Lower Education and Reading and Writing Habits Are Associated With Poorer Oral Discourse Production in Typical Adults and Older Adults

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During normal aging there is a decline in cognitive functions that includes deficits in oral discourse production. A higher level of education and more frequent reading and writing habits (RWH) might delay the onset of the cognitive decline during aging. This study aimed at investigating the effect of education and RWH on oral discourse production in older adults. Picture-based narratives were collected from 117 healthy adults, aged between 51 and 82 years (68.6 ± 6.38) with 0–20 years of formal education (10.1 ± 5.69). Measures of macro, microlinguistic and modalizations were computed and entered as dependent variables in hierarchical regression analyses that included age, education and RWH as regressors. Results revealed that higher education explained a better performance at the macrostructure and microstructure dimensions. Higher frequency of RWH explained the production of fewer modalizations. These results demonstrate the positive effect of education and RWH in oral discourse production in older adults. Therefore, higher attention should be given to these social factors.

Keywords: oral discourse, narrative discourse, education, reading and writing habits, typical aging, macrostructure, microstructure, modalization

INTRODUCTION

Healthy aging involves changes in cognitive functions, including a deficit in oral discourse production (Marini et al., 2005). To generate discourse, the speaker must integrate linguistic and non-linguistic skills to produce and structure a narrative. As a complex task, discourse production is a rich source of information in clinical interviews and cognitive assessment. Thus, discourse production is a valuable tool to support the detection of language and cognitive impairments. Moreover, it is an ecologically valid task, representative of language use in daily life.

During typical aging, discourse comprehension is relatively spared, while discourse production is affected (Ska et al., 2009; Martin et al., 2018). Oral discourse production, the focus of the present study, can be divided into two main dimensions (van Dijk, 2010). The first dimension is the macrostructure. It refers to the semantic information that provides global unity to discourse. The second dimension is the microstructure. It concerns the structure of an individual proposition and
Cotrena et al. (2016) found that RWH predicted speed and accuracy in the Hayling test (Burgess and Shallice, 1997), a linguistic measure of executive functions. Sörman et al. (2018) found that the habit of reading books was associated with higher levels of verbal fluency and episodic recall. Tessaro et al. (2020) found that RWH were associated with the total number of words produced in the phonemic verbal fluency task. Pagliarin et al. (2015) found that the combination of education and RWHs better predicted the linguistic performance in oral discourse, in measures such as the number of words, information units (IU), and scenes, rather than one of the variables in isolation.

Overall, these studies corroborate the importance of RWH in cognition. However, to the best of our knowledge, no studies have further investigated the effects of RWH on oral discourse production in typical adults. The effect of education is still scarce as well, as mentioned before. Toward this aim, we used the same picture sequence task and linguistic variables investigated by Lira et al. (2018). Lira et al. (2018) identified the items in the macrolinguistic dimension of oral discourse that better differentiated individuals with AD from typical older adults with a picture sequence task. The present study aims to investigate the effect of education and the frequency of RWH on oral discourse production in typical adults. We hypothesize that higher education levels and a higher frequency of RWH would be associated with better performance on the macro and microstructure dimensions of oral discourse production, as well as with fewer modalizations.

**METHOD**

**Ethical and Data Collection Procedures**

The study was approved by the Research Ethics Committee at the university where the study was developed under report number 560.073, CAAE registry number 21006913.0.0000.5336. Participation in the study was voluntary, and participants provided their written informed consent before joining the study. Participants were tested individually in a laboratory setting. The participants were recruited at general courses offered for members of the community at the university and at community centers close to it.

**Participants**

One hundred and seventeen adults participated in the study (see Table 1 for their sociodemographic and neuropsychological characteristics). Their ages ranged from 51 to 82 (mean = 68.6; standard deviation, SD = 6.38) and education level ranged from 0 to 20 years of formal schooling (mean = 10.1; SD = 5.69). They were recruited at community centers, in an urban context in the most southern state in Brazil. Participants were mainly blue-collar individuals from low to middle-to-low socioeconomic status (SES; see Table 1). The SES scores of the participants in this study ranged from 13 to 41 (mean = 24.2; SD = 6.05). The scores for RWHs in the present sample ranged from 0 to 26 (mean = 12.2; SD = 6.27). SES was measured with the Questionário de condição social e questionário de uso de medicamentos, taken from ABEP—Associação Brasileira de Empresa e Pesquisa (2015), which establishes the following cut-off
If s/he does not show initiative to produce the story. In this task, the examiner only interferes to encourage the participant is repeated. There is no time limit for the accomplishment of the given time to observe the scenes and, if necessary, the instruction that s/he can observe them while telling the story. Participants are the correct sequence and remained in front of the participant so to ask you to tell me this story as if you were going to tell it to a

