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Reading Comprehension Predictors in Adulthood: A Study on European Portuguese

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Reading Comprehension Predictors in Adulthood: A Study on European Portuguese

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Declaro ser o autor deste trabalho, que é original e inédito. Autores e trabalhos consultados estão devidamente citados no texto e constam da listagem de referências incluída.

Assinatura

(Fábio Daniel Fernandes Gonçalves)

Para a minha mãe,

este feito também é teu.

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Resumo em Português

A compreensão leitora é o objetivo final de qualquer atividade de leitura. Nos adultos, a capacidade de entender os significados dos textos está associada ao sucesso académico, à construção de conhecimento e à aprendizagem ao longo da vida.

Uma forma de lidar com défices nesta capacidade é desenvolver programas de intervenção que tenham como a finalidade a promoção da compreensão leitora. Para tal, é essencial conhecer as capacidades de que depende a compreensão leitora (preditores), uma vez que os melhores preditores serão, potencialmente, os alvos de intervenção mais adequados.

A maioria dos estudos sobre os preditores da compreensão leitora têm sido realizados com amostras de crianças em idade escolar e falantes de Inglês (ortografia opaca), o que representa uma limitação na literatura, pela impossibilidade de generalização destes resultados para populações adultas e ortografias de maior transparência. Desta forma, o desenvolvimento de estudos com amostras de adultos e em ortografias de diferentes níveis de opacidade é relevante.

Dos vários modelos para a compreensão leitora, destaca-se o *Simple View of Reading* (SVR; Gough & Turner, 1986). O SVR postula que a compreensão leitora é o produto das capacidades de descodificação e compreensão da linguagem oral, conseguido explicar percentagens elevadas da variância da compreensão, tanto em crianças como adultos. Porém, outras capacidades têm sido sugeridas como potenciais adições significativas ao SVR, tais como o vocabulário e a fluência de leitura.

O presente estudo procura colmatar as limitações na literatura supracitadas, testando preditores da compreensão leitora numa amostra de adultos estudantes universitários, e numa ortografia semitransparente (Português Europeu). Considerando a meta-análise de Tighe e Schatschneider (2016), os preditores selecionados para o presente estudo foram: leitura de palavras, fluência de leitura, vocabulário, compreensão da linguagem oral, nomeação rápida automática (RAN), descodificação fonológica, consciência fonológica, consciência morfológica e memória de trabalho.

Dois modelos SVR foram testados: um modelo simples que considerou os elementos de descodificação (leitura de palavras) e compreensão da linguagem oral; e um modelo alargado que considerou a adição do vocabulário e fluência de leitura ao modelo simples, para testar o contributo adicional destes dois construtos na compreensão leitora. Foi hipotetizado que nestes modelos o efeito da compreensão da linguagem oral seria superior ao da leitura de palavras.

Adicionalmente, procurou-se testar se os efeitos dos restantes preditores (RAN, descodificação fonológica, consciência fonológica, consciência morfológica e memória de

trabalho) na compreensão leitora seriam diretos ou mediados através da leitura de palavras e da fluência de leitura. Foi hipotetizado que o efeito da consciência morfológica seria direto, enquanto os efeitos das restantes variáveis seria totalmente mediado pelas moderadores referidos.

A amostra foi constituída por 67 estudantes universitários com o Português Europeu como língua materna e considerados leitores normativos. Esta amostra foi retirada do estudo de Faísca et al. (2019). Medidas de consciência morfológica, compreensão da linguagem oral e compreensão leitora foram desenvolvidas para o presente estudo. Para os restantes construtos, foram utilizadas medidas previamente recolhidas no estudo de Faísca et al. (2019). Foi utilizado o método estatístico *path-analysis* em todos os modelos.

Os nossos resultados mostraram que os preditores se correlacionaram de forma positiva, moderada e significativa com a compreensão leitora, com a exceção da descodificação fonológica e RAN, que não se correlacionaram significativamente.

Os resultados no modelo SVR foram ao encontro do esperado, isto é, a compreensão da linguagem oral teve um efeito superior ao da leitura de palavras na compreensão leitora. No entanto, esta diferença não foi estatisticamente significativa. Os dois elementos do SVR explicaram cerca de 27% da variância na compreensão leitora.

Tendo em conta o modelo SVR alargado, a adição das variáveis vocabulário e fluência trouxe uma contribuição significativa adicional de 7%, embora só o vocabulário tenha apresentado uma contribuição individual significativa. Ademais, a adição destas duas variáveis atenuou o efeito da leitura de palavras, tornando-o não significativo. Neste modelo estendido, a leitura de palavras afeta a compreensão leitora indiretamente, através do vocabulário, que por sua vez influencia a compreensão leitora de forma direta e indireta - através da compreensão da linguagem oral. Estes resultam sugerem que a inclusão do vocabulário no modelo SVR é particularmente relevante para a população em estudo.

Dado o RAN e a descodificação fonológica não se correlacionarem significativamente com a compreensão leitora, estes foram excluídos dos modelos de mediação. A hipótese de mediação total foi rejeitada, sugerindo que o efeito da consciência morfológica, da consciência fonológica e da memória de trabalho na compreensão leitora não é totalmente medida pela precisão e fluência da leitura de palavras. Apenas a consciência morfológica apresentou um efeito direto significativo na compreensão da leitora, como hipotetizado, refletindo o papel desta capacidade em níveis de escolaridade mais elevados e em ortografias semitransparentes.

Estes resultados apresentam evidências preliminares de que o SVR (com a possível adição do vocabulário) pode ser um modelo fiável para explicar os níveis de compreensão

leitora numa população adulta e normativa, e numa ortografia semitransparente, apesar da percentagem de variância explicada ser relativamente pequena. Para esta população, a estimulação das capacidades de vocabulário e compreensão da linguagem oral será uma estratégia mais adequada para o aumento dos níveis de compreensão leitora, dado estes aparentemente serem os seus melhores preditores.

Esta investigação representa uma primeira tentativa de testar preditores da compreensão leitora em adultos portugueses com níveis de leitura normativos. Os resultados obtidos podem ser utilizados como termo de comparação para testar modelos em outras amostras e com diferentes ortografias, ou como forma de identificar capacidades adequadas para estimular a compreensão leitora nesta população. No entanto, os instrumentos desenvolvidos caracterizam-se por apresentar níveis inaceitáveis de fiabilidade, e a amostra utilizada foi relativamente pequena, o que comprometeu o alcance de significância estatística em diversas situações. Estudos futuros devem tentar colmatar estas limitações, e validar os resultados obtidos com instrumentos que apresentem melhores propriedades psicométricas e com uma amostra mais representativa da população de adultos portugueses normativos, contribuindo assim para um estabelecimento mais apropriado dos preditores da compreensão leitora na população em estudo.

Resumo

A maioria dos estudos sobre os preditores da compreensão leitora tem sido realizada com crianças em idade escolar e falantes de Inglês (ortografia opaca), o que representa uma limitação dada a impossibilidade de generalizar os resultados para populações adultas com ortografias de maior transparência. No presente estudo, recorrendo a *path analysis*, foram testadas duas versões do modelo *Simple View of Reading* (SVR; simples e alargada – com inclusão de fluência de leitura e vocabulário). Modelos de mediação adicionais foram igualmente testados para verificar se os efeitos da nomeação rápida automatizada, descodificação fonológica, consciência fonológica, consciência morfológica e memória de trabalho na compreensão leitora seriam diretos ou mediados pela leitura de palavras e fluência de leitura. Foi utilizada uma amostra de 67 jovens adultos (estudantes universitários) Portugueses, considerados leitores normativos.

No modelo SVR simples, a compreensão da linguagem oral e a leitura de palavras explicaram cerca de 27% da variância na compreensão leitora, com o primeiro elemento a apresentar um efeito superior. No entanto, esta diferença não foi estatisticamente significativa. No modelo SVR alargado, fluência de leitura e vocabulário proporcionaram uma contribuição adicional significativa de variância explicada de 7%. Ademais, o vocabulário influenciou a compreensão leitora de forma direta e indireta - através da compreensão da linguagem oral. Nos modelos de mediação finais, a hipótese de mediação total foi rejeitada, e apenas a consciência morfológica apresentou um efeito direto na compreensão leitora.

Estes resultados representam evidências preliminares de que o SVR (com a possível adição do vocabulário) pode ser um modelo fiável em populações adultas normativas e em ortografias semitransparentes. Além disso, a compreensão da linguagem oral e o vocabulário foram os melhores preditores na amostra em estudo, pelo que se sugere a sua promoção, de forma a obter melhorias nos níveis de compreensão leitora, nesta população.

Palavras-chave: compreensão leitora, modelo Simple View of Reading, path analysis, leitores adultos normativos, Português Europeu

Abstract

Most studies on the predictors of reading comprehension have been using samples of school-aged children and English speaking (considered an opaque orthography) readers, which represents a possible gap in the literature, since it is not possible to generalize the results to adult populations and other orthographies with different degrees of transparency. In the present study, through path analysis, two versions of the Simple View of Reading (SVR; simple and extended – with reading fluency and vocabulary) model were tested. Likewise, additional mediation models were tested to verify if the effects of rapid automatized naming, phonological decoding, phonological awareness, morphological awareness and working memory on reading comprehension were direct or mediated by word reading and reading fluency. A sample of 67 young adults (university students), considered to be normative readers, was utilized.

In the simple SVR model, oral language comprehension and word reading explained about 27% of the variance in reading comprehension, with the first element displaying a larger effect. However, this difference was not statistically significant. In the extended SVR model, reading fluency and vocabulary provided an additional and significant contribution of 7% of explained variance. Moreover, vocabulary influenced reading comprehension directly and indirectly – via oral language comprehension. In the final mediation models, the total mediation hypothesis was rejected, and only morphological awareness had a direct effect on reading comprehension.

These results provide preliminary evidence that the SVR (with the possible addition of vocabulary), might be a reliable model to explain reading comprehension in adult normative readers speaking a semitransparent orthography. Furthermore, oral language comprehension and vocabulary were the best predictors in the studied sample, so it is suggested that they should be promoted, as a way of increasing reading comprehension levels, in this population.

Keywords: reading comprehension, Simple View of Reading model, path analysis, adult normative readers, European Portuguese

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1. Introduction

The ultimate goal of reading is comprehension (Fernandes et al., 2017a). Reading comprehension can be defined as the ability to extract and construct meaning from a text (RAND Reading Study Group, 2002). To do that, it is necessary that the reader interacts with the text, extracting explicit information or inferring implicit information through textual cues or activation of background knowledge (Day & Park, 2005).

In children, adequate reading comprehension allows for a better environment manipulation which is essential for academic success (Hjetland et al., 2020; Jay, 2003). In adults, this skill is of paramount importance for employment, success in university education and lifelong learning. (Braze et al., 2007; McShane, 2005).

Besides the clear importance of this ability in these age groups, it is also relevant to note that both children and adults without the diagnosis of a learning disorder can present poor levels of reading comprehension (Matheson, 2018). This is a serious issue, especially for adults, as both the modern workplaces and university education require a high level of reading-related abilities (Braze et al., 2007; Cavalli et al., 2019).

Deficits in reading comprehension in adulthood have economic, civic, and cultural repercussions (McShane, 2005; Mellard et al., 2010). One way to address these deficits is to develop intervention programs, with the aim of promoting this ability (Braze et al., 2007). In order to understand and subsequently promote reading comprehension, it is relevant to identify which abilities reading comprehension might depend on (predictor variables) (Mellard et al., 2010). In this way, pinning down what skills might be hindering reading comprehension contributes to the identification of worthy targets of intervention (Braze et al., 2007; Mellard et al., 2010).

However, research on the predictor variables of reading comprehension has been predominantly carried out with samples of school-aged children (Tighe & Schatschneider, 2016), that contrast with adult populations, concerning the processes that they rely on, when reading. When children begin to learn how to read, they mostly rely on sublexical processes (Greenberg et al., 2002), meaning that words are analysed in parts, such as phonemes (Vitevitch, 2003). On the other hand, adults mostly rely on lexical processes when reading (Greenberg et al., 2002), meaning that words are processed as a whole (Vitevitch, 2003).

Moreover, Tighe and Schatschneider (2016) underlined the lack of consensus about the relative importance of reading comprehension predictors in adulthood. In their meta-analysis, they attempted to identify the most important predictors of adult reading

comprehension by assessing the direction and strength of the relationships between the predictors and reading comprehension. They consistently identified 10 constructs across 16 studies (by order of magnitude): morphological awareness, language comprehension, reading fluency, oral vocabulary knowledge, real word decoding, working memory, pseudoword decoding, orthographic knowledge, phonological awareness, and rapid automatized naming (RAN). Although only using correlational evidence and a small number of studies, Tighe and Schatschneider (2016) provided the first systematic review of what are the most important reading-related predictors of reading comprehension in adults providing a foundation on which future studies could base their choice of reading comprehension predictors.

Investigations that attempt to study the influence of predictors on reading comprehension in adults often hypothesize models based on current literature and test them in samples of adults with various levels of literacy (e.g., Mellard et al., 2010; Sabatini et al., 2010). This might represent a literature gap, because these samples tend to be highly heterogeneous in terms of reading abilities (e.g., Braze et al., 2007).

In this manner, researchers might be understudying adult samples such as university students, about whom there have been reported low levels of reading comprehension (e.g., Edelman & Scriba, 2018; Puerto et al., 2018) that contrast with the high complexity of higher education texts (Cavalli et al., 2019).

The contrast between the complexity of higher education texts and the low levels of reading comprehension in higher education students, emphasizes the need to study adults in university, aiming to identify which abilities might be hindering reading comprehension levels. Moreover, Mellard and Fall (2012) highlight the need to test the findings of studies with samples of adults across different samples, which includes university students.

In this way, it is clear that the topic of reading comprehension predictors has been systematically more studied with populations of children, leading to the understudy of adult populations, such as adults with higher levels of education. Moreover, most studies that investigate reading comprehension predictors have been developed with samples of English-speaking children or other opaque orthographies (Florit & Cain, 2011). The transparency of the orthography affects the weight of the contribution of predictors on reading comprehension, meaning that studies with more transparent orthographies (e.g., Portuguese), are also very relevant (Florit & Cain, 2011).

Thus, considering the tendency to understudy adult populations and more transparent orthographies, plus the differences in the cognitive processes associated with reading in children and adults, the development of models that contribute to a better understanding of the reading skills of the Portuguese adult population seem to be extremely relevant. In the present study, data was collected from Portuguese adult university students (normative readers), with the main objective of testing models that predict reading comprehension and determine how reading-related predictors relate to reading comprehension and amongst themselves, in this population.

2. Theoretical Framing

2.1. Cognitive Processes Associated With Reading - Differences Between Children and Adults

There is no long-term stability in the predictors of reading comprehension identified in childhood, as children and adults differ significantly on the cognitive processes and strategies that they rely on when reading (Greenberg et al., 2002).

In children, there are changes in the cognitive processes associated with reading, as children evolve from reading strategies supported by sublexical processes (grapheme-phoneme conversion) to reading strategies based on the orthographic recognition of words (lexical skills) (Fernandes et al., 2017a). Consequently, in the early school years, reading comprehension depends mostly on decoding fluency, as the child is learning grapheme-phoneme conversion rules and reading is not yet fluent (Fernandes et al., 2017a). When reading becomes more fluent and vocabulary increases, it becomes a significant predictor of reading comprehension while decoding fluency importance decreases (see, for example, Fernandes et al., 2017a).

