Особенности познавательной деятельности современных детей, подростков и молодежи в контексте проблем образования

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Research article

What do reading times tell us about the effect of orthographic regularity? Evidence from English and Italian readers

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Abstract

Introduction. We examine the impact of orthographic depth focusing on English and Italian—two languages with quite different orthographies.

Materials and Methods. We review a set of studies comparing English and Italian readers on time measures, in particular, reaction times (RTs). An advantage of using time measures is the availability of processing models that provide a useful interpretative framework (i.e., rate and amount model, RAM; difference engine model, DEM). The data indicate that English children are generally less accurate but not slower than Italian children; furthermore, they are more variable than Italian readers, a tendency confirmed with different paradigms (e.g., rapid serial visual presentation) and age groups (i. e., young adults). While data from Italian children fit very closely with the predictions of the RAM and DEM, those of English children showed several deviations from these models. Thus, we examined whether differences in strategy (or a response criterion) might explain such deviations. In a lexical decision study based on the diffusion model, English young adults showed a more lenient criterion, i. e., they needed less evidence to decide on the lexical quality of the stimulus. Drawing on the multiple read-out model (MROM), we propose that the irregularity of the English orthography may favor reference on the Σ criterion (based on general evidence), while the regular Italian orthography may favor reliance on the M criterion (based on evidence for a specific word).

Results. Overall, we put forward two working hypotheses to interpret the overall pattern of experimental findings. First, the characteristics of the English orthography (possibly emphasized by the teaching method used) foster a global, lexical, approach to recognizing words. Second, not all children can effectively rely on such global processing, and this may be the main source of large individual differences in the English sample.

Conclusion. Understanding the source of these individual differences still represents a challenging task for future research.

Keywords: reading, orthographic depth, reaction times, lexical decision, rapid serial visual presentation

Научная статья

Что время чтения говорит нам о влиянии орфографической регулярности? Свидетельства английских и итальянских читателей

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Аннотация

Введение. Мы исследуем влияние орфографической глубины, сосредоточив внимание на английском и итальянском языках, двух языках с совершенно разной орфографией.

Материалы и методы. Мы рассматриваем ряд исследований, сравнивающих английских и итальянских читателей по показателям времени, в частности, по времени реакции (RTs). Преимущество таких мер заключается в том, что существуют модели обработки, обеспечивающие полезную основу для интерпретации (например, модель скорости и объема, модель оперативной памяти и разностного механизма, DEM). Данные показывают, что английские дети, как правило, менее точны, но не медленнее, чем итальянские дети; кроме того, они более вариативны, чем итальянские читатели, и эта тенденция подтверждается различными парадигмами (например, «быстрое визуальное последовательное представление») и возрастными группами (например, молодежь). В то время как данные итальянских детей очень хорошо согласуются с прогнозами RAM и DEM, данные английских детей показали несколько отклонений от этих моделей. Таким образом, мы исследовали, могут ли различия в стратегии (или критерии реагирования) объяснить такие отклонения. В исследовании принятия лексических решений, основанном на диффузионной модели, английские молодые люди показали более мягкий критерий, т. е. им требовалось меньше доказательств, чтобы принять решение о лексическом качестве стимула. Опираясь на «модель множественного считывания» (MROM), мы предполагаем, что неправильность английской орфографии может способствовать использованию критерия Σ (на основе общих данных), в то время как обычная итальянская орфография может способствовать использованию критерия M (на основе данных для конкретного слова).

Результаты исследования. В целом мы выдвинули две рабочие гипотезы для интерпретации общей картины экспериментальных результатов. Во-первых, особенности английской орфографии (возможно, подчеркнутые используемым методом обучения) способствуют глобальному, лексическому подходу к распознаванию слов. Во-вторых, не все дети могут эффективно полагаться на такую глобальную обработку, и это может быть основным источником больших индивидуальных различий, присутствующих среди английских наблюдателей.

Заключение. Понимание источника этих индивидуальных различий по-прежнему представляет собой сложную задачу для будущих исследований.

Ключевые слова: чтение, орфографическая глубина, время реакции, лексическое решение, быстрое визуальное последовательное представление

Premise

Identifying where to start the scientific investigation of a given topic may be subject to various and sometimes unpredictable influences. The initial studies of Gregor Mendel were on mice, but his bishop was not in favor of an Augustinian friar studying animal sex. Thus, he reverted to plants and, in particular, peas on which he developed his breakthrough observations. Later, Mendel worked with Hieraciums, a genus commonly known as hawkweed, which includes flowers such as helichrysum or marigold. However, many of these plants are apomictic, i.e., they produce their seeds through an asexual process. Thus, to Mendel's frustration, the segregation and independent assortment laws did not apply. So, at least in part, Mendel was guided in his path by some fortune. One may wonder what he could have accomplished had he started with hawkweed and not peas.

Clearly, the observations on hawkweed are not incompatible with those on peas with current knowledge. More generally, one may see that scientific advancement moves toward a general comprehension of phenomena and in principle it makes no difference where the actual line of the research process starts. However, which thread to pull first may, at one point in time, make a difference, and it was certainly fortunate that Mendel started with peas and not helichrysum or marigold.

In the realm of reading, much research has been devoted to understanding the effect of orthographic regularity and its impact on learning disorders. We know that in some languages (such as German, Finnish, Russian, or Italian) word reading closely follows the rules for converting graphemes into phonemes. By contrast, in other languages, some words do not always follow these rules and the reader needs to retrieve the correct pronunciation by lexical look-up. Several languages have some forms of irregularity, including Portuguese, Danish, and Hebrew. However, the language which, for several reasons, has yielded the most amount of research is English. English is very rich in phonological complexities as well as irregularities; furthermore, it is spoken in several countries across the world. Thus, it is not surprising that research on reading has been predominantly 'Anglocentric' (Share 2008). However, one may wonder whether starting with this language was fortunate or resembled an attempt to study the genetic laws beginning with helichrysum or marigold.

Impact of orthographic regularity

The seminal study by P. H. Seymour, M. Aro, and J. M. Erskine (Seymour et al. 2003) illustrates the impact of orthographic regularity on many European languages, including English. At the end of grade 1, children learning various regular orthographies, such as Finnish, Greek, Italian, Spanish, Austrian, German, Icelandic, or Swedish, read a list of regular words appropriate for their age with an accuracy of around 95% or above. Moderately irregular languages, such as Portuguese, French, and Danish, produced lower values (73.5%, 79.1, and 71.1%, respectively). Scottish English-speaking children read only 33.9% of words correctly (Seymour et al. 2003).

The results for time measures apparently paralleled those for accuracy. To read a word from regular orthographies, it took German and Icelandic children about 1.1 and 2.1 sec, respectively. Portuguese, French, and Danish children read at a rate of 3.2, 5.6, and 1.8 sec per word, respectively. English-speaking children read at a rate of 7.8 sec per word (Seymour et al. 2003).

Overall, these results indicate that orthographic regularity is a powerful moderator of reading acquisition, at least in its early stage. Furthermore, the observation that accuracy and time measures yield largely similar results also seems to support the idea that orthographic regularity is a unidimensional factor modulating reading acquisition. All in all, one may hypothesize that the influence of orthographic regularity is quite powerful but essentially quantitative.

However, there are various reasons to suspect that the picture may be considerably more complex and that several different factors may have contributed to the pattern of results in the study reported in (Seymour et al. 2003).

First, one should take time data with a high percentage of error responses cautiously. Indeed, when considering time to read lists of items, the final measure mixes up correct and incorrect responses. This problem is exacerbated when there is a large proportion of incorrect responses. Thus, it is difficult to know what to make up of list reading times in which the child made several errors or refusals to read some items. In experimental studies, a commonly used measure to tackle this problem is reaction time (RT) to single stimuli. This allows teasing out only the correct responses for an internally more consistent measure.