Scoring. Two separate transcripts were made by two independent devices; Ref, referential; Lex, lexical; Conj, conjunction; Eli, ellipsis; Est, structural; CohEs, cohesive errors; Eref, no reference; Econj, conjunction error; Einfo, information error; CCPs, content-related complete propositions; NoCCPs, no-content-related complete propositions; IncPs, incomplete propositions; CohDs, cohesive devices; Ret, referential; Lex, lexical; Conj, conjunction; Eli, ellipsis; Est, structural; CohEs, cohesive errors; Eref, no reference; Econj, conjunction error; Einfo, information error; Emissing, missing element; Esent, inappropriate sentence; Lcoh, local coherence.

SD, standard deviation; MMSE, Mini-Mental State Exam, with cut-off points established by Laks et al. (2003); SES, socioeconomic status measured with the Questionário de condição social e questionário de uso de medicamentos, taken from ABEP—Associação Brasileira de Empresa e Pesquisa (Brasil and de, 2015) (lower SES = 0–16; middle = 17–28; upper middle = 29–44; upper = 45–100); RWH, reading and writing habits quantified according to the weekly frequency of reading and writing activities with different types of texts, with ratings classified as: daily (4 points); a few days a week (3 points); once a week (2 points); rarely (1 point), and never (0 points) (Hübner et al., 2019); Depression (Geriatric Depression Scale–GDS, Brazilian version of Almeida and Almeida, 1999); verbal learning task (episodic memory) (BALE) (Hübner et al., 2019); short-term memory and working memory (WAIS-III Digit Span and Backward Digit Span subtests) (Wechsler, 1997).

**TABLE 1** | Descriptive analyses.

| Variables                        | Mean | SD    | Range  | Skewness |
|----------------------------------|------|-------|--------|----------|
| Age (in years)                   | 68.6 | 6.38  | 51–82  | −0.15    |
| MMSE                             | 27.4 | 2.6   | 18–30  | −1.22    |
| SES                              | 24.2 | 6.05  | 13–41  | 0.62     |
| Education (in years)             | 10.1 | 5.69  | 0–20   | −0.03    |
| RWH (min = 0; max = 32)          | 12.2 | 6.27  | 0–26   | −0.17    |
| GDS                              | 1.59 | 1.48  | 0–5    | 0.68     |
| Verbal learning (free recall) (min = 0; max = 16) | 31.8 | 7.65  | 1–45   | −1.38    |
| Verbal learning (cued recall) (min = 0; max = 16) | 14.9 | 5.69  | 3–30   | 0.37     |
| Verbal learning (late recall) (min = 0; max = 16) | 15.6 | 1.42  | 7–16   | −1.45    |
| Naming (min = 0; max = 60)       | 54.4 | 4.04  | 38–60  | −1.34    |
| Digit span forward               | 7.74 | 2.11  | 4–14   | 0.71     |
| Digit span backward              | 4.13 | 1.83  | 0–9    | 0.35     |
| Mods                             | 0.186 | 0.202 | 0–1.1  | 1.62     |
| Mps                              | 3.79 | 2.13  | 0–6    | −0.585   |
| GCoh                             | 6.29 | 3.17  | 0–14   | −0.29    |
| CCPs                             | 0.666 | 0.272 | 0–1    | −0.79    |
| NoCCPs                           | 0.25 | 0.23  | 0–0.933 | 1.09    |
| IncPs                            | 0.083 | 0.112 | 0–0.566 | 2.02    |
| CohDs                            | 0.171 | 0.067 | 0–0.325 | −0.29    |
| Ref                              | 0.058 | 0.032 | 0–0.129 | 0.202   |
| Lex                              | 0.055 | 0.026 | 0–0.129 | 0.362   |
| Conj                             | 0.028 | 0.018 | 0–0.82 | 0.845    |
| El                               | 0.026 | 0.021 | 0–1.01 | 0.904    |
| Est                              | 0.002 | 0.004 | 0–0.149 | 1.33    |
| CohEs                            | 0.038 | 0.036 | 0–0.171 | 1.48    |
| Eref                             | 0.008 | 0.012 | 0–0.67 | 2.0      |
| Econj                            | 0.001 | 0.004 | 0–0.286 | 1.87    |
| Einfo                            | 0.016 | 0.019 | 0–0.114 | 1.03    |
| Emissing                         | 0.008 | 0.012 | 0–0.508 | 1.4      |
| Esent                            | 0.004 | 0.007 | 0–0.286 | 1.8      |
| Lcoh                             | 10.3 | 4.72  | 0–24   | 0.116    |