On the other hand, adults' reading strategies seem to be greatly supported by lexical processes (vocabulary skills) (Greenberg et al., 2002). Adult readers have larger vocabularies compared to younger readers, due to their life experiences, so reliance on vocabulary skills is expected (Mellard et al., 2010). So, contrarily to children in the early school years, adults typically do not use phonological strategies to read, relying more on the orthographic knowledge of the words (Greenberg et al., 2002).

Greenberg et al. (2002), compared adult literacy students to school-aged children (3rd, 4th and 5th grade), matched for reading level. When analysing the participants´ performance on tasks of word reading, non-word reading, spelling, and rhyme word detection tasks, they found that, while the children group relied mostly on phonological

skills, adults were more likely to utilize orthographic knowledge and visual memory strategies. That is, for example, when confronted by a word that could not be immediately read, children would try to read it through grapheme-phoneme conversion, while adults would typically try to guess the word by comparing it to other words recorded on their lexicon.

Results such as these reflect the different cognitive processes that children and adults rely on when reading, since the two groups resort to distinctive strategies. It is important to take these differences into account when selecting a model that predicts reading comprehension, because models that are developed based on children samples, might not be appropriated for adults.

2.2. Predicting of Reading Comprehension – The Simple View of Reading

The Simple View of Reading (SVR; Gough & Turner, 1986) is a prominent model of reading comprehension in children literature. The SVR postulates that, when measured appropriately, decoding accuracy and oral language comprehension can account for all the variance in reading comprehension: while decoding skills translate print into oral language, oral language comprehension skills make sense of what was read (Gough & Turner, 1986). In children, this combination has been shown to capture between 65% and 85% of the variance in reading comprehension (Catts et al., 2005).

Despite being a prominent model of reading comprehension in children literature, the SVR has also been successfully applied to adults. For instance, Sabatini et al. (2010) found that the SVR model (decoding accuracy and oral language comprehension) accounted for an adequate proportion of reading comprehension variance (64%), while the addition of vocabulary or reading fluency variables did not improve the model. Therefore, even though the SVR is a predictive model based on children, it also can explain a preponderance of reading comprehension variance in adult samples.

Decoding accuracy and oral language comprehension skills are relatively independent of one another, both being necessary for reading comprehension, and neither being sufficient (Gough & Turner, 1986; Hoover & Gough, 1990). Fluent decoding in the absence of satisfactory oral language comprehension levels does not qualify as reading, since the reader is not able to extract meaning from what was read (Hoover & Gough, 1990). Similarly, normal or high levels of oral language comprehension, alongside with poor decoding skills (characteristic of some dyslexic individuals), do not equate to reading, as the reader needs to decode the text before attempting to comprehend it

(Hoover & Gough, 1990). Depending on the study, authors have chosen to assess the decoding component of the SVR using measures of phonological decoding (i.e., lists of pseudowords; e.g., Braze et al., 2007), word reading (e.g., Cadime et al., 2016) or both (e.g., Sabatini et al., 2010).

2.2.1. Relative Contributes of Decoding Accuracy and Oral Language Comprehension to Reading Comprehension – The Role of Reading Expertise and Transparency of the Orthography

As the reader progresses from basic to more complex reading materials, it is expected that the main source of variability in reading comprehension shifts from decoding accuracy to oral language comprehension skills (Mellard et al., 2010). This shift might be explained by Perfetti's Verbal Efficiency Theory (Perfetti, 1985). The author hypothesized that, while reading, the cognitive system has limited capacity for decoding and comprehension simultaneously. That is, only when the reader can decode with accuracy and speed (i.e., fluently) the cognitive system has sufficient free attentional resources allowing the reader to concentrate on extracting meaning from the text.

Indeed, Catts et al. (2005) found that the contribution of oral language comprehension to reading comprehension increases, while decoding accuracy contribution decreases, as children progress through the grades and gain reading experience. Nevertheless, and according to Florit & Cain (2011), this shift seems to occur only in opaque languages.

The relative contribution of decoding accuracy and oral language comprehension seems to be affected by the transparency of the orthographic system (Florit & Cain, 2011). The SVR was developed based on English-speaking children (Gough & Turner, 1986). Accordingly, most studies on the SVR model consider the English language (opaque orthography), and the generalization of conclusions to more transparent orthographies must be cautious (Cadime et al., 2016).

In alphabetical orthographies, grapheme-phoneme correspondences are not always straightforward (Mcclung & Pearson, 2019). When orthographic transparency is mentioned (also depth or consistency), it refers to the level of consistency between phonemes and graphemes. In that way, one could imagine a spectrum in which at one end there are transparent orthographies (i.e., each letter normally represents a sound and each sound is normally represented by a single letter) and at the other end there are opaque orthographies (the same letter or group of letters may represent different sounds; e.g., the

letter <c> in “cat” and “center”; or the same sound may be spelled in different ways; e.g., the sound /k/ in “coat” and “kite”) (Ziegler et al., 2010). English is an example of an opaque orthography, while Finnish is transparent one; Portuguese is an orthography of “intermediate depth” (Seymour et al., 2003).

In more opaque orthographies, learning the rules of phoneme-grapheme conversion is an arduous process, making fluent reading only possible in later school years (Florit & Cain, 2011). In that manner, several studies have confirmed that decoding accuracy stays as the main source of variability in reading comprehension until later in school, when it is replaced by oral language comprehension (Catts et al., 2005). As previously mentioned, when the reader decodes with accuracy and speed, cognitive resources can be allocated to comprehension, triggering the shift from decoding accuracy to oral language comprehension as the most important predictor of reading comprehension (Perfetti, 1985).

On the other hand, in more transparent orthographies, grapheme-phoneme conversion is simpler, allowing readers to achieve fluent decoding faster, and therefore focusing on comprehension during reading. Consequently, oral language comprehension comes up as the main source of variability in reading comprehension early in school years, staying that way as the individual progresses through the grades (Florit & Cain, 2011).

Florit and Cain (2011), in their meta-analysis, compared the performance of school-aged children (1-2 years *vs.* 3-5 years of schooling) reading in orthographies with different levels of transparency (Greek, Finnish, Spanish, Norwegian, Italian, Dutch, French, and English). The authors investigated if the transparency of the orthography affects the weight of the contribution of decoding and oral language comprehension on reading comprehension. For the English group (the opaquer orthography), during the 1-2 years of schooling, decoding was the strongest predictor, while in the 3-5 years oral comprehension emerged as the strongest predictor. This result goes accordingly to the SVR´s prediction that decoding should be the most important predictor of reading comprehension in the early school years, while English children are improving their grapheme-to-phoneme conversion skills, shifting to oral language comprehension later in schooling, when the reader´s decoding is more fluent. In more transparent languages (such as Greek, Finnish, and Spanish), the authors found that during the 1-2 years of schooling, oral language comprehension was already a stronger predictor of reading comprehension than decoding, maintaining itself as the largest contributor to reading comprehension for children with 3-5 years of schooling.

Florit and Cain´s (2011) study showed that in more transparent languages there is a greater influence of oral language comprehension on reading comprehension (compared to decoding). Transparent orthographies, being characterized by more regular spelling patterns, facilitate decoding and, consequently, fluent reading can be achieved earlier in school, making space for the allocation of cognitive resources to the extraction of meaning from text. Therefore, in more transparent orthographies, oral language comprehension is the main source of variability in reading comprehension, since the early school years, and throughout schooling. Decoding starts and remains as a relatively less important predictor.

Overall, these results show that decoding skills are a stronger contributor than oral language comprehension in the early school years in opaque orthographies but not in more transparent orthographies. These findings confirm Florit and Cain's first hypothesis, that the transparency of the orthography affects the weight of reading comprehension predictors. Furthermore, this highlights the need to develop reading models in languages besides English, considering the transparency of the orthography.

Cadime et al. (2016) set out to test if the SVR was a valid model to predict reading comprehension in European Portuguese. They used structural equation modelling to test their hypothesized models and found that for children in 2nd and 4th grades, oral language comprehension was always the strongest contributor to reading comprehension, when compared to decoding. This study adds evidence to Florit and Cain´s (2011) conclusions that in more transparent orthographies fluent reading occurs faster, allowing oral language comprehension to arise as the strongest predictor, since the early school years.

Summing up, in more opaque orthographies fluent reading occurs later, making decoding accuracy the main source of variability of reading comprehension. When decoding becomes fluent, oral language comprehension emerges as the main contributor. Differently, in more transparent orthographies, since grapheme-phoneme conversion is consistent, fluent reading often occurs in the first school years, meaning that oral language comprehension begins and remains as the strongest predictor.

2.2.2. Expansion of the Simple View of Reading

Despite explaining reading comprehension variance, both in children and adult samples, the SVR model has often being considered too "simple" to explain such a complex construct as reading comprehension (Catts, 2018). Therefore, there have been several proposals to expand the SVR model to encompass other constructs such as

vocabulary (e.g., Braze et al., 2007), reading fluency (e.g., Sabatini et al., 2010) or rapid automatized naming (e.g., Joshi & Aaron, 2000).

Vocabulary knowledge contributes to the understanding of words in context, promoting comprehension of textual information (Braze et al., 2007). The relationship of vocabulary and reading comprehension in adults is well verified by numerous studies that show positive moderate-to-strong correlations between these two constructs (e.g., Braze et al., 2007; Mellard et al., 2010).

Vocabulary knowledge is a subcomponent of oral language comprehension, leading to the discussion of whether vocabulary should be subsumed within oral language comprehension or be considered as a distinct component on its own, in the SVR model (Braze et al., 2007; Braze et al., 2016). Gottardo et al. (2017) justify the "unpacking" of oral language comprehension into subcomponents, because when vocabulary is separated from non-lexical aspects of oral language comprehension (e.g., inference making), it becomes a stronger predictor of reading comprehension.

Indeed, through regression models, Braze et al. (2007) found that vocabulary accounted for unique variance in reading comprehension, independently from word reading and oral language comprehension, thus supporting the addition of vocabulary to the SVR, in adults. However, Braze et al. (2016) used latent variable analyses and found that the effect of vocabulary on reading comprehension was completely captured by oral language comprehension, supporting an opposite view: that vocabulary should not be added to the SVR as a separate component, in adults. In conclusion, there is not a consensus yet on what is the role of vocabulary in the SVR, in adults.

Also, the role of reading fluency[1] in reading comprehension is explained by Perfetti's Verbal Efficiency Theory (Perfetti, 1985): when the reader uses grapheme-phoneme conversion (phonemic decoding) or holistic recognition (word recognition) with proficiency, decoding becomes more accurate and faster (i.e., fluent) and the cognitive system can free enough attentional resources for the reader to focus on comprehension tasks. Hence, fluency seems to trigger the previously mentioned shift from decoding accuracy to oral language comprehension, as the main source of variability of reading comprehension (Catts, 2018).

[1] Reading fluency "(…) refers to a level of accuracy and rate where decoding is relatively effortless…" (Wolf & Katzir-Cohen, 2001, p. 219).

Like vocabulary, the relationship between reading fluency and reading comprehension in adults has been repeatedly verified by the existence of positive moderate-to-strong correlations between the two variables (e.g., Braze et al., 2007; Sabatini et al., 2010). However, in Braze et al. (2007) and Sabatini et al. (2010), reading fluency did not provide a significant, additional explanation of variation in reading comprehension, in their extended SVR model. Conversely, in Mellard et al. (2010) study, reading fluency contributed directly to reading comprehension in adults. Indeed, the SVR has been criticized for only taking into consideration the accuracy aspect of decoding, while ignoring speed (Fernandes et al., 2017a). Thus, several authors (e.g., Braze et al., 2007; Sabatini et al., 2010) have proposed the addition of reading fluency to the SVR, some supporting its addition as a distinct predictor of reading comprehension, and others supporting the view that decoding accuracy and oral language comprehension are sufficient to predict reading comprehension, and therefore reading fluency should not be included as a distinct predictor of reading comprehension, in the SVR.

For Perfetti (1985), Rapid Automatized Naming (RAN)[2] relates to reading comprehension in a similar manner as reading fluency. That is, the faster and more accurate the naming of letters, the more cognitive resources can be allocated to comprehension tasks (Silva et al., 2012). Kirby et al. (2008) even dubbed RAN tasks as a "microcosm" of reading, as both RAN and reading tasks require fast visual-verbal connections. Yet, correlations between RAN and reading comprehension in adults tend to be weak (Tighe & Schatschneider, 2016).

Joshi and Aaron (2000) proposed the addition of a processing speed component (RAN) to the SVR model. When testing a sample of 3rd grade children, they found that decoding accuracy and oral language comprehension explained 48% of reading comprehension variance, and RAN added an extra 10% to the explained variance. Thus, the authors suggested that the SVR model could, alternatively, be expressed by the product of decoding accuracy and oral language comprehension, plus the addition of RAN. This proposal has been less explored in adult samples. In the extended SVR model of Mellard et al. (2010), RAN contributed to reading comprehension, but only indirectly, through word reading and reading fluency.

[2] Rapid Automatized Naming (RAN) refers to the speed at which the reader can name sets of stimuli (Cohen et al., 2018).

In a study performed by Braze et al. (2007) it was suggested that working memory[3] skills are related to reading comprehension, as they both require processing and short-term storage of information. When a person reads, working memory integrates new information with previously stored and processed information, being essential for building comprehension (Daneman & Merikle, 1996). Also, during reading activities, working memory coordinates attentional resources (Novaes et al., 2019). If the reader is not yet proficient in decoding, working memory might be overloaded with that process, and meaning extraction will be impaired (Novaes et al., 2019).

Accordingly, working memory often arises in the literature as a strong predictor of reading comprehension in children (Nouwens et al., 2016). Positive and moderate correlations between these skills were found in adult samples (e.g., Braze et al., 2007; Mellard et al., 2010).

The expansion of SVR to include a construct of working memory could be justified by the results of Mellard and Fall (2012). In their component model of reading comprehension for adults, 75% of reading comprehension was explained by principal components analysis – derived variables of word skills, language comprehension, memory, and fluency errors. The memory component included tests of working memory, but also of story recall and listening comprehension. Individually, this component explained 8.3% of reading comprehension variance. Also, in Mellard et al. (2010) study with adults, working memory contributed to reading comprehension, but only indirectly, through oral language comprehension.

The study of phonological awareness[4] is vast in children because phonological awareness is an important predictor of proficient decoding (reading fluency) and contributes to the early identification of reading problems (Catts, 2018). Therefore, the relationship between phonological awareness and reading comprehension seems to be indirect, as phonological awareness contributes to reading fluency, which in its turn promotes comprehension of textual information (Elhassan et al., 2017).

Despite the preference to study phonological awareness in children, some researchers have attempted to study this component in adults, based on the premise that

[3] Working memory "…refers to a brain system that provides temporary storage and manipulation of the information necessary for … complex cognitive tasks" (Baddeley, 1992, p.556).

[4] Phonological awareness is "…the ability to distinguish and manipulate the sound structure of language" (Tighe & Binder, 2015, p.247).

adults with reading difficulties share the same reading subskill deficits as children who struggle to read (Nanda et al., 2010; Tighe & Binder, 2015). This unveils a possible gap in literature about the relationship between phonological awareness and reading comprehension in normative adult readers. Indeed, we did not find studies that investigate the direct relationship between phonological and reading comprehension. However, some studies correlated both constructs in normative adult samples (e.g., Fernandes et al., 2017b; Warmington et al., 2013). Although these correlations were moderate (r = .46 in Fernandes et al., 2017b; r = .34 to .38 in Warmington et al., 2013) they show the potential relevance of this relation, even in normative adult readers.