In the following, we will focus on RT studies to examine the effect of orthographic regularity. However, even data on reading lists of words and pseudo-words do not consistently indicate a clear difference in reading times between English readers and children learning to read regular orthographies. For example, K. Landerl (Landerl 2000, 246) compared English and Austrian children from grade one to four and examined accuracy and time in reading lists of pseudo-words and lists of number words

(and numbers). Confirming previous observations (Wimmer, Goswami 1994), English children were more inaccurate in reading pseudo-words; however, there were no reliable time differences from 2nd to 4th grade (reading data of first graders were quite inaccurate and were analyzed separately). No reading time differences were present for number words and numbers (while errors were generally low for these types of stimuli). Overall, in the early stages of acquisition, English children are less accurate than children learning regular orthographies; however, data from list reading do not consistently yield a similar effect on times, and reference to more reliable measures is needed to clarify this point.

Furthermore, recent research has indicated that several other factors may influence orthographic depth. One area of inquiry concerns the very nature of orthographic depth. There have been several different proposals. X. Schmalz, E. Marinus, M. Coltheart, and A. Castles (Schmalz et al. 2015) have recently proposed that orthographic depth refers to two independent constructs: the complexity of print-to-speech correspondences and the unpredictability of the derivation of word pronunciations. Heuristically, they propose that considering these two separate factors may lead to testable hypotheses. In a recent study, they obtained initial evidence along these lines (Schmalz et al. 2022). An even more complex approach was proposed by R. T. Daniels and D. L. Share (Daniels, Share 2018) with ten multiple dimensions of complexity: linguistic distance, nonlinearity, visual complexity, historical change, spelling constancy despite morphophonemic alternation, omission of phonological elements, allography, dual purpose letters, ligaturing, and inventory size. These authors underscored the importance of examining all languages, including non-European languages and nonalphabetic orthographies. The ultimate goal is to develop a universal model of reading which considers general and language-specific properties separately (Frost 2012).

Another potentially important factor concerns the type of reading instructions. In the Anglo-Saxon areas, there has been a large adoption of whole-language approaches in teaching. By the early years of 2000, most English-speaking countries reverted to a phonic approach (National Reading Panel 2000; Rose 2006). However, several different varieties and combinations have been implemented, and it is quite difficult to tease out common practices across different countries. Thus, a scrutiny of several reading programs (including some with widespread use) indicates that several of them subtly resume aspects of the whole language approach under the banner of 'balanced instruction' (Moats 2007). The strength of the evidence supporting the phonic approach is also a matter of continuous debate (Bowers 2020; 2021; Buckingham 2020; Fletcher et al. 2021).

The role of reading instruction is clear in studies done at a time when both methods were in use. In the cited work by K. Landerl (Landerl 2000), English children learning through a standard or eclectic approach combining phonics and whole-word methods were less effective in reading pseudo-words than children learning with a strict phonic approach (but both groups did worse than German children at least in the early grades). This finding raises the possibility that cross-linguistic differences reported in the literature may be exacerbated (at least for some stimuli) by differences in reading instruction (often difficult to detect in the reports). Note that the approach to the type of instruction has changed over the recent years, with the priority given to the phonics method in the last one or two decades. This raises the possibility that the literature results might be at least partly different over time due to changes in the type of reading instruction.

One additional area of concern is related to the actual ability of teachers to implement an effective literacy curriculum. It has been observed that knowledge of the English spelling system may not be intuitive for teachers even though they are expert readers (Cunningham, O'Donnell 2015), an important concern in view of the complexities of this spelling system. Several studies have reported that teachers may have difficulties in tasks such as counting phonemes, recognizing phonetically irregular words, classifying words by syllable type, and the relationship between syllable division and pronunciation (Bos et al. 2001; Cunningham et al. 2009; Moats 1994). Therefore, over and above the choice of instruction method by a given country/school, there is some reason to believe that the implementation of the teaching method may be quite variable due to individual differences in teachers' competencies. While this factor may be important in shaping the actual learning trajectories of children, it is difficult to judge its role from most published reports.

Overall, the influence of orthographic depth on reading acquisition may be linked to a variety of factors that certainly make the overall picture complex. In this brief narrative review, we will describe a set of studies in which we compared the performance of English and Italian readers. We draw here on time measures (but see Marinelli et al. 2022 for an English/Italian comparison in terms of measures of reading accuracy). As stated above, when measuring reading time or speed, it is crucial to account for differences in accuracy performance. Indeed, using lists of words (or pseudo-

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words) is not optimal as accuracy and time are interwoven and cannot be reliably separated. A well-known measure envisages vocal RTs to read aloud single words. On the one hand, this measure is effective as it captures the encoding process of reading (ignoring the actual pronunciation time). An important additional advantage is that there are processing models based on RT measures. They provide a framework to interpret such performance. However, different measures may provide complementary information on reading and contribute to the overall picture (an idea referred to as 'functional overlap' by J. Grainger and A. M. Jacobs (Grainger, Jacobs 1996). This is also the case when the focus is to establish cross-linguistic differences in reading processing, the aim of the present report. Thus, we will draw on several tasks apart from vocal RTs, including the lexical decision and rapid serial visual presentation (RSVP). Their possible contribution will be described along with a description of experimental results.

Are English children slower in reading than children learning a regular orthography?

A general observation is that most studies examining the reading of English-speaking children rely on measures of accuracy and not time. Presumably, the high rate of errors makes accuracy quite sensitive and reduces the need to look at time measures.

However, several reports compare the reading of English children with that of children learning various regular orthographies. While in these studies accuracy data consistently indicate lower performance in English children compared to various other regular orthographies; Welsh: N. C. Ellis and A. M. Hooper (Ellis, Hooper 2001); Albanian–Greek–Hiragana-Kanji: N. C. Ellis, M. Natsume, K. Stavropoulou, L. Hoxhallari (Ellis et al. 2004); German: J. C. Ziegler, C. Perry, A. Ma-Wyatt, D. Ladner, and G. Schulte-Körne (Ziegler et al. 2003); Dutch: T. K. Patel, M. J. Snowling, and P. F. de Jong (Patel et al. 2004); Italian: C. V. Marinelli, C. Romani, C. Burani (Marinelli et al. 2016), the results for time measures are much more variable. Thus, some studies have reported that English children showed slower RTs in reading words and less accuracy; German-English comparison: J. C. Ziegler, C. Perry, A. Ma-Wyatt, D. Ladner, and G. Schulte-Körne (Ziegler et al. 2003); Dutch-English comparison: T. K. Patel, M. J. Snowling and P. F. de Jong (Patel et al. 2004). However, other studies obtained different outcomes. N. C. Ellis and A. M. Hooper (Ellis, Hooper 2001) found that Welsh children were more accurate than English children; however, overall latencies were slower in Welsh than in English children, although this effect was only due to the words with the lowest frequency. The authors also noted that the latencies of Welsh children were closely related to stimulus length (which accounted for 70% of the variance), while this influence was lower in English children (22%). Similar results were obtained by R. Hanley, J. Masterson, L. Spencer, D. Evans (Hanley et al. 2004). There was a clear cross-linguistic difference in reading accuracy with English children less skilled than Welsh children but no difference in terms of reading latencies. In a further study, Ellis et al. (Ellis et al. 2004) compared reading latencies in English versus Greek, and Hiragana-Kanji Japanese. Latencies were slowest in Greek followed by Japanese Hiragana, English and Japanese Kanji. The effect of stimulus length was maximal in Japanese Hiragana, followed by Greek, English, and Japanese Kanji.

Overall, while accuracy in reading English is consistently lower than in various more regular orthographies, the results on reading times are much more variable, with several studies reporting no differences or even faster latencies in English children.