Picture Sequence Task

The picture sequence task is known as “The dog story,” a subtest of the Battery for Language Assessment in Aging (Hübner et al., 2019). Participants are asked to tell the story based on seven scenes, following this instruction: “I will show you a story with scenes. Each scene is a moment in the story, which has a beginning, middle, and end. I will ask you to take a good look at the scenes and try to understand the story. Then, I am going to ask you to tell me this story as if you were going to tell it to a friend. Are you ready? Can we start?” The scenes are presented in the correct sequence and remained in front of the participant so that s/he can observe them while telling the story. Participants are given time to observe the scenes and, if necessary, the instruction is repeated. There is no time limit for the accomplishment of the task. The examiner only interferes to encourage the participant if s/he does not show initiative to produce the story. In this case, expressions such as “tell me more,” “can you continue?, “Uhmm,” “and then, what happens?” are addressed. All discourse samples were audio-recorded for later transcription and data scoring. Two separate transcriptions were made by two independent...
examined variance inflation factor (VIF) and Tolerance to assess for multicollinearity. The reference value for the VIF was <4, and for the tolerance, the reference value was >0.2. The values for VIF and Tolerance were within the acceptable ranges, and thus, there was no multicollinearity issue in this analysis. Model improvement was evaluated using ΔR²-statistic. Improvement in the explained variance was calculated using ΔR². Statistical significance level was assumed at p < 0.05. All the data are available in Supplementary Table 1.

RESULTS

Table 1 provides the means, standard deviations, ranges (minimum and maximal values), and skewness for the demographic and neuropsychological variables of the sample, as well as for all the linguistic measures (dependent variables).

Results of the hierarchical regression analyses, including values of change in R² (ΔR²) and standardized coefficients (β) for the predictor variables at each step are presented in Table 3.

Data Analysis

We analyzed the data using the Tidyverse package (Wickham et al., 2019), implemented in RStudio (R Core Team, 2020). First, we examined the data for skewness and kurtosis. The values were within the acceptable respective ranges (−2 to +2 for skewness and −9 to +9 for kurtosis) (Schmider et al., 2010), and thus, no transformations were performed (see Table 1). In our regression models, we entered one dependent variable per construct of interest (macrostructure, microstructure, and modalizations). Since macrostructure and microstructure were composed of several variables, we computed two composite scores, one for macrostructure and one for microstructure. For some variables, a higher score indicates better performance; for other variables, a higher score denotes worse performance. For instance, a better score in global coherence indicates better performance, while more cohesive errors indicate a worse performance. Thus, we rendered all the variables in the same direction (i.e., higher scores associated with better performance). To that end, we subtracted each individual score from its maximum number. In this way, a higher score always means better performance. We calculated two composite scores by summing the scores of the variables related to the macrostructure (Mps, GCoh) and the microstructure (CCPs, NoCCPs, IncPs, CohDs, Ref, Lex, Conj, Eli, Est, CohEs, Eref, Econj, Einfo, Emissing, Esent, and Lcoh).

Following Lira et al. (2018), we analyzed CCPs, NoCCPs, IncPs, Mps, and Mods as a proportion of all the propositions. The total of the CohDs and CohEs, as well as their subtypes, represent the ratio of the sum of the words produced. GCoh and Lcoh were considered as absolute numbers.

Oral Narrative Variables Computation

We used 19 variables. Their explanation can be seen in Table 2. Following Lira et al. (2018), we analyzed one variable for modalizations ( Mods), two for macrostructure [macropropositions (Mps) and appropriated global coherence (GCoh)] and 16 for microstructure [content-related complete propositions (CCPs); no-content-related complete propositions (NoCCPs); incomplete propositions (IncPs); cohesive devices (CohDs) and its five subtypes: referential (Ref), lexical (Lex), conjunction (Conj), ellipsis (Eli), or structural (Est); cohesive errors (CohEs) and its five subtypes: no reference (Eref), conjunction error (Econj), information error (Einfo), missing element (Emissing), or inappropriate sentence (Esent); and appropriated local coherence (Lcoh)].

First, we ran a single hierarchical regression model for each microstructure (CCPs, NoCCPs, IncPs, CohDs, Ref, Lex, Conj, Eli, Est, CohEs, Eref, Econj, Einfo, Emissing, Esent, and Lcoh). This method allows examining the variation in the dependent variable with each subsequent addition of an independent variable (Schmider et al., 2010). We grouped the independent variables in the regression models in three separate steps. Step 1 included age and status socioeconomic, step 2 included education, and step 3 included frequency of RWHs.