Evidence supporting the addition of a phonological awareness component to the SVR model in adults seems to be scarce. In fact, Mellard and Fall (2012) found that phonological awareness fitted in a principal components analysis - derived variable denominated as "word skills", that is, the decoding component of the SVR, supporting the view that phonological awareness should not be a separate and additional component of this model in adults.

Morphological awareness[5] allows for the reading of morphologically complex words (words with more than one morpheme), which fosters word reading accuracy and speed and provides clues for vocabulary knowledge, facilitating meaning extraction from the text (Kirby et al., 2008; Kuo & Anderson, 2006; Tighe & Binder, 2015). Furthermore, there is an inverse relation between morphological complexity and word frequency, making morphological complex words more difficult to read and less prone to holistic recognition (Gottardo et al., 2017; Kirby et al., 2008). This component relates strongly with reading comprehension in adults, with correlations between the two variables often being positive and moderate to strong (e.g., Tighe & Binder, 2015, Law et al., 2015).

Contrarily to phonological awareness, there are studies that attempted to investigate the relation between morphological awareness and reading comprehension, both in children (e.g., Gottardo et al., 2017) and adult skilled readers (e.g., Guo et al., 2011). One could argue that, since morphological awareness is a subcomponent of oral language comprehension (same as vocabulary), the same logic that served to add vocabulary as an additional component to the SVR could be used with this construct. That is, separating morphological awareness from the non-lexical characteristics of oral

[5] Morphological awareness is "an understanding of how words can be broken down into smaller units of meaning such as roots, prefixes, and suffixes" (Tighe & Binder, 2015, p. 245).

language comprehension might increase its predictive power. However, contrarily to vocabulary, there is no evidence that morphological awareness could be a significant addition to the SVR.

Nonetheless, morphological awareness seems to be a good reading comprehension predictor, showing moderate to strong correlations across studies (Tighe & Schatschneider, 2016) and directly and significantly predicting reading comprehension in children (e.g., D´Alessio et al., 2019; Gottardo et al., 2017) and adults (e.g., Guo et al., 2011).

2.3. Present Study

Based on the previous literature review, it should be emphasized that children and adults rely on different cognitive processes while reading, resulting in a dissimilar relative weight of predictors of reading comprehension in these two populations (Greenberg et al., 2002). Since most investigations studying the predictors of reading comprehension use samples of school-aged children, several authors point out the great importance of also studying adult populations (e.g., Mellard et al., 2010; Tighe & Schatschneider, 2016).

It can also be concluded that despite the adequacy of the SVR in predicting reading comprehension, both in children and adults, other variables such as vocabulary and reading fluency may provide an additional and significant contribution to this model (Braze et al., 2007). Furthermore, the SVR was initially developed based on samples of English-speaking children (an opaque orthography). Thus, some of the SVR´s predictions may be orthographic-specific and inaccurate for more transparent orthographies, as it is known that the transparency of the orthography influences comprehension processes (Hanley et al., 2004). This highlights the need to test this model in more transparent orthographies, such as European Portuguese (Florit & Cain, 2011).

Therefore, in this present work, we sought to test several reading-related predictors of reading comprehension in European Portuguese speaking adults. The main objective of this investigation was to examine the relations between several reading-related predictors and reading comprehension in European Portuguese adults, and how do they relate among them. In order to achieve this objective, a SVR model and an extended SVR model were tested, the latter including the additions of vocabulary and reading fluency, as these were the skills that had more evidence backing their inclusion in the SVR. The remaining predictors (RAN, phonological decoding, phonological awareness, morphological awareness and working memory) were tested separately, to

examine if their effects on reading comprehension were direct, or totally mediated by reading measures (word reading and reading fluency). The predictors chosen for the present study were selected from Tighe and Schatschneider´ (2016) meta-analysis on the relative importance of reading-related predictors of reading comprehension in English adult struggling readers.

In the SVR model (Figure 1), word reading and oral language comprehension measures were included as reading comprehension predictors, as postulated by the SVR. Furthermore, in the extended SVR model, reading fluency and vocabulary measures were also included.

Considering reading expertise and transparency of the orthography, we hypothesize that oral language comprehension will be a greater contributor to reading comprehension than word reading, in this first model. Since the readers in the present study have all attained secondary education and are considered normative readers, fluent reading is expected, which in its turn, suggests that the main source of variability in reading comprehension is oral language comprehension (Mellard et al., 2010). Moreover, Portuguese is a relatively transparent orthography, implying that fluent reading was probably achieved in the early school years in the present sample (Florit & Cain, 2011). Accordingly, a reliance on oral language comprehension is expected, along with a limited contribution of word reading (Florit & Cain, 2011).

In the extended SVR model (Figure 2), word reading was considered as an exogenous variable, with paths leading to reading fluency, vocabulary and reading comprehension. The more accurate the reader is in word reading, the faster he can read, resulting in fluent reading (Fernandes et al., 2017a), thus explaining the first predicted path. The path to vocabulary can be justified by Mellard and colleagues´ (2010) premise that word reading experience contributes to the learning of new word meanings, both in context and isolated. Lastly, the path from word reading to reading comprehension expresses the role of decoding accuracy in the SVR (Gough & Turner, 1986).

Reading fluency was placed as an intermediate variable, with a path leading to reading comprehension because when reading is fluent, the cognitive system can free enough attentional resources for the reader to focus on comprehension tasks (Fernandes et al., 2017a; Perfetti, 1985).

Vocabulary was another intermediate variable, with paths leading to reading fluency, oral language comprehension and reading comprehension. A larger lexicon signifies a greater number of words that the reader understands and reads by holistic

recognition, contributing to a more fluent reading (Kirby et al., 2008). Moreover, vocabulary is known for influencing comprehension, since knowledge of a word´s meaning in context aids in understanding and inference making, both in oral and written modalities (Braze et al., 2007).

Oral language comprehension was the last intermediate variable considered. Only one path was tested, from oral language comprehension to reading comprehension, reflecting the role of oral language comprehension in the SVR (Gough & Turner, 1986).

For the mediation analyses of the remaining predictors, we hypothesize that the effects of RAN, phonological decoding, phonological awareness and working memory on reading comprehension will be completely mediated by word reading and reading fluency. This prediction is based on the fact that we could not find evidence for direct relations between those skills and reading comprehension, in adults.

Conversely, we could find evidence of a direct and significant effect of morphological awareness, both in children (e.g., Gottardo et al., 2017) and adults (e.g., Guo et al., 2011), suggesting that the effect of morphological awareness on reading comprehension is still important in adulthood. Accordingly, we hypothesize that the effect of morphological awareness will not be completely mediated by word reading and reading fluency, showing a direct and significant path to reading comprehension, in our sample of adults.

Figure 1

Hypothesized SVR Model

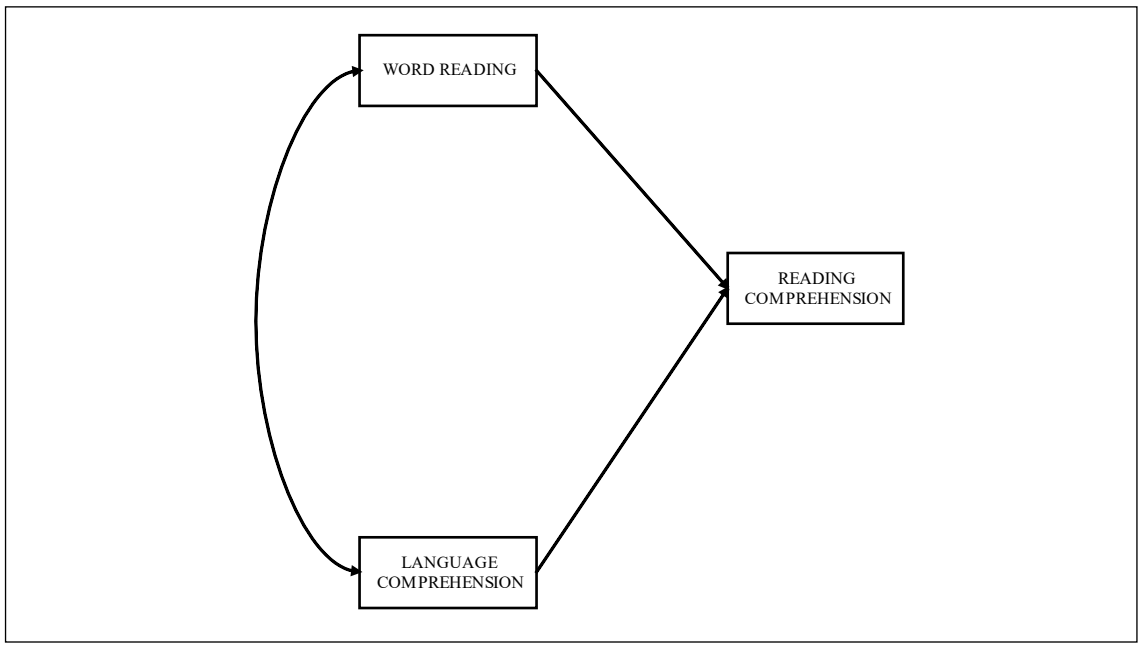
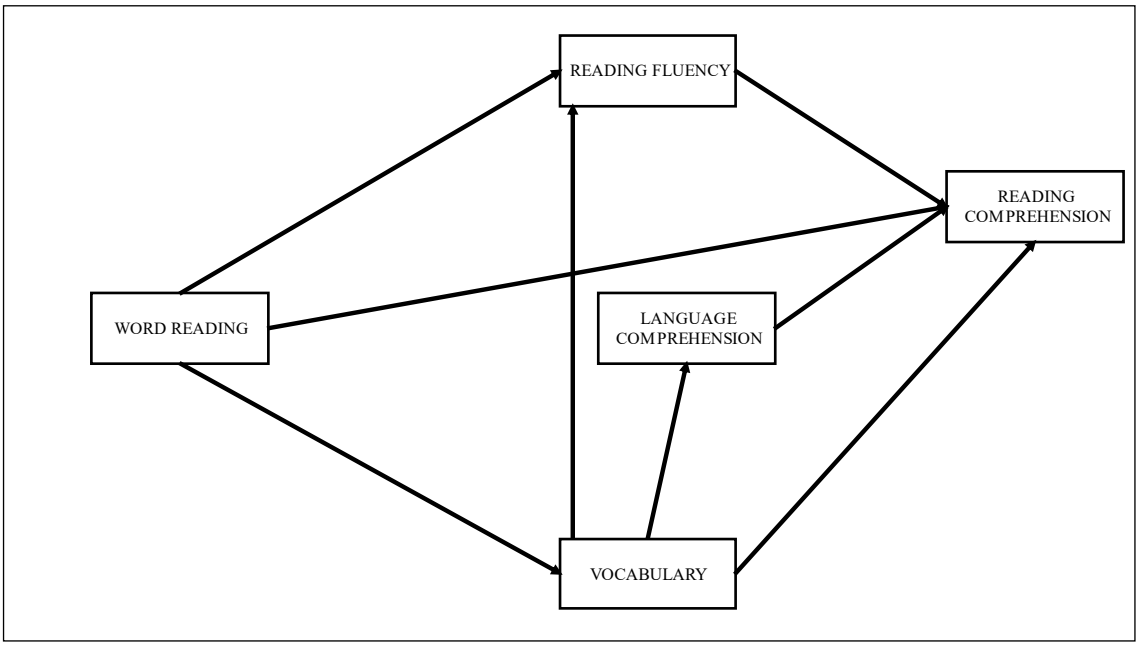


Figure 2

Hypothesized Extended SVR Model



3. Method

3.1. Participants

Sixty-seven participants (54 females – 80.6% and 13 males – 19.4%), with ages ranging from 19 to 47 years (mean ± standard deviation: 21.9 ± 4.4) were tested, with years of formal schooling ranging from 12 years (secondary education) to 23 years (doctorate) (14.4 ± 1.7). Fifty-eight (86.6%) participants were students, with no other occupation. Five (7.5%) participants were employed and did not frequent any formal education and the remaining four (6.0%) were students-workers. All participants had European Portuguese as their first language. These participants were selected from a large pool (Faísca et al., 2019).

The participants' inclusion criteria were: (1) age 18-year-old or older; (2) European Portuguese as the first language; (3) having at least concluded the secondary education; and (4) being considered a normative reader. Exclusion criteria included: (1) being a low outlier on the reading fluency or the non-verbal IQ estimate, or an high outlier in the Adult Reading History Questionnaire (ARHQ; Lefly & Pennington, 2000; Questionário de Hábitos de Leitura; QHL; Alves & Castro, 2005; Portuguese version); (2) and a diagnosis of reading, neurological, psychiatric, and psychologic disorders.

3.2. Materials and Instruments

3.2.1. Reading Tasks

3.2.1.1. Reading difficulties. The Portuguese version of the Adult Reading History Questionnaire (Questionário de Hábitos de Leitura; QHL; Alves & Castro, 2005) was administered as a measure of self-reported reading difficulties. This questionnaire is composed of 25 Likert-type items that explore the participant´s reading history and current reading habits on a 0-4 scale, with a possible maximum score of 100. The higher the score, the stronger the complaint and potential risk of reading difficulties.

3.2.1.2. Phonological Decoding, Word Reading and Reading Fluency. The Reading Fluency Subtest of ADLER Battery (Faísca et al., 2019) was applied. All five conditions were used: high-frequency words (60 consistent and 30 inconsistent words), low-frequency words (60 consistent and 30 inconsistent words), medium-frequency consistent words, medium-frequency inconsistent words and pseudowords. Word frequency was derived from the European Portuguese lexical corpus (Procura-Palavras; P-PAL; Soares et al., 2018). High-frequency words ranged from 30.41 to 692.02 occurrences per million, low-frequency words ranged 0.01 to 3.47 occurrences per million and medium-frequency words ranged from 4.14 to 19.43 occurrences per million. Pseudowords were derivations of high-frequency consistent words, through rearrangement of syllables.

The subtest was computer-driven, and the Presentation® *software* (version 21.1) was used to present the instructions and the stimuli. There were 90 words/pseudowords per condition, divided in 6 sheets (15 words per sheet, 10 consistent and 5 inconsistent for the mixed lists). Throughout each condition, words increased in difficulty, regarding length (2-5 syllables) and syllabic structure (with and without consonant clusters) as the participant progressed. When the participant reached the end of each sheet, they pressed the space bar for the next sheet to appear. Participants had 30 seconds to read aloud as many stimuli as possible and, when this time elapsed, the task automatically finished.

Before the first condition, participants read task instructions and performed a training trial. Phonological decoding was computed as the percentage of correctly read pseudowords, and word reading as the average percentage of correctly read words on the four real word conditions (accuracy measures). Reading fluency was computed as the average correctly read words/pseudowords on the five conditions (speed measure). Faísca

et al. (2019) reported test-retest correlation coefficients that ranged from .55 to .70 (*M* = .63).

3.2.1.3. Reading Comprehension. A reading passage (Stocker, 2016) was translated into Portuguese and further adapted. Reading comprehension questions were developed according to Day and Park (2005) taxonomy and scoring criteria were agreed between the author and the supervisors.