We carried out a study comparing Italian and English children at two critical developmental ages during primary school (Marinelli et al. 2016). Younger children were 7–8 years old, while older children were 9–10 years old. Due to the differences in the age at which children enter primary school, younger Italian children were in the second grade, while English children were in the third grade. As for older children, Italian pupils were in the fourth grade, while the English ones were in the fifth grade. To control for the effect of school experience, we also tested an additional group of fifth-grade Italian children (averaging 11 years of age) and compared them to the English fifth graders. The results indicated that, on average, English children were slightly less accurate but tended to be faster, not slower than Italian children. These tendencies varied somewhat depending on specific conditions and children's age. In interpreting the pattern of results for time measures, we relied on two different yet complementary general models of individual processing in timed tasks, i. e., the rate and amount model, RAM (Faust et al. 1999), and the difference engine model, DEM (Myerson et al. 2003).

M. E. Faust, D. A. Balota, D. H. Spieler, and F. R. Ferraro (Faust et al. 1999) proposed that the individual performance in a timed task can be largely ascribed to two factors: the difficulty of the condition (amount) and the speed of processing

(rate) characteristic of a given individual (or group). These two components interact multiplicatively so that more difficult conditions will generate larger group differences between 'fast' and 'slow' individuals than easier conditions. A clear example is the effect of ageing. Older individuals tend to be slower across several tasks (Verhaeghen, Cerella 2002). Group differences between young and older adults tend to grow bigger for more difficult conditions, a pattern referred to as 'over-additivity'. Importantly, this effect is independent of the specific characteristic of a given condition; in other terms, a large amount of the aging effect can be seen due to the slowing of a single factor (speed of processing). The variability in the observed pattern of results is due to the interaction of this factor with the difficulty of a given condition. Faust et al. (Faust et al. 1999) consider the possibility that specific conditions may add to the rate and amount factors and propose statistical data transformations (such as the use of individually based z scores) for detecting such specific residual effects. However, the RAM emphasizes that a large part of individual variability is due to global influences and that group x condition interactions should be seen with caution in order not to interpret them as 'specific' effects that are due to over-additivity.

Also, the DEM focuses on the role of global components in the performance on timed tasks. J. Myerson, S. Hale, Y. Zheng, L. Jenkins, K. F. Widaman (Myerson et al. 2003) propose that individual performance can be seen as made of two components (named 'compartments'). One compartment refers to the decisional part of the response, while the other to the sensory-motor part. A keyway for establishing these two components is based on the plot between the condition means and the standard deviations (SD). Typically, in RT studies SDs increase as a function of condition difficulty (over and above the effect of specific conditions). This part of the plot marks the decisional compartment; according to the DEM, groups of slow (e. g., older adults) or fast (e. g., young adults) individuals show the same (near-linear) relationship between means and SDs, although their performances cluster in different parts of the curve. For the DEM, the sensory-motor compartment is seen as 'constant' and can be identified as the intercept on the x-axis of the means versus SDs plot. This value (often in the 300 ms range) indicates the time to perceive the stimulus and plan a response and is invariant as to the characteristics of the tasks, as well as of the subjects (e. g., older adults show a very similar intercept on the x-axis as younger adults (Myerson et al. 2003)). Thus, according to the DEM, the means versus SDs plot represents a key rule or law to interpret the individual performance on timed tasks.

It may be observed that the systematic variation of SDs as a function of condition difficulty represents an important violation of the homogeneity of variance—a key assumption of standard parametric analyses such as ANOVAs. Thus, both the RAM and the DEM warn of the risk of performing parametric analyses on RT data as they are prone to be influenced by global components over and above the putative influence of the experimental manipulations.

In several studies, we have proposed that reference to the RAM and DEM can effectively describe the performance in reading tests of children with and without a reading deficit (De Luca et al. 2010; Zoccolotti et al. 2008). We also used this approach in examining the differences between English and Italian children in the quoted study (Marinelli et al. 2016).

First, we examined whether the increase in performance with age/reading experience could be ascribed to a global factor within each language. Figure 1 (top) shows a Brinley plot with data on younger Italian children plotted as a function of the corresponding means for the older children. The performance of the two groups of children is closely related so that the resulting regression line accounts for a very large proportion of variance ($R^2 = 0.97$). Thus, the increase in performance associated with two additional years of reading experience/age can be largely accounted for by a single multiplicative factor of 1.54 (slope of the regression). The results of English children are different and indicate a low-moderate fit of the regression line ($R^2 = 0.71$). Older children are generally faster but there is much spread in performance, so the two groups appear to behave differently depending on the experimental manipulations. Overall, data indicate that the increase in reading performance with increased reading experience/age closely fits the predictions of the RAM in the Italian sample but much less in the English sample, where other factors need to be invoked to account for the improvement of performance with increasing reading experience/age.

Following the DEM, we also examined the plot of the means versus SDs (see Fig. 2). Fig. 2 indicates two separate relationships for the English and Italian groups. In the case of Italian children, the predictions of the DEM are closely followed. Thus, a single linear relationship accounts for a very large proportion of variance ($R^2 = 0.96$) across a variety of conditions for the groups of 2nd, 4th, and 5th grade children. Note that the linear regression has a very steep slope (.93) indicating a substantial increase

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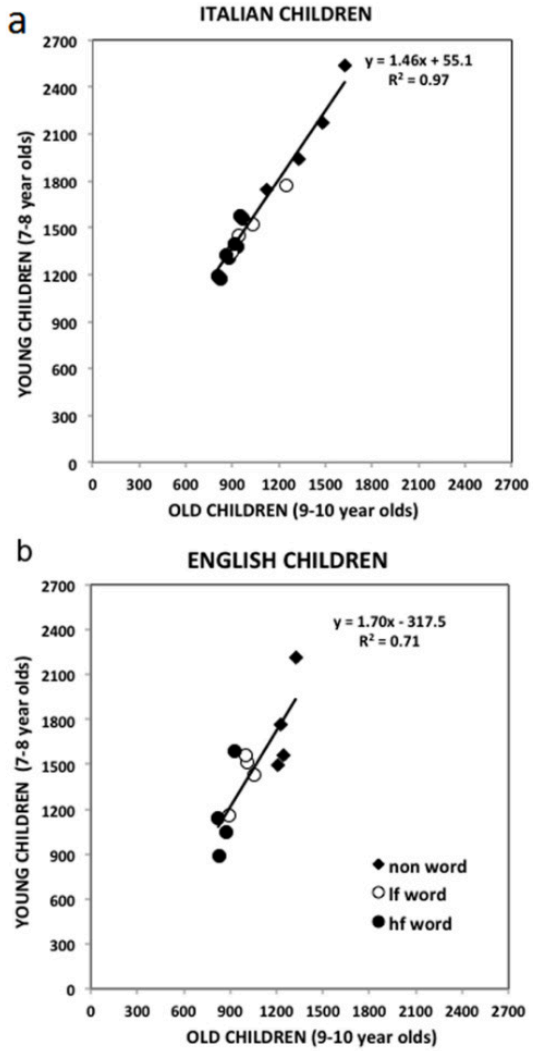

Fig. 1. Condition means of younger children are plotted as a function of older readers' means in English (Fig. 1a) and Italian (Fig 1b) children (Marinelli et al. 2016)

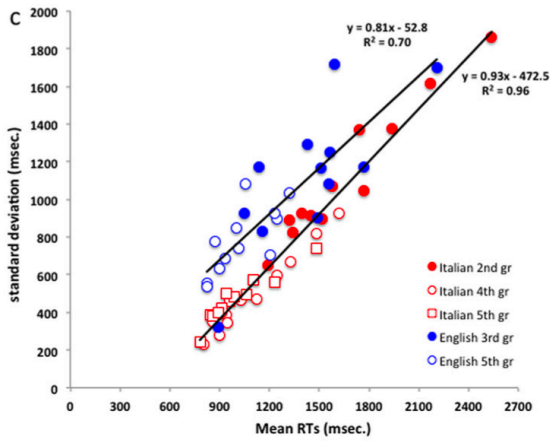

Fig. 2. Standard deviations plotted as a function of condition means for various groups of English and Italian children (Marinelli et al. 2016)

in interindividual variability as a function of condition difficulty. The intercept on the x-axis was ca. 500 ms. Both slope and intercept are higher than what is usually found across a variety of tasks; J. Myerson, S. Hale, and Y. Zheng (Myerson et al. 2003) reported as typical values of ca .30 for the slope and of ca. 300 msec for the intercept (sensory-motor component). However, in a meta-analysis of several studies, we observed that, across a large variety of experimental conditions, RTs in reading aloud are systematically associated with a steep slope (0.66) and a large intercept (482.6 ms). Indeed, these increased values seem typical for the reading aloud task and mark a discontinuity between this and most other timed tasks, including lexical decision (Zoccolotti et al. 2018).

