errors, and previous evidence (Friedmann & Rahamim, 2007; Kezilas et al., 2014; Kohnen et al., 2012) and our findings also seem to favour the involvement of the orthographic-visual analyser in migration errors, further research into migration errors in Urdu that investigates the potential roles of the orthographic lexicon and phonemic buffer with targeted stimuli is recommended.

4.5 Conclusion

Although at first glance it might seem difficult to learn to read Urdu considering its position-dependent multiple letter shapes, our results indicate the opposite. Given the higher accuracy for cognates in which the letters changed shape when they changed position, this feature of Urdu appears to facilitate letter-position processing. In comparison to orthographies like English where letter shapes are not position-dependent, Urdu might then be easier to process for readers suffering from LPD. However, since we looked at struggling readers that had not been formally diagnosed due to the absence of validated tests, we were unable to test this hypothesis.

To evaluate letter-position processing in beginning readers of Urdu further, and as we found greater differences in the performance of the typical and struggling readers in these conditions, we propose targeted studies in which impaired and unimpaired readers are assessed with low-frequency, same-shape cognates that have the potential for medial-letter migrations while response and reading times at item-level are recorded. Investigations of this nature will further uncover the complex mechanisms of letter position processing in Urdu and other orthographies.

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