The text had 495 words and was called "Anne Frank" (Appendix A). This topic was found appropriate, because it is well-addressed in Portuguese basic and secondary education, thus guaranteeing similar levels of background knowledge among the sample. Three domains of reading comprehension were assessed: literal, inferential and vocabulary (see Appendix B for the instructions and questions).

Inferential comprehension questions were divided into those that the participant had to infer based on implicit textual information (intratextual inference; four questions) and those where the participant had to activate background knowledge (extratextual inference; four questions). Literal comprehension questions were about facts in the text (eight questions). Vocabulary questions assessed the ability to deduce the meaning of an ambiguous word in context (four questions). Vocabulary words ranged from low-to-high frequency (0.21 to 72.90 occurrences per million; *M* = 21.78 occurrences per million) to control for a meaning deduction based on familiarity. All selected words had two or more possible meanings, according to the Dicionário de Língua Portuguesa (2017), and only one was considered correct. There was a total of 20 comprehension questions.

The examiner explained that a reading comprehension test was about to take part, where participants had to read a text silently and after, answer aloud to comprehension questions. Participants were also advised to refer back to the text at any time during question answering. Then, the participant was asked to begin reading and would notify the examiner when finished. Reading time (minutes and seconds) was recorded. Silent reading was chosen because it is expected that this method fosters comprehension, as the reader can allocate most cognitive resources to extracting meaning, instead of pronunciation or prosody (Hale et al., 2010). Questions could always be repeated if the participant did not understand. The order of the questions was fixed for all participants and there was no time limit to answer questions.

Answers were scored with 0, 1 or 2 points, if the answer was completely incorrect, partially correct, or completely correct, respectively. Partially correct answers are

considered incomplete or have decreased transparency of the target-idea. This scoring procedure was used to assure more variability, as a means to increase reliability coefficients, since reading comprehension tasks are often limited by low-reliability levels (Braze et al., 2007). Reading comprehension was computed as the total of correct answers, with a possible maximum of 40 points. Despite being superior to Faísca et al. (2019) (α = .24), Cronbach's alpha for this task was .49, and also showed poor reliability.

3.2.2. Reading-Related Tasks

3.2.2.1. Oral Language Comprehension. In studies that investigate the relationship of oral language comprehension with reading comprehension, measures should be well-calibrated with one another (Braze et al., 2007). Thus, efforts were made to equate these tasks, regarding scoring and following the taxonomy of Day and Park (2005). For this task, passages were adapted, and comprehension questions were developed. Presentation® software (version 21.1) was used to give the instructions and deliver the auditory stimuli.

The passages were adapted from Vilas-Boas and Vieira (2017) and had the topic of Fernando Pessoa biography (a Portuguese poet, writer and translator) (Appendix C). This topic was selected because it is a part of the curricular content of Portuguese basic and secondary education, so the present sample´s background knowledge should not differ.

The passages were recorded and played twice through headphones. All the passages had a relative similar length of words (42.17 ± 8.4, range = 35-55), [H (5) = 5, p = .416]. A sheet with the questions was provided to the participants, at the beginning of the task. It was explained that they had to respond orally to those questions, based on information present on auditory passages. The participants could silently read the questions beforehand and during the listening of the passages to scan them for relevant information. Repeating the passages was done to avoid working memory constraints. After answering the questions, participants pressed the space bar to listen to the next passage

There was a total of 12 questions (see Appendix D for instructions and questions), two for each passage (total of 6 passages). However, questions 1 (passage 1) and 5 (passage 3) were later removed from the analysis because they showed clear ceiling effects. The comprehension questions assessed literal comprehension (two questions), knowledge of vocabulary in context (three questions), intratextual inference (three

questions) and extratextual inference (two questions). Vocabulary words range from low-to-high frequency (2,08 to 43,48 occurrences per million; *M* = 17.51 occurrences per million) to control for a meaning deduction based on familiarity. All selected words had two or more possible meanings, according to the Dicionário de Língua Portuguesa (2017) and only one was considered correct.

Answers were scored with 0, 1 or 2 points, if the answer was completely incorrect, partially correct, or completely correct, respectively. The sum of all correct answers, with a maximum of 20, was taken as an oral language comprehension measure. Cronbach´s alpha was .40, showing poor reliability.

3.2.2.2. Phonological Awareness. Three phonological awareness tasks were used (Faísca et al., 2019). All the stimuli were auditorily presented through headphones and Presentation® software (version 21.1) was used to deliver the stimuli, present the instructions, and register accuracy and response times. In the three tasks, participants would respond orally, and then press the space bar to listen to the next set of stimuli. The tasks were self-paced, and there was no time limit to respond. All responses were registered by the examiner. Participants´ performance was always computed as the sum of correctly given answers. Before the tasks, participants performed training trials.

3.2.2.2.1. Phoneme Deletion. Participants must repeat 36 target pseudowords in three conditions (without the initial, middle or last phoneme). Each condition comprises 12 pseudowords that increase in length (one to three syllables) and syllabic structure (with or without consonant cluster). One point is given for each correct answer, with a maximum of 36 points.

3.2.2.2.2. Spoonerisms. Participants must shift the initial sound of two orally presented words and verbalize the resulting two words (e.g., *são-cal* to *cão-sal*). The pairs of words can have one to five syllables of length and are presented in a pseudorandomized order. There is a total of 24 pairs of words. One point is given if the participant can swap the sound correctly in just one of the words and two points are given if both words´ sounds are swapped correctly. A maximum of 48 points can be given.

3.2.2.2.3. Phonological Acronyms. Participants must listen to 30 pairs of words and verbalize the syllable that results from the combination of the first sounds of the two

words (e.g., Banco *Oval* would result in the syllable /bo/). One point is given for each correct answer, with a maximum of 30 points.

All tasks showed moderate to strong correlations (Mean $r = .53$; all $p < 0.01$), so accuracy scores were transformed into z-scores and a phonological awareness composite was made, representing the mean z-score of the three tasks. Faísca et al. (2019) reported test-retest correlation coefficient that ranged from .67 to .78 and Cronbach's alphas that ranged from .70 to .90 for these tasks, indicating good reliability.

3.2.2.3. Rapid Automatized Naming (RAN). A digit naming and a letter naming task were used (Alves et al., 2007). Each task includes five stimuli repeated 10 times horizontally, making a total of 50 items per task. Participants were asked to name the stimuli aloud, as accurate and fast, as possible. A practice trial was carried out before the two main tasks. As these tasks correlated strongly and significantly ($r = .737$, $p < .01$) a RAN composite was made, representing the average correctly read items per second in these two tasks. The previously correlation was also used as a reliability index.

3.2.2.4. Morphological Awareness. We developed three computer-driven tasks on Presentation® software (version 21.1). These tasks were based on Cavalli et al. (2016) procedures and accessed explicit morphological awareness, as they required extracting the base word from a derived form (Martin et al., 2014).

In the three tasks, all words were nouns, in the singular form, and had a regular grapheme-phoneme conversion, to ensure that performance was based on morphology. Moreover, word frequency was manipulated and/or controlled to minimize possible cofounding. Also, suffixed words within suffixation cases were matched for phonological/orthographic shift[6]. Additionally, words within suffixation/prefixation cases were matched for length, having three of four syllables.

Word definitions and respective etymology were found on the Portuguese Language Dictionary (Dicionário de Língua Portuguesa, 2017), and grammatical subclass, grammatical number, number of syllables, word frequency and phonological

[6] The reading of morphologically complex words can be influenced by changes on the phonology/orthography, from the base word to the derived form. There are words with zero shifts (e.g., loyal-loyalty), one shift on phonology (e.g., sign-signature), one shift on orthography (e.g., pity-piteous) or shifts on both orthography and phonology (e.g., mature-maturation) (Wilson-Fowler & Apel, 2015)

transcription were based on the European Portuguese lexical corpus (P-PAL; Soares et al., 2018). All the words were pre-recorded and played through headphones to avoid aiding the participants in word base extraction by word reading and possible cofounding with word reading skills (Cavalli et al., 2016).

Before the morphological awareness tasks, participants were instructed on the definitions of base words, affixes (suffixes and prefixes), suffixed and prefixed words and pseudoaffixed and pseudosuffixed words. Tasks were always presented in this order: suffixation decision task; suffixed word detection task and prefixed word detection task.

3.2.2.4.1. Suffixation Decision Task. Thirty-two words were orally presented to the participant, half being morphologically complex, suffixed (e.g., *carteiro*) and half being morphologically simple and pseudosuffixed (e.g., *dinheiro*) (Appendix E). Pseudosuffixed words have a suffix-like ending but are monomorphemic (Martin et al., 2014). Also, half of the 32 words had high frequency (94.40 ± 64.52) and the other half had low frequency (1.53 ± 1.27). High and low frequency words differed significantly in frequency (U = 0, $p < .001$).

The frequency was then matched between suffixed and pseudosuffixed conditions. Suffixed and pseudosuffixed words within frequency cases did not differ significantly for high frequency suffixed and pseudosuffixed words ($U = 25$, $p = .462$) and for low frequency suffixed and pseudosuffixed words ($U = 30$, $p = .834$). The frequency of base words ranged from 0.91 to 531.87, with a majority of high-frequency base words (68.75%).

Firstly, a cross appeared in the middle of the screen for 250ms and then the participant heard the stimulus. Immediately after hearing the stimulus, a screen would appear with the question “Was the listened word suffixed?”. The participants´ task was to decide if the word was suffixed or not, by pressing the right control key or the left control key, respectively (this was reversed for left-handed participants). Participants were instructed to respond as fast and accurately as possible. Then, a 1100ms intertrial interval would separate the participant response from the beginning of the next trial. The order of presentation was pseudorandomized and fixed across participants. Before the task, participants trained with four example words and oral feedback was given.

Accuracy and reaction times were analysed. Only the reaction times for correct answers were considered. Reaction times for each participant were turned into logarithmized z-scores, to search for possible outliers. Then, reaction times above 2.5 SD

(standard deviations) (12 data points) or under -2.5 SD (three data points) were deleted and treated as missing values. Answers given under -2.5 SD were considered to be anticipations, and the respective accuracy scores were deleted and treated as missing values. Three participants had missing accuracy values, so accuracy scores were calculated as the percentage of correctly answered items.

3.2.2.4.2. Suffixed Word Detection Task. Twelve triplets (groups of three words) were orally presented to the participant (Appendix F). Half the triplets included high-frequency words (95.03 ± 98.92), and the other half, low-frequency words (1.59 ± 1.37). High and low frequency words differed significantly (U = 0, $p < .001$). Within triplets, there was one suffixed word and two pseudosuffixed words. The frequency was then matched between suffixed and pseudosuffixed words. Suffixed and pseudosuffixed words within frequency did not differ significantly: high frequency suffixed *vs.* pseudosuffixed words [H (2) = 0.88, $p = .645$] and low frequency suffixed *vs.* pseudosuffixed words [H (2) = 4.83, $p = .089$]. The frequency of base words ranged from 2.52 to 529.56, with a majority of high-frequency base words (66.67%).

Firstly, a cross appeared in the middle of the screen for 250ms and then the participants heard the triplet. Words within triplets were presented one by one, with a one-second pause between words. Triplets would always be presented twice, with two seconds between them, to avoid working memory constraints. Immediately after hearing the triplet by the second time, a screen would appear with the question "Which one of the listened words is suffixed?". The participants had to detect the word that was suffixed, by pressing either the 1, 2 or 3 keys on the computer keyboard, if the suffixed word was the first, second or third, respectively. Participants were instructed to respond as fast and accurately as possible with the preferred hand. Then, an 1100 ms intertrial interval would separate the participant response from the beginning of the next trial. The order of words within the triplets was fixed, but the order of the triplets was randomized. Before the task, participants trained with two example triplets and oral feedback was given.

Accuracy and reaction times were analysed. Only the reaction times for correct answers were considered. Reaction times for each participant were turned into logarithmized *z*-scores, to search for possible outliers. Then, reaction time above 2.5 SD (11 data points) were deleted and treated as missing values. In this case, fast answers were not considered to be outliers or anticipations, as the participant listened to each triplet twice and could have the answer prepared as soon as the response screen appeared.

Because two participants had missing accuracy values, accuracy scores were calculated as the percentage of correctly answered items.

3.2.2.4.3. Prefixed Word Detection Task. Seven triplets were orally presented to the participant (Appendix G). Each triplet included a prefixed word and two pseudopreffixed words. All the words in this task were of low frequency (2.09 ± 1.73) because it was not possible to find enough high frequency prefixed words to pair with the low frequency prefixed words. Frequency was matched between suffixed and pseudosuffixed words [H (2) = 2.76, p = .251]. Base word frequency ranged from 13.48 to 355.50, with a majority of high-frequency base words (71.43%).

The procedure was the same as in the suffixed word detection task, except that the question on the screen was "Which one of the listened words is prefixed?". This task was later removed from all analyses as all items presented clear ceiling effects and reliability levels were unacceptable (Cronbach´s alpha was negative).

The suffixation decision and the suffixed word detection tasks correlated moderately and significantly (r = .383, p = .001) so accuracy scores were turned into z-scores and a morphological awareness composite score was created, averaging the accuracy z-scores in those two tasks. Since accuracy scores varied in the same manner (0-1), Cronbach´s alpha was calculated using all the items from the two tasks (44 items, α = .49), showing poor levels of reliability.

3.2.3. Cognitive Tasks

3.2.3.1. Auditory Working Memory. The backward condition of the Digit Span subtest of the WAIS-III (Weschler, 1996; Weschler, 2008; Portuguese version) was used to assess working memory. This was done because the forward condition is a measure that only considers storage of information, while the backwards condition implicates storage and manipulation of information (Novaes et al., 2019; Nouwens et al., 2016). Participants must repeat aloud increasingly higher sequences of numbers, but in the inverse order. Each sequence length has two trials and after the participant fails the two trials of the same length, the task is ended. The sum of the scores on the backward condition were used as a working memory measure.

3.2.3.2. Vocabulary. The Vocabulary subtest of the WAIS-III (Weschler, 1996; Weschler, 2008; Portuguese version) was used to measure vocabulary knowledge. This

subtest requires that the participant gives an oral definition of a maximum of 33 increasingly difficult words. The participant's answer is scored with 0, 1 or 2 points. If the participant's answer is scored with 0 points for six straight answers, the task is discontinued. In the present work, raw scores were converted to standardized scores, based on the WAIS-III age groups (Portuguese Version) and used as a vocabulary knowledge measure.

3.3. Procedure

The sample of the present study was composed of a group of participants from Faísca et al. (2019; ADLER Battery). Measures of phonological awareness, RAN, phonological decoding, working memory, word reading, reading fluency, vocabulary and non-verbal IQ were taken from the ADLER's session. Non-verbal IQ was measured by the sum of the standardized scores from the Block Design, Matrix Reasoning, Picture Completion and Digit Symbol Coding subtests from the WAIS-III (Weschler, 1996; Weschler, 2008; Portuguese version)

Although the ADLER Battery included two reading comprehension tasks, the Test of Reading Age (Teste de Idade de Leitura; TIL; Fernandes et al., 2017b) fits better as a reading fluency measure for comprehension (Faísca et al., 2019) and the History of Chocolate reading comprehension task presented low levels of reliability (Faísca et al., 2019), so a new reading comprehension task was developed for the present study.