The data on English children present several peculiar characteristics and generally fit less well with the predictions of the DEM. Fig. 2 indicates that English children tend to be faster (i.e., their means are somewhat moved toward the left) but also considerably more variable than Italian children (i. e., the experimental data points are moved upwards). This pattern is generally inconsistent with the predictions from the RAM and DEM both of which anticipate a close relationship between performance level and interindividual variability. Furthermore, the fit of the regression accounts for a substantially smaller proportion of variance ($R^2 = 0.70$) than in the case of Italian children; note that individual condition means appreciably deviate from the regression line, particularly among younger children. Additionally, the regression line crosses the x-axis very near zero, making the estimate of the sensory-motor compartment unreliable. Finally, one may note that the range of mean performances across different conditions is relatively small among English children, particularly among older children. Summarizing this pattern, one can say that English children are somewhat faster but much more variable; notably, the performance of this group is not well captured by a global factor, as predicated by the RAM or DEM. This indicates that something over and above the global factor envisaged by these models is at work.

Overall, the results summarized in Figures 1 and 2 indicate various key differences between the reading patterns of English and Italian children and suggest a few lines of further in-depth explorations. First, there is an indication that English children may be more variable than readers learning a regular orthography. Below, we will show various ways in which we tackled this problem. Second, while data on Italian children fit very closely with the predictions of the RAM and DEM, those of English children show several deviations from these models. Thus, one line of inquiry aims to understand which additional factor(s) may account for such deviations.

Testing individual differences in reading performance

Quartile analysis in reading RTs

The first approach to examine individual differences was carried out within the previously described study (Marinelli et al. 2016). We split children into approximate quartiles of performance based on overall RTs across conditions and examined the plot of the means versus SDs separately for these subgroups of children. The results (for the older children) are illustrated in Figure 3. As for Italian children, RTs grow proportionally slower from the first to the fourth quartile and differences among experimental conditions become progressively larger, as expected based on the RAM and DEM. Differences among the four groups appear largely quantitative and are consistent with the predictions of these two models.

The pattern of results for the English children is quite different. The first three quartiles of performance are largely overlapping. Children are generally quite fast, and there is a very small spread of performance as a function of the experimental manipulations (frequency and length). Children in the fourth quartile behave quite differently. First, they are much slower overall than children in the other three quartiles; second, there is a very large spread of performances as a function of experimental manipulations. Overall, this analysis indicates that a substantial group of English children behaves in a qualitatively different way from the others.

Interestingly, a very similar pattern of findings was reported in the studies comparing English and Welsh children (Hanley et al. 2004; Spencer, Hanley 2003). English (but not Welsh) children in the lowest quartile performed much more poorly than the other groups. However, although time measures were also recorded, these studies only reported the results for accuracy measures.

Individual differences in rapid serial visual presentation (RSVP)

It has been observed that in standard conditions absolute reading speed is limited by two main factors. One is eye movements. Saccadic eye movements occur with an approximate frequency of 4–5 times per sec. Thus, research subjects can make a maximum of 250–300 fixations per min. Indeed, R. P. Carver (Carver 1992) reports that 300 words per minute (wpm) is an upper limit of reading;

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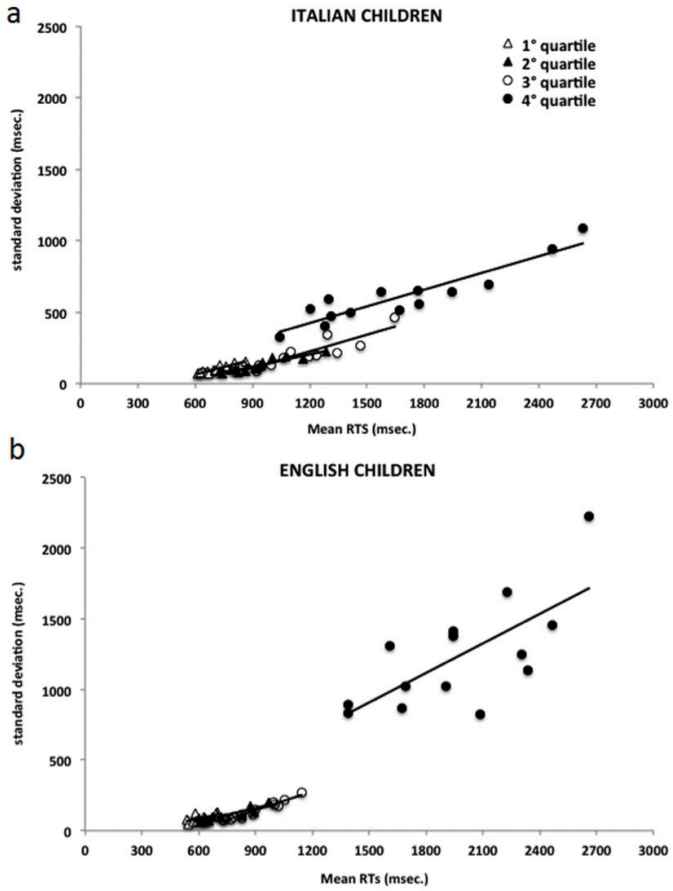

Fig. 3. Standard deviations plotted as a function of condition means for English and Italian children separately for different quartiles of overall performance (Marinelli et al. 2016)

he notes that achieving this level of performance allows the reading level to be equated with the usual speed of speech with clear functional advantages (and no real need for further speeding up). A critical re-analysis of this hypothesis has been recently presented by Marc Brysbaert (Brysbaert 2019). A related limit of performance is linked to the speed of articulation; it is well-known that silent reading may be faster than reading aloud, particularly in expert readers (Ciuffo et al. 2017).

While functionally it may not be so important to speed up reading over 300 wpm, limiting the role of eye movements may allow detection of the full potentiality of the reading processor. This is the aim of the paradigm known as 'rapid serial visual presentation' (RSVP). In RSVP, words appear sequentially in the same position limiting the need for saccadic eye movements; in this way, readers can achieve very high levels of reading (up and above 1000 wpm in the case of texts) (Rubin, Turano 1992).

Thus, RSVP allows evaluating the reading processor to its full potential and as such may be particularly suited to examine individual differences in performance. In two separate experiments (Marinelli et al. 2014), we examined the reading performance of English and Italian college students using this paradigm. In the first experiment, English and Italian readers were not different as a group; however, the English group showed a much greater variability with both very fast and very slow readers (as indicated by a significant difference in Levene's test for equality of variances) (Levene 1960).