Normative readers were selected and contacted to participate in the present study. For those who agreed, an additional session took place, to administer the new tasks. The tasks were always administered and scored by the author of the present study and the order of administration was fixed for all participants (reading comprehension, oral language comprehension, and morphological awareness).

Before the administration of the tasks, informed consent information was given to the participants (Appendix H), according to the current Portuguese personal data protection law (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 (General Data Protection Regulation) approved by law number 58/2019, 8th of August). This document provided information regarding the proposal of the study, description, and methodology, as well as personal data handling. Furthermore, participants were informed that their participation was voluntary and that they were free to leave the process at any time. Finally, confidentiality and anonymity of the collected

data were assured. Moreover, participants also filled a questionnaire with relevant sociodemographic information.

3.4. Data analysis

For the present study, regression and path analyses approach were used to test the hypothesized extended SVR models and the mediation models. Path analysis is a statistical method that was developed to study simultaneously the direct and indirect effects of a set of independent variables on one or more dependent variables (Olkin & Sampson, 2001; Streiner, 2005). The results of this analysis provide estimates of the magnitude and significance of hypothesized relationships (*paths*) among variables (Mellard et al., 2010). Path analysis has been used in studies that aim to examine the predictors of reading comprehension, both in children (e.g., Fernandes et al., 2017a) and adults (e.g., Mellard et al., 2010).

The main purpose of path analysis is to test if a multivariate set of nonexperimental data fits well with a causal model (hypothesized *a priori*) (Pedhazur, 1997). In these models, variables can be the cause or effect (Olkin & Sampson, 2001). Since linear relations between variables are based on correlations, causality is still hypothetical (Pedhazur, 1997). When multiple variables are included in a model, path analysis is adequate to examine "chains" of influence, that is, when a variable influences another variable, that in its turn influences a third variable (Streiner, 2005), these paths of influence being called indirect. Alternatively, when a variable influences another, that represents a direct path of influence.

Exogenous variables only have unidirectional arrows emerging from them to endogenous variables, because their variance is assumed to be caused entirely by variables not in the causal model (Streiner, 2005). However, correlations between exogenous variables can still be expected and are represented with bidirectional arrows (Streiner, 2005).

To test a mediation model, first a full mediation model (direct effects are restricted to zero, except the direct effects involving the mediator) is estimated, to check for non-null indirect effects (using bootstrap procedures based on 2000 samples). If indirect effects exist, the full mediation model is compared to the partial mediation model (direct effects are freed). Significant goodness-of-fit differences between these models (using the chi-square statistic) will indicate that restricting the direct effects to zero hinders the model´s adjustment, and so the total mediation model cannot be accepted, and direct paths

should be maintained (partial mediation). Contrarily, non-significant differences indicate that restricting the direct effects to zero does not hinder the model´s adjustment and so full mediation can be assumed. The *p*-value for a chi-square statistic was computed by an online chi-square distribution calculator (DI Management, 2020).

Besides the path analyses, descriptive and correlational statistics were performed. Cohen´s (1988) guidelines for the strength of correlations in behavioural sciences were followed, with coefficients between .10 and .30 expressing weak correlations, coefficients between .30 and .50 moderate correlations, and coefficients above .50 considered to be strong correlations.

All data were processed using the IBM SPSS Statistics (v.26) and IBM SPSS AMOS (v.26) software.

4. Results

4.1. Descriptive Statistics

Table 1 shows the descriptive statistics for all variables in study. Kline (2005) proposes that data with skewness value above 3.0 and kurtosis value above 8.0 should be considered problematic, as these are indicators of marked deviation from a normal distribution. In the present study, skewness and kurtosis values were always below these stated values, which suggests that our data does not significantly deviate from normality. Scores on morphological awareness and phonological awareness measures were somewhat skewed to the left, but the visual inspection of their distribution (boxplot and histogram) indicates that the relatively high concentration of scores on the right may not be considered a ceiling effect, in both cases. Z-scores for measures of phonological decoding (M = 0.18, min = -2.58, max = 1.36), word reading (M = 0.19, min = -3.20, max = 2.06) and reading fluency (M = 0.13, min = -2.65, max = 3.00), were computed based on the scores of 150 normative adult readers (Faísca et al., 2019) and they indicate that, on average, the present sample does not deviate from the expected performance.

Table 1

Descriptive Statistics for the Variables in Study

Variables	Mean ± SD	Skewness	Kurtosis
RAN	3.04 ± 0.46	0.326	-0.592
Morphological Awareness	0 ± 0.83	-1.028	2.455
Phonological Decoding	93.77 ± 5.15	-0.638	-0.266
Phonological Awareness	0 ± 0.83	-2.034	6.527
Working Memory	7.13 ± 2.12	0.105	-0.066
Word Reading	96.83 ± 1.55	-0.860	2.271
Reading Fluency	1.67 ± 0.26	-0.033	-0.317
Vocabulary	10.67 ± 2.56	0.010	2.603
Oral Language Comprehension	11.47 ± 2.35	0.164	-0.218
Reading Comprehension	24.34 ± 4.23	0.144	-1.025

Note. RAN – Average of correctly read items per second (letter and digit naming lists), Morphological Awareness – Average of the z-scores for accuracy in the suffixation decision and suffixation detection tasks, Phonological Decoding – Percentage of correctly read pseudowords (pseudowords list of the ADLER Reading Fluency Subtest), Phonological Awareness – Average of the z-scores for accuracy in the phoneme deletion, spoonerisms and phonological acronyms tasks, Working Memory – Sum of scores from backward condition of the Digit Span subtest of the WAIS-III, Word Reading – Average percentage of correctly read words (real word lists of the ADLER Reading Fluency Subtest), Reading Fluency – Average of correctly read words per second (all lists of the ADLER Reading Fluency Subtest), Vocabulary - Standardized scores from the Portuguese Version of the WAIS-III (Vocabulary subtest), Oral Language Comprehension – Sum of correct answers (max = 20; Fernando Pessoa task), Reading Comprehension – Sum of correct answers (max = 40; Anne Frank task).

4.2. Correlations

Table 2 shows the correlation matrix for all the studied variables. Correlations among predictors were always positive (except for the null correlation between RAN and morphological awareness, r = -.01, p = .918), but not always significant. Significant correlations ranged from weak to moderate.

Predictors correlated significantly with reading comprehension, with the exceptions of phonological decoding and RAN. All significant correlations were positive and moderate and ranged from .30 (reading fluency) to .47 (oral language comprehension).

Table 2

Correlation Matrix for the Variables in Study

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. RAN	1	-.01	.08	.09	.06	.06	.47**	.14	.07	.11
2. Morphological Awareness		1	.17	.35**	.05	.18	.15	.15	.23	.34**
3. Phonological Decoding			1	.33**	.19	.40**	.23	.02	.00	.06
4. Phonological Awareness				1	.50**	.29*	.26*	.35**	.23	.35**
5. Working Memory					1	.26*	.34**	.34**	.37**	.36**
6. Word Reading						1	.34**	.36**	.27*	.34**
7. Reading Fluency							1	.31*	.25*	.30*
8. Vocabulary								1	.27**	.42**
9. Oral Language Comprehension									1	.47**
10. Reading Comprehension										1

*p <. 05, **p < .01

4.3. SVR model

Figure 3 shows the SVR model, with standardized path coefficients. This is a saturated model (0 degrees of freedom), so goodness of fit indexes could not be computed. Both word reading (β = 0.227) and oral language comprehension (β = 0.405) have a significant direct effect on reading comprehension. Together, these two predictors explained about 27% of variance in reading comprehension (R^2 = .266). Although the standardized coefficient for oral language comprehension seems to express a greater effect on reading comprehension compared to word reading, pairwise parameter comparisons showed that this difference was non-significant (critical ratio = 0.268, p > .05).

Bootstrap percentile confidence intervals (based on 2000 samples) for the two abovementioned regression weights were computed: effect of word reading on reading comprehension, β = 0.227, 95% CI (.038, .391); effect of oral language comprehension on reading comprehension, β = 0.405, 95% CI (.157, .713). Confidence intervals were rather wide and overlapped, suggesting that the magnitude of these effects cannot be considered reliably different.

4.4. Extended SVR model

To test if reading fluency and vocabulary could add a significant contribution to the SVR model, we performed a hierarchical regression analysis with two blocks. The first block contained the two main components of the SVR (word reading and oral language comprehension), and the second block included the measures of reading fluency and vocabulary. This regression model provided a solution that explains about 34% of the variance in reading comprehension, with the significant addition of near 7% of explained variance [R^2 = .335; R^2 change = .069; F change (2, 62) = 3.228, p = .046]. In this model, the effect of vocabulary on reading comprehension was significant (β = 0.256, p = .030) but not the effect of reading fluency (β = 0.091, p = .429). Also, the effect of word reading on reading comprehension was attenuated, losing its significance when reading fluency and vocabulary were considered (β = 0.227, p = .045 in the first block and β = 0.122, p = .297 in the second block). The effect of oral language comprehension on reading comprehension maintains its significance e in the presence of reading fluency and vocabulary (β = 0.342, p = .003).

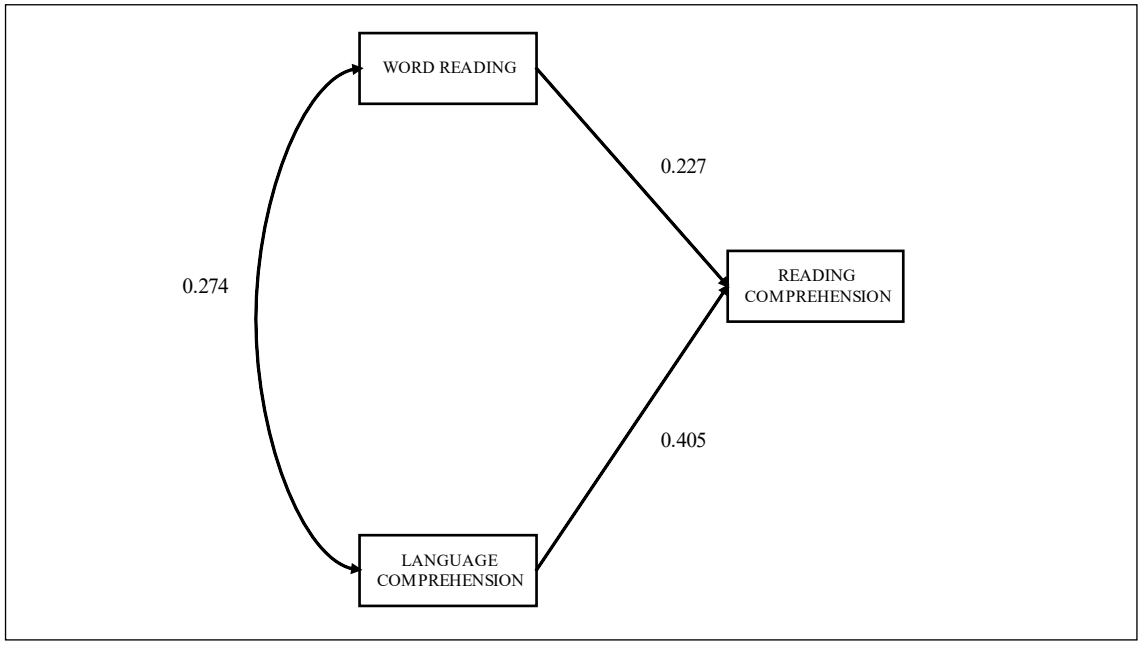
The path analysis of the extended SVR model (Figure 4) helps to elucidate the consequences of including reading fluency and vocabulary to explain reading comprehension. Chi-square goodness of fit statistic was non-significant for this model [χ^2 (2) = 3.814, p = .149]; the other indexes used to assess the model's goodness of fit were the Comparative Fit Index (CFI = .961) and the Root Mean Square Error of Approximation (RMSEA = .117). CFI values higher than .9 indicate an acceptable fit (Hu & Bentler, 1999), while RMSEA should be lower than .05 to verify a good fit, with values between .05 and .08 suggesting a reasonable fit (Browne & Cudeck, 1993; MacCallum et al., 1996). So, considering that RMSEA is known to be too restrictive when the model has a small number of degrees of freedom and a small sample size (Kenny et al., 2014), and considering the Chi-square and CFI indexes, we can assume the extended SVR model depicted in Figure 4 represents the sample data adequately.

Table 3 shows the standardized and unstandardized path coefficients, plus the standard errors, for the paths in our extended SVR model. Five out of the eight hypothesized paths were significant. Lastly, Table 4 shows the standardized direct, indirect, and total effects of the variables on reading comprehension. Overall, word reading does not have a direct effect on reading comprehension, exerting its indirect

influence mainly though vocabulary. Vocabulary influences reading comprehension both directly and through oral language comprehension.

Figure 3

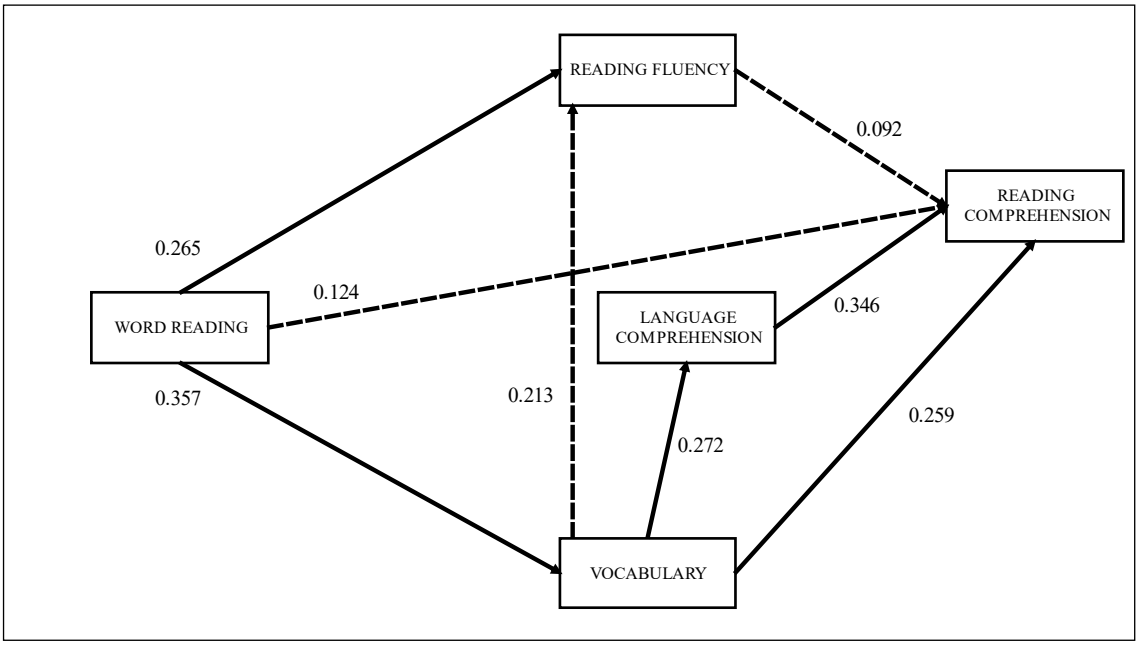
SVR Model with Standardized Path Coefficients



Note. [χ^2 (0) = 0, since the model is saturated]. Dashed lines represent non-significant paths; Solid lines represent significant paths ($p < .05$).

Figure 4

Extended SVR Model With Standardized Path Coefficients



Note. [χ^2 (2) = 3.814, p = .149]; Comparative Fit Index (CFI) = .961; Root Mean Square Error of Approximation (RMSEA) = .117. Dashed lines represent non-significant paths; Solid lines represent significant paths ($p < .05$).

Table 3

Unstandardized and Standardized Path Coefficients for the Extended SVR Model

Paths	**Unstandardized**	**Standard Error**	**Standardized**	***p***
Word Reading → Reading Fluency	0.045	0.020	0.265	.028
Word Reading → Vocabulary	0.592	0.190	0.357	.002
Vocabulary → Reading Fluency	0.022	0.012	0.213	.078
Vocabulary → Oral Language Comprehension	0.250	0.109	0.272	.021
Word Reading → Reading Comprehension	0.079	0.072	0.124	.272
Reading Fluency → Reading Comprehension	0.349	0.421	0.092	.407
Vocabulary → Reading Comprehension	0.100	0.044	0.259	.024
Oral Language Comprehension → Reading Comprehension	0.145	0.044	0.346	.001

Table 4

Standardized Direct, Indirect, and Total Effects of Predictors on Reading Comprehension, in the Extended SVR Model

Variable	Direct (*p*)	Indirect (*p*)	Total (*p*)
Word Reading	.124 (.169)	.158 (.019)	.281 (.017)
Reading Fluency	.092 (.438)	-	.092 (.438)
Vocabulary	.259 (.018)	.114 (.035)	.373 (.010)
Oral Language Comprehension	.346 (.019)	-	.346 (.019)

4.5. Effects of the Remaining Predictors on Reading Comprehension

Since RAN and phonological decoding did not correlate significantly with reading comprehension, they were not included in the following mediation models. Thus, the effects of phonological awareness, morphological awareness and working memory on reading comprehension were tested, to verify if direct effects on reading comprehension exist, or if these effects were totally mediated by word reading and reading fluency. To test our mediation hypotheses, two models were tested: 1a – full mediation through word reading and reading fluency and 1b – partial mediation through word reading and reading fluency.

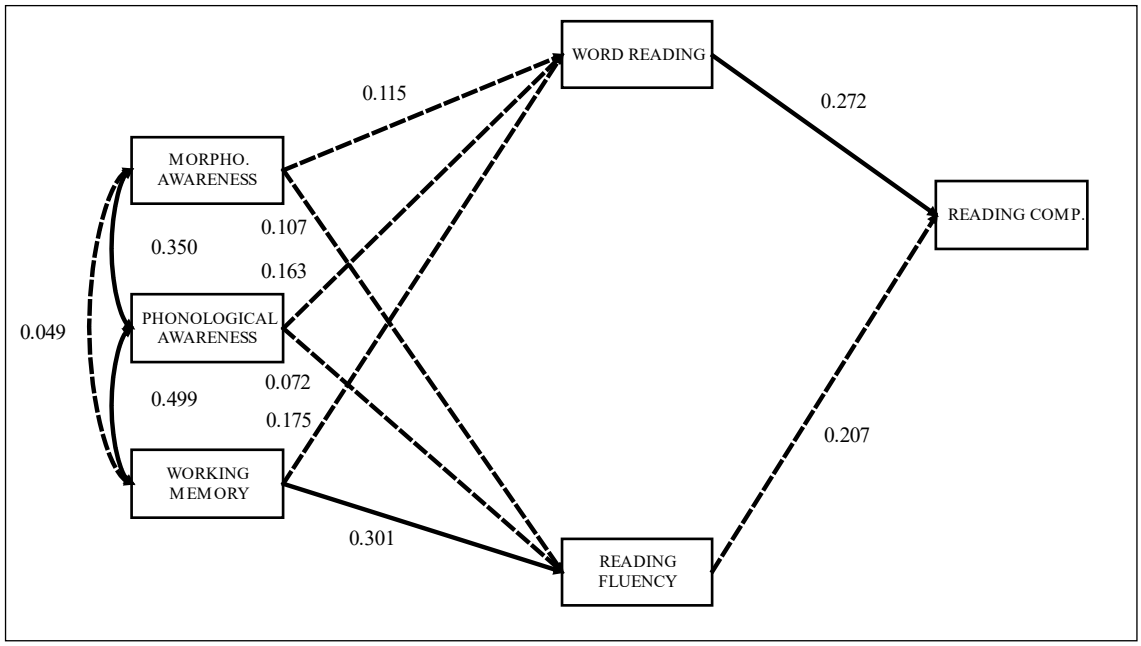
Figures 5 and 6 show the graphical presentation of the mediation models, with standardized path coefficients. Table 5 shows the models´ goodness of fit indexes and the *p*-values for the comparisons between full and partial mediation models. Chi-square statistics were significant in both models ($p < .05$), indicating a poor model fit. CFI value indicates a good fit only for the partial mediation model (> .9). Again, as expected due to the small number of degrees of freedom (Kenny et al., 2014), RMSEA index suggests a poor model fit (>.05) in both models. However, the crucial step in this analysis is to compare the two models. The difference in chi-square statistics between total and partial mediation models was significant ($p < .05$), suggesting that word reading and reading fluency did not completely mediate the relation between morphological awareness, phonological awareness, working memory and reading comprehension.

Table 6 shows the standardized direct, indirect, and total effects of predictors on reading comprehension, in the mediation models. Indirect effects on reading comprehension through word reading and reading fluency were null, except for working memory (model 1a; $\beta = 0.110$, $p = .045$). When direct effects were allowed (model 1b), morphological awareness displayed a significant direct effect on reading comprehension

(model 1b; β = 0.259, *p* = .023). Phonological awareness showed no significant indirect or direct effects on reading comprehension. Concerning the mediators, only word reading showed a significant direct effect on reading comprehension in the full mediation (model 1a; β = 0.272, *p* = .035). Conversely, in the partial mediation model, the direct effect of word reading lost its statistical significance (model 1b; β = 0.177, *p* = .167).

Figure 5

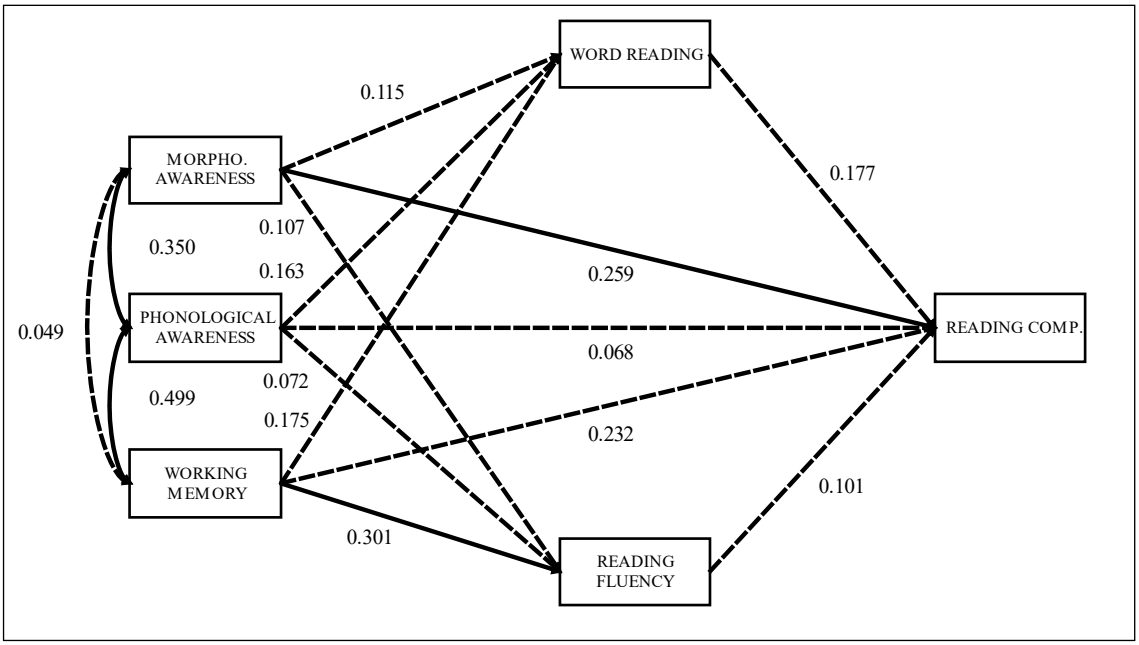
Full Mediation by Word Reading and Reading Fluency Model, With Standardized Path Coefficients



Note: [χ^2 (4) = 15.641, *p* = .004]; Comparative Fit Index (CFI) = .800; Root Mean Square Error of Approximation (RMSEA) = .210; Dashed lines represent non-significant paths; Solid lines represent significant paths (*p* < .05).

Figure 6

Partial Mediation by Word Reading and Reading Fluency Model With Standardized Path Coefficients



Note: [χ^2 (1) = 4.417, p = .036]; Comparative Fit Index (CFI) = .941; Root Mean Square Error of Approximation (RMSEA) = .228; Dashed lines represent non-significant paths; Solid lines represent significant paths (p < .05).

Table 5

Model Fit Indicators for the Mediation Models and Comparisons Between Full and Partial Mediation Models

Models	χ^2(df), p	CFI	RMSEA	Comparisons
1a - Full mediation by word reading and reading fluency	15.641(4), .004	.800	.210	-
1b - Partial mediation by word reading and reading fluency	4.417(1), .036	.941	.228	$\Delta\chi^2$ = 11.224, Δdf = 3, p = .011

Note. df = degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation.

Table 6

Standardized Direct, Indirect, and Total Effects of Predictors on Reading Comprehension, in the Full Mediation (1a) and Partial Mediation (1b) Models

	Model 1a			Model 1b		
Variable	**Direct (*p*)**	**Indirect (*p*)**	**Total (*p*)**	**Direct (*p*)**	**Indirect (*p*)**	**Total (*p*)**
PA	-	.059 (.273)	.059 (.273)	.068 (.575)	.036 (.259)	.104 (.436)
MA	-	.053 (.282)	.053 (.282)	.259 (.023)	.031 (.280)	.291 (.025)
WM	-	.110 (.045)	.110 (.045)	.232 (.114)	.062 (.109)	.293 (.032)
WR	.272 (.035)	-	.272 (.035)	.177 (.167)	-	.177 (.167)
RF	.207 (.073)	-	.207 (.073)	.101 (.382)	-	.101 (.382)

Note. PA = Phonological Awareness; MA = Morphological Awareness; WM = Working Memory; WR = Word Reading; RF = Reading Fluency. Model 1a – full mediation through word reading and reading fluency; Model 1b – partial mediation through word reading and reading fluency.

5. Discussion

Research on the predictors of reading comprehension has been largely carried out with samples of school-aged children (Tighe & Schatschneider, 2017). This might be problematic because it leads to the development of theoretical models or interventions that are unsuitable for adult populations, as it is known that these age-groups rely on different cognitive processes when reading (Greenberg et al., 2002). Moreover, models that predict reading comprehension are often developed in opaque orthographies, such as English. The transparency of the orthography affects the weight of the contribution of predictors on reading comprehension (Florit & Cain, 2011), so testing reading comprehension models in more transparent languages (such as European Portuguese) might be relevant. Lastly, the SVR model (Gough & Turner, 1986), despite some cases of adequate percentages of explained variance of reading comprehension in both children (e.g., Catts et al., 2005) and adults (e.g., Sabatini et al., 2010), has been often criticized for being too simplistic, and other components have been suggested (e.g., vocabulary and reading fluency; Sabatini et al., 2010).

Considering these limitations, we set out to examine the relations between several reading-related predictors and reading comprehension in European Portuguese speaking adults, and how do they relate among them. For that, we selected a set of predictors (word reading, reading fluency, vocabulary, oral language comprehension, rapid automatized naming (RAN), phonological decoding, phonological awareness, morphological awareness and working memory) that were identified in Tighe and Schatschneider's

(2016) meta-analysis on the relative importance of reading-related predictors of reading comprehension in English adult struggling readers.

Initially, we analysed correlations between predictors and reading comprehension. Then, we tested the original SVR model (word reading and oral language comprehension as unique predictors of reading comprehension), hypothesizing that oral language comprehension would make a greater contribution to reading comprehension, compared to word reading. Also, an extended SVR model was tested, to analyse how two commonly suggested additions to this model (reading fluency and vocabulary) relate to the elements of the SVR in the Portuguese adult population and to verify if this inclusion would provide a significant contribution to explaining variance in reading comprehension. Lastly, additional mediation models were tested, to see if the effects of the remaining variables at study (RAN, phonological decoding, morphological awareness, phonological awareness and working memory) on reading comprehension were direct or mediated by word reading and reading fluency. We hypothesised that all predictors would have mediated effects, except morphological awareness, which should show a direct effect on reading comprehension.

All the predictors selected for our study correlated significantly, positively and moderately with reading comprehension as was expected considering the reviewed literature (see, for example, Tighe and Schatschneider, 2016), with the exceptions of RAN and phonological decoding (non-significant correlations). The absence of a significant correlation between phonological decoding and reading comprehension (r = .06) could be partially explained by the transparency of the European Portuguese orthography in the print-to-reading conversion. In more transparent orthographies such as Portuguese, the grapheme-phoneme conversion is simpler, allowing readers to achieve fluent decoding since the first school years (Florit & Cain, 2011). When fluent reading is achieved, reading performance no longer depends on grapheme-phoneme rules, and therefore correlations between phonological decoding and reading comprehension lose strength. This might be an explanation for the null correlation between phonological decoding and reading comprehension in the present study.

The absence of a significant correlation between RAN and reading comprehension in our study (r = .11) could be a result of reading expertise. Tighe and Schatschneider (2016) contrasted the correlations in their meta-analysis with correlations presented in samples of children included in the National Early Literacy Panel (NELP; 2008) and found that RAN was weakly related to reading comprehension in the samples of

struggling adult readers (average r = .15), but this correlation has a moderate magnitude for NELP samples (average r = .43 for RAN letters and digits). Tighe and Schatschneider (2016) hypothesized that this divergence in the magnitude of the correlations between children and adult should be due to grade level. Similarly, the meta-analysis conducted by Araújo and colleagues (2014) reported a moderate average correlation of .39 (95% CI: .34 to .44) for the association between RAN and reading performance in children. Overall, these results show that while RAN maintains a moderate positive correlation with reading comprehension in children, this association loses its strength in adulthood, suggesting a moderation effect of reading expertise or grade level.

To understand this moderation effect, we could hypothesize that RAN affects reading comprehension mostly in an indirect manner, via reading fluency, since RAN is a well-known predictor of reading fluency (Savage, & Frederickson, 2005). In the early school years, while fluent reading is not yet achieved, reading fluency is an important predictor of the variance in reading comprehension, as well as its strongest associate (RAN). However, in higher grade levels, readers have already achieved proficient reading fluency, showing similarly high levels of fluency, and consequently reading fluency will show a reduced effect on reading comprehension. In this case, it is expected that the effect of RAN on comprehension also loses its strength. Thus, considering its developmental path across education levels, the abovementioned correlation between RAN and reading comprehension in children (moderate strength) and adults (weak strength) make more sense.