The results of the second experiment are shown in Figure 4. In this case, average reading rates for English subjects were slightly faster than those of Italian subjects (geomean = 453 wpm and 325 in a list matched for the number of letters and geomean = 514 wpm and 299 in a list matched for the number of phonemes, respectively). Critically for the aim of the study, there was a much wider spread of performances in the English group which included both the fastest individual (reading at over 1000 wpm) and the slowest individual (reading below 100 wpm). Again, the variances of the Italian and English samples were significantly different in Levene's test for both lists used. Note that none of the subjects tested with RSVP reported a reading

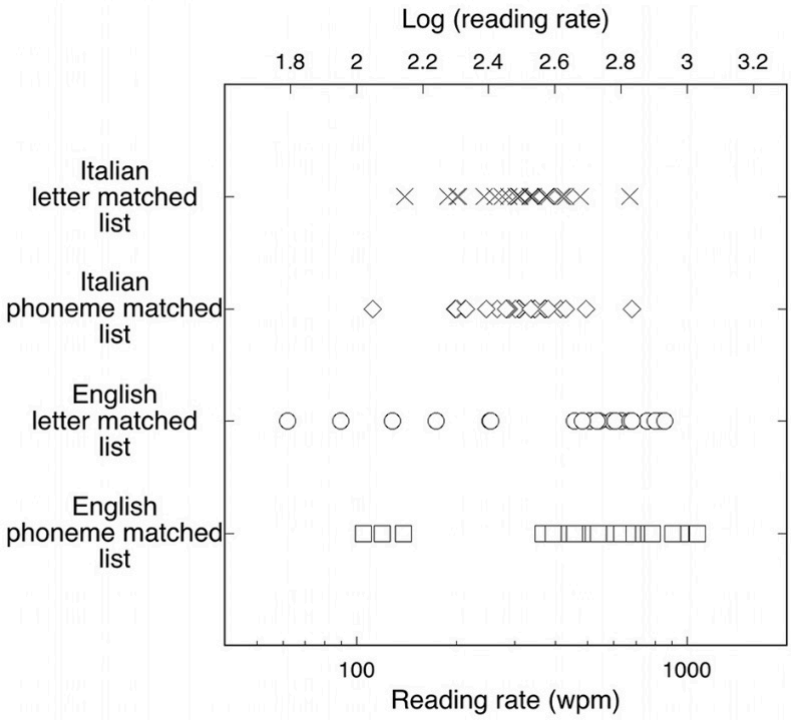

Fig. 4. Individual reading rates for Italian and English subjects for letter- and phoneme-matched lists. Reading rates for the English sample are much more variable than rates for Italian subjects (Marinelli et al. 2014)

deficit and they all performed within normal limits in a standard achievement test.

RSVP results indicate that young English adults are very variable and appear consistent with the data on quartile analysis shown above. Many English individuals perform quite well and are in fact faster than the corresponding readers of a regular orthography, but a sizeable proportion of them perform very slowly.

Cross-linguistic differences in RT distribution

It is well known that RT distributions present several systematic characteristics: (a) they are typically skewed to the right; (b) the skew increases with test difficulty; and (c) the spread of the distribution grows as a function of the mean (Wagenmakers, Brown 2007). Various distributions (including the ex-Gaussian, the shifted lognormal, the shifted Wald, the shifted Weibull, and the Gumbel) have been proposed to account for these characteristics. In a further experiment of the study described above (Marinelli et al. 2014) we used the ex-Gaussian distribution to characterize the RT reading performance of English and Italian college students who read high- and low-frequency words matched for the number of letters or the numbers of phonemes.

The ex-Gaussian distribution is the convolution of a Gaussian (normal) and exponential distribution that accounts well for the positively skewed RT distribution often seen in empirical data. The distribution contains three parameters: mu (μ) and sigma (σ) are the mean and standard deviation of the Gaussian distribution, respectively, and tau (τ) is the mean of the exponential component.

The results of the study are presented in Table 1. The table illustrates some main findings:

- the two linguistic groups were similar in μ both in terms of mean performance and inter-individual variability;
- Italian subjects showed higher τ and lower σ values than English subjects;
- independent of group mean differences, English subjects were more variable across individuals for both τ and σ.

These results correlate with the data on children as they also reveal substantial differences in inter-individual variability among English and Italian readers. Of particular interest is the greater variability in τ. Various studies have found that the exponential component (particularly sensitive to the tail of the RT distribution) correlates well with the lexical competence of the individual (Yap et al. 2012). Thus, these data confirm greater individual differences in reading among English individuals and indicate

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Table 1. Means (and standard deviations) of the ex-Gaussian parameters for RTs to single word reading (Marinelli et al. 2014)

Ex-Gaussian parameters	Italian participants		English participants		Student test		Levene's test	
	Mean	SD	Mean	SD	*t*	*p*	*t*	*p*
Mu	439.0	45.9	445.6	59.7	–0.46	0.64	0.36	0.55
Sigma	35.7	18.7	75.9	32.3	–5.63	<0.0001	8.67	0.005
Tau	66.7	28.0	45.3	40.3	2.30	0.026	7.42	0.009

that these differences concern components of the response which may be critical for lexical processing.

Individual differences in reading performance: General comments

The findings illustrated above consistently indicate the presence of larger interindividual differences among English rather than Italian readers. Data are based on different paradigms and span both children and young adults. Thus, the large variability present among English readers seems a reliable finding that needs a corresponding interpretation. Further observations will be put forward in the General section. Here, we confine ourselves to observing that a simple interpretation based on the greater difficulty of the English orthography does not easily accommodate the observed pattern. Thus, even in the context of greater variability, some English readers show very fast and effective performances, an observation that is inconsistent with a general difficulty hypothesis.

The role of criterion in crosslinguistic differences in reading

Above we have described a study in which RT-related reading performance was evaluated in two models of individual information processing, i. e., the RAM and DEM. In general, these models provide a comprehensive evaluation of responses allowing for the segregation of different aspects of performance (such as sensory-motor versus decisional components) and placing responses to specific experimental conditions within more global factors affecting responding. Still, it has been observed that these models fail to account for differences in the criterion of responding (for a discussion see Spieler 2001).

It is well known that subjects can strategically adjust their level of responding by adopting different criteria, for example, favoring accuracy over speed or vice versa favoring speed of response over accuracy. One line of research focusing on the role of criterion in reading was developed by S. Lupker and his colleagues. These authors noted that there are systematic differences between pure blocks (i. e., composed only of a type of stimuli, such as high- or low-frequency words) and mixed blocks (i. e., composed of both high- and low-frequency words). S. Lupker and colleagues described a 'homogenization pattern': in mixed blocks, RTs to easier stimuli (such as high-frequency words) are slower than in pure blocks, but more difficult stimuli (such as low-frequency words or pseudowords) are read faster than in pure blocks (Lupker et al. 1997). They proposed that, on each trial, participants set a time criterion representing the time at which they expect to begin articulation (Lupker et al. 1997). The position of this time criterion would be determined by the context both in terms of global components (such as general characteristics of the stimuli or type of instructions) or local components (how fast/slow the response was in the previous trial) (Taylor, Lupker 2001).

There is some reason to believe that differences in the response criterion may contribute to generating cross-linguistic differences between English and Italian readers. Thus, D. Paizi, P. Zoccolotti, and C. Burani (Paizi et al. 2010) reported a set of experiments in which they consistently found that the RTs of Italian subjects were not sensitive to blocking manipulations; in particular, the size of the frequency effect remained stable across several different blocking conditions. For the sake of comparison, in Table 2, we compare the original data by S. J. Lupker, P. Brown, and L. Colombo (Lupker et al. 1997, 573) with those by D. Paizi, P. Zoccolotti, and C. Burani (Paizi et al. 2010, experiment 5; p. 1056). English subjects present the homogenization pattern, with slower RTs for high-frequency words in mixed blocks and faster RTs for low-frequency words. By contrast, Italian subjects only show a mixing cost but no benefit for low-frequency words in mixed blocks.

The purpose of the table is illustrative as the two experiments are not balanced. However, experimental

Table 2. Reading RT means for English and Italian adult samples in pure and mixed blocks experiments

	Pure	Mixed	Effect
Canadian English-speaking young adults*			
HF words	463	485	+22
LF words	563	547	–16
Italian-speaking young adults°			
HF words	484	509	+ 25
LF words	504	521	+17

Note: *—Data from (Lupker et al. 1997); °—data from (Paizi et al. 2010).

conditions are generally similar, and both sets of results are quite stable. Thus, the homogenization pattern has been replicated in several separate studies by S. Lupker and his colleagues (Chateau, Lupker 2003; Kinoshita, Lupker 2002; 2003; Lupker et al. 1997). Also, D. Paizi, P. Zoccolotti and C. Burani (Paizi et al. 2010) reported the absence of blocking effects over five different experiments on different groups of subjects. Thus, these findings raise the possibility that differences in the criterion could contribute to cross-linguistic differences in reading performance between English and Italian subjects.

One should add that a definite interpretation of the blocking effect as well as the specific definition of the conditions in which it occurs is under debate. Lupker and his colleagues favor an interpretation in terms of a time criterion, i. e., the idea that subjects preset the time at which they expect to begin articulation. However, other interpretations have been advanced. C. T. Kello and D. C. Plaut (Kello, Plaut 2000; 2003) proposed that readers adjust the 'input gain', i. e., the level of processing speed as a function of the difficulty of the stimuli. Other interpretations focus more on the possibility of a 'quality criterion', i. e., the idea that subjects can set the processing of the stimulus to continue until the quality of information reaches a particular level. For example, in the dual-route perspective, S. Monsell, K. E. Patterson, and A. Graham (Monsell et al. 1992) originally proposed that readers may be able to de-emphasize one or the other route depending on the nature of context (e. g., in presence of many irregular words they may de-emphasize the role of the phonological route).

Furthermore, the conditions in which a strategic influence can be detected in reading-aloud tasks are debated. The studies of S. Lupker et al. indicate the presence of a homogenization pattern, with both costs for easier stimuli in mixed versus pure blocks (mixing cost), and facilitation for more difficult stimuli (mixing benefit). However, a different pattern of responding has been reported under similar, although not identical, conditions. Thus, S. A. Los (Los 1996) noted that in various experiments only costs associated with mixed blocks are observed but not benefits. Possible interpretations of these mixing costs focus on changes in the nature of processing and often refer to experiments in which different processing routines are called into action, although several exceptions to this generalization are present (for a discussion see Lupker et al. 2003). Thus, a definite conclusion of which conditions yield a homogenization pattern, and which only mixing costs is still to come.

We set out to study strategic (criterion) effects and their possible differential effect as a function of the type of orthography based on the diffusion model developed and updated by R. Ratcliff (Ratcliff 1978; Ratcliff, McKoon 2008). The diffusion model focuses on two-alternative choice tasks and proposes a decomposition of the various factors that affect the overall RT performance. The general idea is that readers progressively acquire noisy information until they reach sufficient information to produce either a YES or NO response. Various factors can be teased out in this process: a starting point toward one of the two response criteria or boundaries (z), a criterion bias (boundary separation, i. e., the amount of evidence needed until a decision threshold is reached), a sensitivity parameter (drift, i. e., the rate with which the decision is made), as well as a non-decision component (Ter). We should note that this model focuses on two-alternative choices and cannot be easily extended to standard reading-aloud conditions. Still, in keeping with the idea of 'functional overlap' (Grainger, Jacobs 1996), we consider that seeing the lexical decision task from the diffusion perspective may offer useful formal information on a factor (strategic criterion) and its potential role in reading.

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We presented word sets of medium-to-low frequency words and derived pseudowords to a group of English and Italian college students (Mauti et al. 2023). We purposely used relatively difficult stimuli as the diffusion model requires subjects to make a substantial number of errors to effectively fit the model parameters. As for accuracy, English participants made more errors than Italian participants, particularly in the case of low-frequency words. Lexical decision times for English and Italian college students are presented in Figure 5. The two linguistic groups did not differ overall but there was a greater lexicality effect in Italian than in English samples (as indicated by a significant lexicality by language group interaction). In general, these observations support data (summarized above) that English subjects are less accurate but not slower (if anything slightly faster) than Italian ones.

RTs were analyzed in terms of the diffusion model. The two linguistic groups were not different in the starting point (z) and the non-decision component (Ter). As for the drift (Fig. 6, left panel), the two groups did not differ significantly; the interaction lexicality by group was significant indicating a larger difference between words and pseudowords in Italian subjects. Finally, the two groups were different in terms of boundary separation (Fig. 6, right panel): the English sample showed a more lenient criterion, i. e., they needed less evidence to decide on the lexical quality of the stimulus.

A second experiment indicated that these differences in the criterion were specific to the orthographic task and did not extend to a control figural task (face gender judgment).

The results of this study indicate that differences in the criterion may contribute to generating

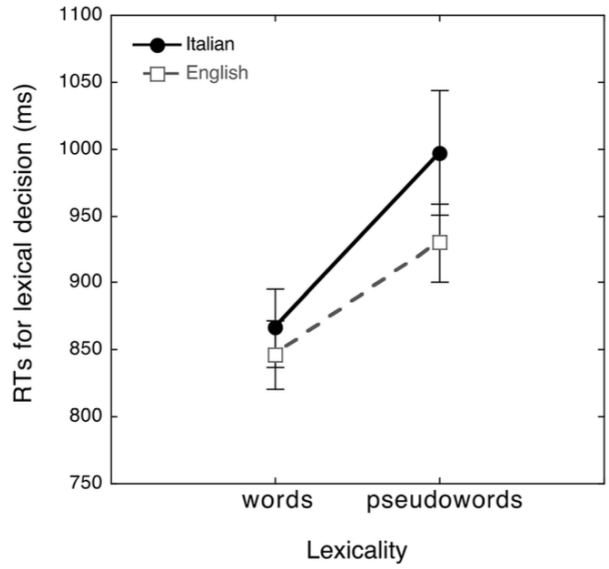

Fig. 5. Lexical decision times for Italian and English subjects for words and pseudowords (Mauti et al. 2023)

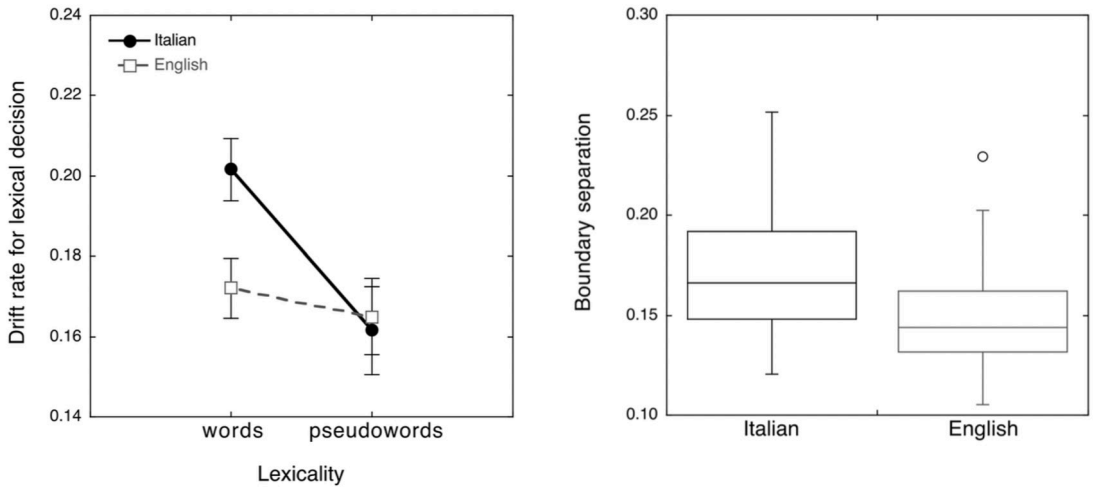

Fig. 6. Left: drift rate for words and pseudowords for Italian and English subjects; boundary separation values for Italian and English subjects (Mauti et al. 2023)

the asymmetrical pattern between accuracy and time which has been observed in many, though not all, studies on differences between readers of English and various regular orthographies (including Dutch, German, Italian, and Welsh). On the one hand, English readers may be less accurate because of the intrinsic difficulties of the orthography; on the other, their processing time may not be slower in part due to the adoption of a more lenient criterion to accept the stimulus as a word or a pseudo-word. The diffusion model was effective to detect this criterion contribution. However, this model does not formulate hypotheses on the underlying processes involved in reading (De Moor et al. 2005). To this aim, it is useful to refer to psycholinguistic models of lexical decision.