Concerning the simple SVR model, our results demonstrated that both word reading and oral language comprehension displayed direct and significant effects on reading comprehension, with the latter displaying a stronger effect ($\beta = 0.227$, $\beta = 0.405$, respectively), apparently confirming our hypothesis. However, inferential procedures (pairwise parameter comparisons and bootstrap percentile confidence intervals) indicate that this difference cannot be considered statistically significant (perhaps due to the lack of statistical power). Taking that into consideration, we suggest that the putative superior contribution of oral language comprehension to reading comprehension should be interpreted with caution until further studies can provide additional and more robust evidence of this difference, namely with a larger and more representative sample of the Portuguese adult population.

The two components of the SVR model only explained about 27% of the variance in reading comprehension, contrasting with the higher values found in the literature (e.g.,

76% in Braze et al., 2007; 64% in Sabatini et al., 2010). A possible explanation for such differences might result from the samples used in the cited studies, namely English adult struggling readers, whose performance and consequent relative contribution of predictors on reading comprehension greatly differ from our sample. It is noteworthy that in our literature review we did not find any study addressing the direct test of the SVR model in a sample of adult normative readers. So, the comparison with the available studies involving populations of struggling adult readers should be done with precaution.

Another possible explanation for the small amount of explained variance by our SRV model may result from using exclusively observable variables, while other studies used latent variables (e.g., Braze et al., 2016; Sabatini et al., 2010) or composite measures (e.g., Braze et al., 2007) in their models, solutions that diminish measurement error and allow more reliable measures of the constructs. We employed composite measures only for some of our variables; furthermore, reliability coefficients for our oral language comprehension and reading comprehension tasks were not appropriate (Cronbach's alpha = .40 and .49, respectively). In the future, we should consider adopting methods to improve reliability in our measures, to lessen measurement errors and hence proving more accountability for the variance in reading comprehension.

The tested extended SVR model, including reading fluency and vocabulary, provided a significant addition of 7% of explained variance in reading comprehension. Nonetheless, vocabulary was the only one of the two added variables that showed a significant individual contribution, affecting reading comprehension directly and indirectly, through oral language comprehension. The inclusion of these new variables also caused the direct effect of word reading to become non-significant, demonstrating that word reading only affects reading comprehension indirectly. A more detailed analysis shows that this significant indirect effect happens mostly via vocabulary. Thus, this seems to suggest that at least in our adult sample, word reading accuracy effects on reading comprehension mostly reflect the association between reading accuracy and the acquisition of new word meanings.

Moreover, the direct effect of vocabulary on reading comprehension was expected. Fernandes et al. (2017a) findings in a sample of Portuguese children suggest that while reading fluency remains important from the 1st to the 6th grade, vocabulary emerges as a significant predictor since the 2nd grade, gaining importance throughout the school years, as reading fluency loses relevance. By the 6th grade, vocabulary´s importance catches up with reading fluency´s, and this tendency could go on as the reader

advances in schooling, with reading becoming more fluent and vocabulary size increasing. Indeed, in our sample of Portuguese adults with higher education, reading fluency was not a significant predictor of reading comprehension, while vocabulary showed significant direct and indirect (through oral language comprehension) effects. Once again, this suggests that, at least in more transparent orthographies, decoding skills are important in the early school years, until reading becomes fluent. Then, higher-order skills such as vocabulary emerge and remain important to achieve reading comprehension, throughout schooling.

Thus, the effect of vocabulary on reading comprehension, in our study, provides support for its addition as a separate component in the SVR model. Other studies that used path analysis (e.g., Mellard et al., 2010) or regression models (e.g., Braze et al., 2007) also support this idea. On the other hand, studies using confirmatory factor analyses (e.g., Sabatini et al., 2010) or latent variable analyses (e.g., Braze et al., 2016) suggested that the effect of vocabulary on reading comprehension is completely subsumed in oral language comprehension and should not be added as an additional component of the SVR. For instance, Braze et al. (2016) proposed that the observed effect of vocabulary on reading comprehension can be explained by the common low-reliability levels of oral language comprehension measures, which might not be capturing all aspects that are relevant for reading comprehension. In this way, vocabulary measures could be capturing those aspects that are missed by oral language comprehension measures. Our oral language comprehension measure presented low reliability, so this may be the case for our study. Thus, this significant effect of vocabulary on reading comprehension should be interpreted with caution, until other studies, with different statistical procedures or more reliable measures of oral language comprehension, can confirm its relevance in the SVR model.

To summarize, results from the present study provide preliminary evidence that the SVR model (with the possible addition of vocabulary) can reliably predict reading comprehension in a population of normative adult readers in a semi-transparent orthography, such as European Portuguese. However, the percentage of explained variance by the model is smaller than the reported in previous studies with English struggling adult readers, a difference that may be due both to the different levels of reading expertise of the samples or to orthographies' transparency. More studies are needed to verify the model´s adequacy in adult normative readers, and they should include proposals for additional inclusions for the SVR (e.g., inference making and

comprehension monitoring; Kim et al., 2017; 2020) as a way of increasing the percentage of explained variance of reading comprehension.

In the final mediation models, we wanted to test if the effects of the remaining variables at study (RAN, phonological decoding, morphological awareness, phonological awareness and working memory) on reading comprehension were direct or mediated by word reading and reading fluency. The total mediation hypothesis was clearly rejected, suggesting that word reading and reading fluency did not completely mediate the contribution of morphological awareness, phonological awareness and working memory to reading comprehension. As we hypothesized, morphological awareness was the only variable that presented a direct and significant effect on reading comprehension. The effect of morphological awareness on reading comprehension in adults is particularly relevant because, as Kirby and colleagues (2008) mention, this skill gains more importance as the reader progresses to more advanced levels of schooling. This is because as text exposure increases, so does the number of morphologically complex words that the reader may find, providing more opportunities for the use of morphological awareness skills (Kirby et al., 2008). Therefore, students in higher education (like the ones in our sample), having to cope with more complex terminology in their studies, should have plenty of opportunities to use morphological awareness to comprehend textual information.

Moreover, the direct effect of morphological awareness on reading comprehension in adults is well verified in more opaque orthographies (i.e., English; e.g., Fracasso et al., 2014; Wilson-Fowler & Apel, 2015). Note that in Tighe and Schatschneider's (2016) meta-analysis, considering five studies with English native and non-native speakers (avr. r = .59; 95% CI: .47 – .68; N = 336), morphological awareness was the strongest predictor of reading comprehension. In opaque orthographies, since grapheme-phoneme conversion is not consistent, the ability to manipulate morphemes aids in accurately reading morphologically complex words and comprehending the text. In more transparent orthographies such as Portuguese, decoding is easier, since grapheme-phoneme conversion is more consistent, and therefore morphological awareness is not so relevant to accurately read words, but still plays an important role in meaning extraction to achieve comprehension of what was read.

Furthermore, in the final mediation models, although individual direct and indirect (through word reading and reading fluency) paths were non-significant, working memory showed a significant total effect on reading comprehension. A direct effect of working

memory on reading comprehension is reasonable, since working memory is a system that, while reading, allows readers to store and manipulate important information from the text as they read and integrate new information with previously stored and processed information, being essential for inference-making based on textual cues and associations with background knowledge (Daneman & Merickle, 1996). Also, an indirect effect of working memory on reading comprehension, through word reading and reading fluency, makes theoretical sense. The larger the amount of information that readers can store and process continuously, the more accurate and faster they can read since they can quickly retrieve word pronunciations and meanings from their long-term memory. In its turn, reading fluency influences comprehension, freeing cognitive resources from word decoding, that can be allocated to extracting meaning (Perfetti, 1985).

Surprisingly, phonological awareness did not show a significant direct or indirect path of influence to reading comprehension in the final mediation models, even though it correlated significantly with reading comprehension. An explanation we could provide for this is that phonological awareness and working memory correlated moderately (r = .50, p < .01), sharing explained variance. This correlation probably reflects the working memory demands of phonological awareness tasks, as the participant typically needs to store and manipulate verbal information of increasing difficulty. In this way, phonological awareness could be reflecting the effects of working memory on reading comprehension, lessening its effect when the two predictors are considered together. In the future, other studies should try to disentangle the relations between these variables and reading comprehension.

It is also noteworthy that direct effects from word reading and reading fluency on reading comprehension became non-significant, when direct paths from phonological awareness, morphological awareness and working memory on reading comprehension were included, in the partial mediation model. This suggests that in this populations, accurate and rapid reading of word lists is no longer important, after accounting for the effects of other skills such as morphological awareness. This is probably due to the normative adult readers of the present sample most likely having attained ceiling levels of fluent decoding, and so differences in the accuracy or speed of word reading are no longer predictive of variances in reading comprehension.

Finally, as a way of providing a brief reflection about the potential application of the contributes of our study, we would like to address the performance levels of comprehension in our sample. Standardized data for the oral language comprehension

and the reading comprehension task cannot yet be presented, but analysis of means shows that, on average, our participants scored just slightly above the midpoint in both tasks. We may consider that these are low results in a sample composed of higher education students.

Higher education texts require a multitude of reading comprehension skills, such as reorganization of textual information, inferring based on implicit textual information, and vocabulary knowledge (Puerto et al., 2018). Despite the importance of these skills for progressing in higher education, university students show significant difficulties in tasks that require them (Edelman & Scriba, 2018; Puerto et al., 2018). According to Edelman and Scriba (2018) and Puerto et al. (2018), these difficulties are associated with a shortage of enriching reading experiences in childhood and adolescence, low levels of motivation for reading tasks, lack of reading models in the family or school, and poor development of reading comprehension skills in secondary education.

In fact, 22 of our 67 participants (32.84%) scored above the cut-off point (40) suggested by the authors of the Adult Reading History Questionnaire (ARHQ; Lefly & Pennington, 2000; Questionário de Hábitos de Leitura; QHL; Alves & Castro, 2005; Portuguese version). Scores above the cut-off point are suggestive of poor current and past reading habits and reading difficulties. Faísca et al. (2018; 2019) also showed Portuguese normative adult readers in higher education scoring above this cut-off point in the QHL. This implies that perhaps the Portuguese university population does not develop adequate reading habits before entering higher education, which can contribute to hindering reading comprehension levels.

Our results suggest that training skills such as oral language comprehension and vocabulary might help in promoting reading comprehension in this population, being those the best predictors in this study. Braze et al. (2007) tested a sample of young adults with a wide range of reading ability and verified that oral language comprehension and vocabulary were also the best predictors of reading comprehension, in their regression models, leading the authors to advise improvement on these skills as a way of fostering reading comprehension levels.

We consider that the greatest contribution of the present work is that it provides a re-thinking about the models of reading comprehension for normative adult readers, in a relatively transparent language. Future investigations might use these results as a term of comparison with other age-groups, groups with different education levels, groups with different reading skills and groups from different orthographies, or as a way of identifying

relevant targets of intervention for the improvement of reading comprehension levels in Portuguese adults.

However, this study was the first one about predictors of reading comprehension in a sample of European Portuguese speaking adults, so we lacked standardized instruments to measure some of our constructs, and developed tasks that showed non-satisfactory reliability levels. In the future, the conclusions presented here should be contrasted with new evidence, backed up by using instruments with better psychometric qualities, and a larger and more representative sample of the Portuguese adult population.

5.1. Limitations and future studies

The findings of the present work should be interpreted considering some limitations. Firstly, to provide measures of phonological decoding and word reading, we used the percentage of correctly read items in lists of pseudowords list and real words lists of the Reading Fluency subtest of the ADLER Battery, respectively. We consider that these accuracy measures are not very pure, as they take speed into account since the participant has a time limit to read the list. This computation brings problematic results, such as a case where a participant reads 10 out of the 90 words correctly and has a score of 100% accuracy, while another participant that read more words (for instance 20 out of 90) but misread two words, will obtain a lower accuracy score (90%). Future studies should develop measures of word and pseudoword reading accuracy for adults, that have no time limit, to provide more adequate measures of decoding accuracy, essential for models such as the SVR.

Furthermore, the three morphological awareness tasks for Portuguese adults that were designed for the present study, presented low levels of reliability (Cronbach´s alpha < .50). According to Murphy and Davidshofer (1988), reliability values below .60 should not be acceptable and values above .70 are low but acceptable. Low reliability has the effect of attenuating correlations between measures, so the effects involving morphological awareness may have been underestimated.

Likewise, our oral language comprehension and reading comprehension tasks presented low values of reliability. Comprehension tasks are often characterized by low-reliability levels (e.g., Faísca et al., 2019; Warmington et al., 2013). We tried to improve the low values previously obtained by Faísca et al. (2019) by developing tasks that had more items and more answer categories, as these are expected to increase Cronbach´s alpha values (Peterson, 1994). Despite getting superior values, more work is needed to

further improve reliability in these tasks. Again, low reliability may have reduced the effects involving these variables. Future studies should invest in increasing reliability and further validate our morphological awareness and comprehension tasks.

Furthermore, we consider that our relatively small sample size (N = 67) only provided statistical power to detect moderate effects on reading comprehension (r ~.3). A bigger sample should contribute to increasing statistical power to detect lower but still relevant effects. It is clear that our small sample was not representative of the Portuguese normative adult population or even the Portuguese adult population in higher education, so generalizations made for these populations, based on the results of the present study, should take the small sample into the consideration.

In addition to the proposals for future studies that have been suggested throughout this discussion, we would also like to propose the utilization of different types of measures for reading comprehension, such as the cloze technique (Taylor, 1953) or sentence-level comprehension tasks (e.g., Wagner et al., 2010) because the relative contributions of predictors can depend on how reading comprehension is measured (Cutting & Scarborough, 2006) and on which level (i.e., micro/sentence level or macro/text level) is considered (e.g., phonological decoding is more important at the micro/sentence level, while comprehension monitoring is more relevant at the macro/text level; Brown, 2004).

5.2. Conclusion

In the present study, we aimed at examining the relations between several reading-related predictors and reading comprehension in European Portuguese speaking adults. For that, we initially analysed correlations between predictors and reading comprehension. Also, we tested a simple (word reading and oral language comprehension) and an extended (inclusion of reading fluency and vocabulary) SVR model, and additional mediation models to verify if the effects of RAN, phonological decoding, morphological awareness, phonological awareness and working memory on reading comprehension were direct or mediated by word reading and reading fluency.

Predictors correlated significantly, positively and moderately with reading comprehension, with the exceptions of RAN and phonological decoding (non-significant correlations). In the simple SVR model, word reading and oral language comprehension explained about 27% of explained variance in reading comprehension. Moreover, even though the effect of oral language comprehension was greater than that of word reading, this difference was non-significant. In the extended SVR model, reading fluency and

vocabulary added 7% of additional explained variance in reading comprehension. Also, vocabulary was a mediator of the relation between word reading and reading comprehension in the path analysis, and in its turn affected reading comprehension directly and indirectly, through oral language comprehension. Finally, in the mediation models for the remaining variables, with imposed moderation by word reading and reading fluency, morphological awareness was the only skill that showed a significant direct effect on reading comprehension.

Results on the correlations add evidence that the transparency of the orthography and the reading expertise might affect the relative contribution of predictors on reading comprehension. Moreover, results on the SVR models show that the SVR could be an adequate model to predict reading comprehension in normative adult readers in a semi-transparent orthography, even more with the inclusion of vocabulary. Oral language comprehension and vocabulary were the better predictors of reading comprehension in the present study, displaying correlations of moderate strength and the strongest effects on reading comprehension, in the SVR models. So, we propose these abilities as possible targets of intervention for increasing reading comprehension levels, in this population. Moreover, the direct effect of morphological awareness on reading comprehension in the final mediation models, adds evidence that this skill is important in higher levels of education, when readers may find more morphologically complex words, and in semi-transparent orthographies, where the knowledge of base words and affixes can aid in word reading when there are inconsistencies in grapheme-phoneme conversion and meaning extraction, to achieve comprehension of what was read.