One well-known model of lexical decision (multiple read-out model, MROM) was proposed and updated by J. Grainger and his colleagues (Dufau et al. 2012; Grainger 2018; Grainger, Jacobs 1996). Two types of intra-lexical processes may contribute to identifying the target as a word: the activation level of the most activated word unit (M criterion), and the sum of the activation levels of all word units, an overall measure of 'word-likeness' (or cumulated evidence for a word—the Σ criterion). Interestingly, imaging data indicate an association between the dorsomedial prefrontal cortex and the activation of orthographically similar codes in verbal working memory, supporting the notion of a fast-guessing mechanism for words with many neighbors (Braun et al. 2015). J. Grainger and A. M. Jacobs (Grainger, Jacobs 1996) note that a lexical decision does not necessarily rest upon the full identification of the target word. In this view, a 'positive' response can be reached because enough information is obtained on the specific word (M criterion) but also because of a high-level activation of the Σ criterion.

These two criteria are thought to be differently sensitive to strategic influences. The M criterion is generally believed to be fixed or invariant, while the Σ criterion is more sensitive to stimulus characteristics (De Moor et al. 2005), such as task demands (Grainger, Jacobs 1996) or the context of the list (Carreiras et al. 1997). Thus, we have proposed that the irregularity of the English orthography may favor reference on the Σ criterion based on general evidence, while the highly regular Italian orthography may favor the adoption of the M criterion, based on evidence for a specific word (Mauti et al. 2023). The reliance on a criterion based on general evidence may be favored in the presence of generally high levels of neighborhood density, characteristic of the English language.

In this perspective, a difference in the criterion contributes to generating cross-linguistic differences observed between English and Italian readers. To the extent in which English subjects rely also on general lexical evidence, they can set a more lenient criterion for accepting the stimulus as a word and obtain relatively fast responses despite their generally lower levels of accuracy. As stated above, the diffusion model is limited to the interpretation of two-alternative choice tasks and cannot be applied to standard reading conditions. However, the lexical decision task can provide useful, although indirect, evidence on reading in the perspective of 'functional overlap' proposed by J. Grainger and A. M. Jacobs (Grainger, Jacobs 1996).

Note that the interpretation based both on the diffusion model and MROM envisages a criterion set to determine the quality of information needed to reach a decision. S. Lupker and his colleagues proposed the time criterion of setting an expected time for articulating the response. Thus, there is a substantial difference in these two perspectives, although, as we have shown above, both paradigms point to substantial cross-linguistic differences, with English readers being more sensitive to strategic influences both in lexical decision and in mixed-pure block experiments.

We propose here one possible way to reconcile this difference in interpretation. The critical observation by S. Lupker et al. (Lupker et al. 1997) is that in mixing conditions subjects show both a cost for the easier conditions and an advantage for more difficult conditions. However, as stated above, there is reason to believe that mixing costs may point to a separate mechanism indicating changes in the nature of processing (Los 1996). Thus, one possibility is that different mechanisms could contribute to generating the homogenization pattern found by S. Lupker et al. (Lupker et al. 1997) with only the facilitation part of the effect indicating criterion differences. Indeed, we would expect partial facilitation in responding when the context (mixed blocks) favors the activation of general lexical information (Σ criterion in the MROM) (Grainger, Jacobs 1996), particularly in English subjects. Further work is certainly needed to see whether this speculation can be experimentally supported.

General discussion

We have reported evidence on a series of experiments that aimed to characterize the impact of orthography on the reading performance of English and Italian individuals. We focused on time measures. Indeed, while studies consistently report a greater number of errors in English subjects, the results for time measures are more inconsistent. Frequently (although not always), the outcome

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of these studies is that English readers are less accurate but not slower.

In our study on children (Marinelli et al. 2016), we reproduced this pattern of findings and noted two main general characteristics of this cross-linguistic difference. First, the performance of Italian children fits very closely with the predictions of general models of performance in timed tasks, such as the RAM (Faust et al. 1999) and the DEM (Myerson et al. 2003); by contrast, the performance of English children did not fit well with the predictions of these models indicating that some additional factors were in place. Second, there were substantial individual differences in the English sample with one-fourth of children performing much worse and in a qualitatively different way than the others; by contrast, individual differences in the Italian sample were less marked and generally indicated only quantitative differences in performance. Notably, these latter results are in line with the studies comparing English and Welsh children (Hanley et al. 2004; Spencer, Hanley 2003).

Further studies with a variety of different paradigms confirmed the presence of large individual differences in the English sample. When using the RSVP paradigm, in two separate experiments, English young adults were extremely variable with the sample including both the fastest and the slowest individuals (as compared to a group of Italian subjects matched for age and gender). When the distributions of vocal RTs were examined with reference to the ex-Gaussian distribution, that of the English sample was characterized by more variable values for both τ (the mean of the exponential component) and σ (standard deviation of the Gaussian component) as well as generally higher σ mean values.

Using the lexical decision task, we examined possible strategic differences between English and Italian readers. It has been observed that the quoted models (Faust et al. 1999; Myerson et al. 2003) cannot easily account for strategic or criterial differences (Spieler 2001). The diffusion model (Ratcliff 1978; Ratcliff, McKoon 2008) allows detecting the role of criterion over and above the other components of the RT response. We observed that English readers showed a lower (more lenient) criterion in judging the lexicality of orthographic strings than the Italian sample. A control experiment indicated that this difference was specific to orthographic materials and did not extend to pictorial stimuli (face gender judgment). Regarding the MROM (Grainger 2018; Grainger, Jacobs 1996), we proposed that the difference in the criterion may indicate a greater reliance of English than Italian subjects on the Σ criterion, a measure of the activation levels of all word units (or 'word likeness'). By contrast, the performance of Italian readers can be interpreted as closely linked to the M criterion, i. e., the activation level of the most activated word unit. Note that the diffusion model only applies to binary two alternative forced-choice tasks and cannot be directly used in tasks of word reading. Thus, it appears again that the reference to a variety of tasks (including lexical decision) may be instrumental in obtaining information on various facets of reading differences (Grainger, Jacobs 1996).

A possible synthesis

We propose two general and related working hypotheses to interpret cross-linguistic differences between English and Italian samples. First, the characteristics of the English orthography (possibly also emphasized in some cases by the teaching method used) foster a global lexical approach to recognizing words. Second, not all children can effectively rely on such global processing and this may be the main source of large individual differences present among English subjects.

Children learning a highly irregular orthography such as English face a very complex task, particularly at the very onset of acquisition. The learning (and indeed also the formal teaching) of the basic rules of grapheme-to-phoneme correspondences is comparatively difficult (Cunningham, O'Donnell 2015) and there is a substantial number of words that cannot be read based on these rules (Schmalz et al. 2015). For these combined reasons, English children may, to a varying degree, rely on a global analysis of written words, rather than attempting to translate graphemes or grapheme clusters into phonemes. This may entail trying to remember individual words or large sub-word parts, such as rhymes or endings (Ziegler, Goswami 2005) because English is less unpredictable when considering larger units of analysis (Treiman et al. 1995). This tendency to focus on global components may be partly favored, or even enhanced, by some teaching methods and types of instruction (particularly, approaches related to 'whole language' methods). However, because of the complexity and perduring variability of teaching methods of English orthography (Moats 2007), the impact of reading instruction on the reading pattern of English readers is difficult to determine with certainty and remains an open question. Indeed, it cannot be excluded that teaching methods may contribute, although in yet undetermined ways, to the peculiarity of the reading profile in this language.