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Appendices

Appendix A

Text for the Anne Frank Reading Comprehension Test

Anne Frank

É possível que tenha ouvido mencionar a palavra Holocausto nas suas aulas de História ou Inglês. O Holocausto ocorreu entre 1939 e 1945. Tratou-se de uma tentativa do partido Nazi de **purgar** a raça humana, através da eliminação de judeus, ciganos, católicos, homossexuais e quaisquer outros que fossem considerados inferiores à sua "perfeita" raça ariana. Os nazis utilizavam campos de concentração, que por vezes eram utilizados como campos de morte, com o objetivo de exterminar as pessoas lá mantidas. O facto mais lastimoso relativo ao Holocausto consiste na morte de mais de um milhão de crianças com menos de 16 anos de idade em campos de concentração Nazi. A apenas algumas semanas do fim da Segunda Guerra Mundial, Anne Frank tornou-se numa dessas crianças.

Antes do Partido Nazi começar a sua perseguição aos judeus, Anne Frank tinha uma vida feliz. Anne nasceu em junho de 1929. Em junho de 1942, por ocasião do seu décimo terceiro aniversário, recebeu um simples presente que viria a ter impacto na vida de milhões de pessoas em todo o mundo. Esse presente foi um pequeno diário vermelho a que ela chamou Kitty. Este diário viria a ser a posse mais prezada de Anne, quando ela e a sua família se esconderam dos nazis num **anexo** secreto por cima do edifício da empresa do seu pai em Amsterdão.

Durante vinte e cinco meses, Anne, a sua irmã Margot, os seus pais, outra família, e um dentista judeu idoso esconderam-se dos nazis neste pequeno anexo. Eles nunca saíam à rua e a comida e mantimentos eram trazidos por Miep Gies e o seu marido, que não concordavam com a perseguição aos judeus por parte dos nazis. Foi uma vida muito **penosa** para a pequena Anne e ela utilizava Kitty como forma de descrever a sua vida em reclusão.

Posteriormente, Anne e a sua família foram traídos e presos pelos nazis. Até aos dias de hoje, desconhece-se quem traiu a família Frank e os outros residentes do anexo. Anne, a sua mãe e a sua irmã foram separadas de Otto Frank, pai de Anne. Posteriormente, Anne e Margot foram separadas da mãe. Em março de 1945, Margot Frank morreu à fome num campo de concentração nazi. Alguns dias depois, com quinze anos de idade, Anne Frank morreu de tifo. De todas as pessoas que se esconderam no anexo, apenas Otto Frank sobreviveu ao holocausto.

Otto Frank regressou ao anexo após o fim do Holocausto. Foi lá que encontrou Kitty, **pleno** dos pensamentos e sentimentos de Anne relativamente às suas circunstâncias de rapariga judia perseguida. Otto Frank publicou o diário de Anne em 1947 e este tem vindo a ser impresso desde então. Atualmente, o diário já foi publicado em mais de cinquenta e cinco idiomas e mais de vinte e quatro milhões de cópias foram vendidas em todo o mundo. O Diário de Anne Frank conta a história de uma corajosa jovem mulher que tentou ver o bem em todas as pessoas.

Appendix B

Instructions and Questions for the Anne Frank Reading Comprehension Test

Compreensão da Leitura - Anne Frank – instruções e questões

"*Por favor, leia este texto em silêncio. Vou contar o tempo que demora a lê-lo, mas por favor leia a um ritmo normal. Para tal, vou-lhe dar sinal para que comece a ler e peço-lhe que me avise quando terminar. Em seguida, vou fazer algumas perguntas sobre o texto; pode voltar a olhar para o texto para responder às perguntas*." Iniciar o cronómetro após dizer "pode começar", pausar o cronómetro quando o sujeito indicar que terminou de ler o texto. Proceder às questões.

Tempo de leitura = _____ segundos

Ritmo de Leitura = (número de palavras/tempo de leitura) x 60 = _____ palavras por minuto

1. Segundo o texto, quando é que o Holocausto aconteceu? (*compreensão literal*)

2. No contexto do parágrafo 1, o que significa "purgar"? (*vocabulário contextualizado*)

3. Segundo o texto, como era a vida de Anne Frank antes da perseguição dos nazis? (*compreensão literal*)

4. Que idade tinha Anne Frank quando recebeu Kitty? (*compreensão literal*)

5. Porque considera que o diário viria a ser a posse mais estimada de Anne? (*inferência extratextual*)

6. No contexto do parágrafo 2, o que significa "anexo"? (*vocabulário contextualizado*)

7. De acordo com o texto, qual era a profissão do pai de Anne? (*inferência intratextual*)

8. Quem se escondeu, juntamente com Anne Frank, no anexo? (*compreensão literal*)

9. Quem trazia a comida e mantimentos aos habitantes do anexo? (*compreensão literal*)

10. Qual seria a razão que Miep Gies e seu marido teriam para não concordar com o movimento do Partido Nazi? (*inferência extratextual*)

11. No contexto do parágrafo 3, o que significa "penosa"? (*vocabulário contextualizado*)

12. Segundo o texto, quem traiu a família Frank e os outros residentes do anexo? (*compreensão literal*)

13. Após terem sido separadas da mãe, o que aconteceu às irmãs Frank? (*compreensão literal*)

14. O que aconteceu ao dentista judeu idoso que se escondeu com a família de Anne no anexo? (*inferência intratextual*)

15. Em que ano terá Otto Frank regressado ao anexo secreto onde se tinha escondido com a sua família? (*inferência intratextual*)

16. No contexto do parágrafo 5, o que significa "pleno"? (*vocabulário contextualizado*)

17. Após a descoberta do anexo pelos nazis, o que aconteceu ao diário de Anne Frank? (*inferência intratextual*)

18. Qual terá sido a razão que levou Otto Frank a regressar ao anexo secreto? (*inferência extratextual*)

19. Porque é que o pai de Anne Frank decidiu publicar o diário da sua filha? (*inferência extratextual*)

20. Em quantos idiomas foi publicado o diário de Anne Frank? (*compreensão literal*)

Appendix C

Passages for the Fernando Pessoa Oral Language Comprehension Test

1- Fernando Pessoa era natural de Lisboa, onde nasceu em 1888, filho de um crítico musical e de uma senhora açoriana. Aos cinco anos ficou órfão de pai e iniciou uma profunda relação com a sua mãe.

2- Aos oito anos acompanhou a mãe, para a cidade de Durban, na África do Sul. Aí, a sua mãe voltou a casar com o cônsul de Portugal e nasceram-lhe os irmãos. Fez, com brilhantismo, os seus estudos básicos e secundários, em língua inglesa.

3- Por essa altura lia principalmente autores de língua inglesa e entre eles o seu muito amado Shakespeare. Ficou na África do Sul até aos dezassete anos, tendo, contudo, feito umas férias nos Açores, em 1901.

4- Em 1905 regressou a Portugal e a Lisboa, cidade onde viveu até à sua morte aos 47 anos, em 1935. Na sua vida prática, viveu de empregos circunstanciais e em *part-time*, fazendo escritas comerciais e correspondências em língua estrangeira.

5- Em 1934, recebeu um prémio pelo único livro em português que publicou em vida, Mensagem. Respeitado em Lisboa como intelectual e como poeta, o seu génio literário só foi plenamente reconhecido após a sua morte.

6- Os seus restos mortais estão, como os de Camões e Vasco da Gama, no Mosteiro dos Jerónimos, desde 1988. Pode-se dizer que a vida de Pessoa foi dedicada a criar. Alguns críticos questionam, se Pessoa realmente teria transparecido o seu verdadeiro *eu* ou se tudo não teria passado de um produto, da sua vasta criação.

Appendix D

Instructions and Questions for the Fernando Pessoa Oral Language Comprehension Test

Compreensão Oral – Fernando Pessoa – instruções e questões

"*De seguida, vai ouvir algumas passagens. Após cada passagem, vou pedir-lhe que responda oralmente a duas questões. Na folha que lhe entreguei, pode ler as questões antes de ouvir cada passagem. Peço-lhe que esteja atento às passagens pois irá ouvir cada uma apenas duas vezes. Ouvirá as perguntas de seguida, deve responder apenas após ouvir a segunda pergunta."*

Passagem 1

1. Que idade tinha Fernando Pessoa quando ficou órfão de pai? (*compreensão literal*)
2. Porque considera que Fernando Pessoa iniciou uma profunda ligação com sua mãe? (*inferência extrapassagem*)
3.

Passagem 2

4. Segundo a passagem, que língua é falada na cidade Durban, na África do Sul? (*inferência intrapassagem*)
5. Qual a escolaridade de Fernando Pessoa? (*compreensão literal*)

Passagem 3

6. Qual o autor amado de Fernando Pessoa? (*compreensão literal*)
7. Onde, em Portugal, fez férias Fernando Pessoa? (*compreensão literal*)

Passagem 4

8. Fernando Pessoa voltou para África do Sul? (*inferência intrapassagem*)
9. No contexto desta passagem, o que significa **circunstanciais**? (*vocabulário contextualizado*)

Passagem 5

10. No contexto desta passagem, o que significa **intelectual**? (*vocabulário contextualizado*)
11. Porque é que o génio literário de Pessoa, só foi reconhecido depois da sua morte? (*inferência intrapassagem*)

Passagem 6

12. Porque considera que os restos mortais de Fernando Pessoa estão no Mosteiro dos Jerónimos? (*inferência extrapassagem*)
13. No contexto desta passagem, o que significa **transparecido**? (*vocabulário contextualizado*)

Appendix E

Stimuli for the Suffixation Decision Task

High Frequency		Low frequency	
Suffixed	**Pseudosuffixed**	**Suffixed**	**Pseudosuffixed**
bombeiro	dinheiro	carteiro	cieiro
fronteira	maneira	lancheira	esteira
sondagem	paisagem	filtragem	menagem
julgamento	elemento	fingimento	testamento
duração	tradição	datação	secreção
cidadão	multidão	paredão	edredão
autoria	galeria	cantoria	iguaria
bancário	salário	preçário	canário

Appendix F

Stimuli for the Suffixed Word Detection Task

High Frequency			Low Frequency		
Suffixed	**Pseudosu1**	**Pseudosu2**	**Suffixed**	**Pseudosu1**	**Pseudosu2**
barreira	cadeira	madeira	pulseira	vieira	charneira
bancada	estrada	jornada	ossada	geada	cilada
paragem	imagem	mensagem	travagem	vantagem	tanchagem
casamento	instrumento	monumento	enchimento	condimento	filamento
altura	fatura	postura	tontura	sutura	ventura
semanário	necessário	calendário	tarifário	dromedário	sagitário

Note. Pseudosu = Pseudosuffixed.

Appendix G

Stimuli for the Prefixed Word Detection Task

Low frequency		
Prefixed	**Pseudoprefixed1**	**Pseudoprefixed2**
desconforto	descalabro	despautério
indecisão	intestino	intelecto
bimotor	bigode	bitoque
recarga	relíquia	resina
retradução	reverendo	relâmpago
bisneto	bisnaga	bisturi
triciclo	tribuno	tributo

Appendix H

Informed Consent Form for the Present Study

FICHA DE INFORMAÇÃO PARA CONSENTIMENTO INFORMADO, ESCLARECIDO E LIVRE PARA PARTICIPAÇÃO EM ESTUDOS DE INVESTIGAÇÃO

PARTE I – IDENTIFICAÇÃO DO ESTUDO

Título do estudo de investigação: Preditores da Compreensão da Leitura na idade adulta: Um estudo no Português Europeu

Investigador: Mestrando Fábio Gonçalves

Instituição de Ensino: Departamento de Psicologia e Ciências da Educação – Faculdade de Ciências Humanas e Sociais (FCHS) da Universidade do Algarve

PARTE II – DESCRIÇÃO E METODOLOGIA DO ESTUDO

Enquadramento: Este estudo está a ser desenvolvido pelo investigador Fábio Gonçalves (endereço eletrónico: a51714@ualg.pt) no âmbito do Mestrado em Neurociências Cognitivas e Neuropsicologia da Universidade do Algarve, sob a responsabilidade dos orientadores, o Professor Doutor Luís Faísca (endereço eletrónico: lfaisca@ualg.pt) e a Professora Doutora Alexandra Reis (endereço eletrónico: aireis@ualg.pt), docentes da FCHS-UAlg.

Descrição e Metodologia do Estudo de Investigação: O objetivo desta investigação é compreender a magnitude e a direção da influência das diversas variáveis preditoras da compreensão da leitura, numa amostra de adultos fluentes na língua portuguesa. Para tal, será necessário o preenchimento de um questionário com dados pessoais sociodemográficos (data de nascimento, e-mail pessoal e/ou contacto telefónico) e eventual informação relativa à existência ou não de perturbações da leitura e da escrita no agregado familiar, ou problemáticas de natureza psiquiátrica/neurológica que se mostrem pertinentes para o estudo. Adicionalmente, será necessária a realização de tarefas computacionais, de leitura e de resposta a questões orais, com o objetivo de obter medidas para as variáveis em estudo. Os dados serão armazenados numa plataforma a que só o investigador terá acesso.

Condições: A sua participação é voluntária e possui o direito de interromper a sua participação a qualquer momento, bem como de requisitar ao investigador todos os esclarecimentos que considere necessários.

Confidencialidade e anonimato: Todos os dados fornecidos permanecerão sob o controlo e acesso único do investigador. Será garantida a confidencialidade, a sua identidade será salvaguardada e os dados recolhidos serão utilizados exclusivamente para fins investigativos. Os

dados pessoais serão objeto de anonimização, não sendo as informações de caráter pessoal publicadas ou comunicadas.

PARTE III – INFORMAÇÃO E CONSENTIMENTO

As operações de tratamento de dados pessoais dos participantes no estudo de investigação são realizadas de acordo com o Termo de Informação e Consentimento em anexo (Anexo A).

Por favor, leia com atenção todo o conteúdo deste documento. Verifique se todas as informações estão corretas. Não hesite em solicitar mais informações se não estiver completamente esclarecido/a. Se estiver de acordo, assine este documento.

OBRIGADO PELA SUA DISPONIBILIDADE!

Termo de receção de informação e confirmação de consentimento para participação em estudo
O titular dos dados e subscritor da presente ficha declara ☐ Que pretende participar no estudo de investigação acima identificado e no preenchimento dos respetivos questionários e tarefas e que lhe foram prestadas as necessárias informações relativamente aos objetivos, termos e condições de funcionamento e ao carácter confidencial do tratamento dos dados, e que as compreendeu disponibilizando voluntariamente todos os dados necessários solicitados pelo investigador. E que, sem face das informações aqui prestadas e nos referidos termos e condições: ☐ Aceita participar voluntariamente no estudo conforme a informação prestada. ☐ Não aceita participar voluntariamente no estudo conforme a informação prestada.

Titular dos Dados			
Nome			
Contacto		**Data de Nascimento**	___/___/_____
Assinatura (conforme CC)			

Assinatura do Recetor

_____

___/___/_____