Some experimental evidence provides support to the hypothesis of a tendency for a global lexical approach in reading English. We compared English

and Italian children in a lexical learning task requiring them to associate pseudo-words with pictures (Marinelli et al. 2020). English and Italian children were very similar at the start, but the former were more able to learn these new associations than the latter (Fig. 7). This cross-linguistic difference was present when the two linguistic groups were matched either on a chronological basis or grade. These results provide evidence that in a lexical learning task English children tend to use larger units of analysis than Italian ones.

The emphasis on global processing may be characterized in different ways. J. C. Ziegler and U. Goswami (Ziegler, Goswami 2005) have proposed that readers of regular orthographies rely more on smaller grain sizes, while readers of irregular orthographies rely on larger grain sizes. In keeping with the MROM (Grainger 2018; Grainger, Jacobs 1996), we have proposed (Mauti et al. 2023) that readers acquiring a regular orthography, such as Italian, largely rely on the detection of the most activated word unit (M criterion in the model), while readers acquiring a highly irregular orthography, such as English, heavily rely on the activation levels of all word units (Σ criterion in the model). While the lexical decision task can be useful to identify these different criteria, it is expected that they will also be active in more standard reading conditions. In this case, activation based on the Σ criterion would be expected to favor the emergence of neighborhood density (N-size) effects. Indeed, it is well known that English orthography is characterized by a prevalence of short mono-syllabic words often with a dense orthographic and/or phonological neighborhood, while Italian contains several long, multisyllabic, morphologically complex words with comparatively fewer orthographic neighbors (Burani et al. 2017). Thus, this structural characteristic of English orthography may contribute to favoring an early reliance on a general measure of word likeness.

The general trend for more global, lexical processing was also recently confirmed by the analysis of the error profile in the two languages (Marinelli et al. 2022): while Italian reading children showed a predominance of errors characterized by a slow and progressive approach to the target through multiple attempts, English reading children mainly committed word substitutions and non-word lexicalizations. Moreover, English children made more errors resulting in words (but not pseudowords) than Italian reading children. Taken together, evidence points to a greater reliance on the sub-lexical routine in Italian readers and on the lexical routine in English readers.

However, the increased use of lexical strategy in opaque languages like English is not without its costs. Not all readers seem able to handle this skill effectively and some of them fail to reach an adequate performance in reading. Thus, about a fourth of English children read quite slowly, with a high proportion of errors, and with a very large spread of performances as a function of experimental manipulations (Marinelli et al. 2016). Higher interindividual variability shown by English readers in comparison to Italian ones was confirmed using

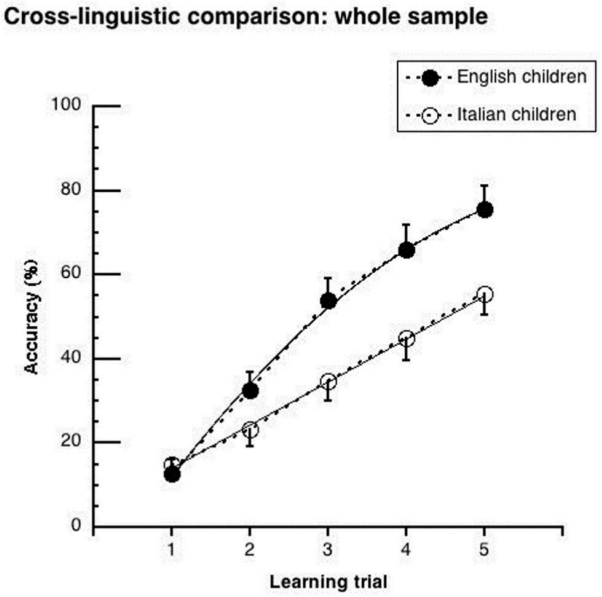

Fig. 7. Mean performance (and .05 confidence intervals) on the lexical learning task as a function of trial sequence. Data (averaged between younger and older children) are presented separately for Italian and English participants (Marinelli et al. 2020)

 https://www.doi.org/10.33910/2686-9527-2023-5-3-345-365

several experimental paradigms and in different age ranges (Marinelli et al. 2014). On the other hand, almost all Italian participants gain the ability to read their consistent orthography, producing smaller interindividual variability (except deviant patterns showed by a minority of dyslexic readers).

The source of these individual differences is difficult to pinpoint. An interesting line of research was put forward by L. A. Cooper (Cooper 1980; 1982). She reported the presence of relatively stable individual tendencies with some subjects consistently behaving as holistic processors and others as analytic processors in various visual comparison tasks. Although it does not deal directly with reading, the author's characterization of holistic versus analytic processing is particularly enlightening for processing modality requirements. L. A. Cooper (Cooper 1980; 1982) reported that in a pattern recognition task, some individuals prefer analytic processing, in which RTs are monotonically influenced by the degree of stimulus-target dissimilarity, whereas others show holistic processing, in which RTs are largely independent of stimulus characteristics. Interestingly, RTs and accuracy measures yield consistent findings in analytic individuals but not in holistic ones. Although accuracy measures closely reflect the difficulty of a given experimental condition, response times are (relatively) insensitive to the characteristics of the stimulus. L. A. Cooper (Cooper 1980; 1982) rejected simple interpretations of this pattern in terms of a speed-accuracy trade-off and floor effects and posited that "the difference between subjects (lies) in the nature of the strategies they naturally use for comparing internally represented and externally presented visual information" (Cooper 1982, 84).

Interestingly, Cooper (Cooper 1982) also investigated whether analytic individuals can be forced to behave holistically and vice versa using tasks that could be effectively accommodated only in one of the two modalities. The results indicated that holistic individuals have no apparent problem in becoming analytic on a multi-dimensional task; by contrast, not all analytic subjects were able to switch to parallel processing on a face recognition task. In the reading domain, this would indicate that not all subjects are effective in managing a global analysis of the stimulus even if this is made preferable by the characteristics of the orthography, the type of instructions or a combination of these factors.

To the best of our knowledge, the initial observations by Cooper (Cooper 1980; 1982) have not been followed up by further systematic research. However, we propose that this characterization raises an interesting heuristic concerning the adoption of a global strategy in reading and the source of large individual differences present among English readers. Thus, one could hypothesize that English children with a holistic tendency may adapt easily to the boost given by the characteristics of the orthography (and possibly by the teaching methods) to process words holistically. This will produce generally fast levels of responses largely independent of the characteristics of the stimulus (which will, however, influence performance accuracy). Indeed, we know that several English children respond quite fast with very small differences among experimental conditions which emerge more clearly in accuracy measures (Marinelli et al. 2016). Some English children with an analytic style of responding may adapt relatively well to process stimuli holistically but some will find this extremely difficult and will maintain an analytic style of responding. This will produce generally slower RTs and much greater differences among conditions, a pattern present in about one-fourth of children in C. V. Marinelli's study (Marinelli et al. 2016). Further research is certainly needed to confirm this speculation.

Conclusions

Describing cross-linguistic differences among English and Italian individuals in several reading paradigms, this review highlights convergent evidence on the modulating role of orthographic consistency on reading performance. We propose two working hypotheses to interpret the pattern of experimental findings. First, from an early stage of acquisition, the characteristics of English orthography may foster a global-lexical approach to reading. Note that the observed cross-linguistic differences were also present among adult readers, underscoring the pervasiveness of the effect of orthographic consistency on reading processes. Second, a large proportion of English children are in difficulty in managing such global processing generating large individual differences detected in a variety of reading paradigms. Understanding the source of these individual differences still represents a challenging task for future research. Notably, this question is aggravated by the difficulty in pinpointing the precise role of teaching methods. Thus, even after several decades of experimental research and various systematic attempts to produce unambiguous guidelines for teaching orthography, English maintains, to some extent, its uniqueness, questioning its central role in scientific investigations of reading.

Conflict of Interest

The authors declare that there is no conflict of interest, either existing or potential.

Ethics Approval

The authors declare that the study complies with all ethical principles applicable to human and animal research.

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