In the first step of the regression analysis, neither age nor socioeconomic status significantly predicted modalizations [R² = 0.042, F(2,109) = 2.409, p = 0.094], and the addition of education in Step 2 did not accounted for a significant increase in the variance of modalizations beyond of that explained by the previous sets of predictors [R² = 0.067, ΔR² = 0.024, F(3,108) = 2.595, p = 0.056]. However, in Step 3, RWH accounted for a significant amount of variance in modalizations [R² = 0.106, ΔR² = 0.038, F(4,107) = 3.179, p = 0.016] beyond the variance explained by the variables entered in the two previous steps. RWH significantly contributed to the change in variance in Mods [β = −0.252, t(107) = −2.160, p = 0.033], indicating that the higher the frequency of RWH, the fewer the comments on the content of the story or on the participant’s own performance during the task (modalizations) (Figure 1).

Macrostructure

In the first step of the analysis, socioeconomic status accounted for a significant amount of variance in macrostructure score [R² = 0.068, F(2,109) = 3.99, p = 0.021]. Socioeconomic status was found to significantly contribute to the change in variance in macrostructure [β = 0.234, t(109) = 2.505, p = 0.013], indicating that the higher the socioeconomic status, the better the performance at the macrostructure level. The addition of education in the step 2 accounted for a significant increase in the variance of macrostructure beyond of that explained by the previous sets of predictors [R² = 0.167, ΔR² = 0.099, F(3,108) = 7.234, p ≤ 0.001] beyond that explained by the previous sets of predictors. Education significantly contributed to the change in variance in macrostructure [β = 0.371, t(108) = 3.585, p ≤ 0.001]. In step 3, the addition of RWH did not accounted for a significant amount of variance in macrostructure score [R² = 0.067, ΔR² ≤ 0.001, F(4,107) = 5.384, p ≤ 0.001] (Figure 1).

1https://www.R-project.org/
TABLE 2 | Linguistic variables used in the study, based on Lira et al. (2018).

| Variables | Explanation | Example |
|-----------|-------------|---------|
| **Modalizations** | | |
| 1 | Modalizations ( Mods) | The participant’s comments about story content or his/her performance during the task. | Eu não sei o que é isto/isto aqui é um cachorro? (I do not know what this is/this a dog?) |
| **Macrostructure** | | |
| 2 | Macropropositions (Mps) | The basic components of a narrative structure that summarize the story: (1) a little boy takes a stray dog home; (2) he is worried about his parent's reaction; (3) he hides the dog in the wardrobe; (4) the mother finds the dog; (5) she asks the boy for an explanation; (6) the mother allows the boy to keep the dog. | O menino esconde o cachorro no armário. (The boy hides the dog in the closet.) |
| 3 | Appropriated global coherence (GCoH) | The frequency of complete or incomplete propositions that are conceptually related to the main topic of the instrument. | O menino encontra o cachorro e leva o cachorro para casa. (The boy finds the dog and takes the little dog home.) |
| **Microstructure** | | |
| 4 | Content-related complete propositions (CCPs) | The frequency of the propositions with the main predicate and their argument(s) identified in the story. | O menino viu um cachorro perdido na calçada. (The boy saw a dog on the sidewalk.) |
| 5 | No-content-related complete propositions (NoCCPs) | The frequency of the propositions that present a predicate and their argument(s) but that was not related to the content of the story. | Uma mulher está atravessando a rua. (A woman is crossing the street.) |
| 6 | Incomplete propositions (IncPs) | The frequency of the propositions lacking a predicate or argument. | Um menino viu um. (A boy saw a.) |
| 7 | Cohesive devices (CohDs) | The linguistic items used to establish a connection between elements. | A mãe deixa o menino ficar com o cachorro. (The woman lets the boy keep the dog.) |
| 8 | Referential (Ref) | An element that presents a semantic relation to a preceding element, such as third-person personal pronouns, possessive pronouns, demonstrative pronouns, or adverb of place. | A mãe aceitou o cachorro e então construiu uma casinha para ele. (The mother accepted the dog and then built him a little house.) |
| 9 | Lexical (Lex) | The repeated element of a lexical item or the use of a synonym, superordinate, subordinate name, or other semantic related nouns. | O menino encontra o cachorro e leva o cachorro para casa. (The boy finds the dog and takes the little dog home.) |
| 10 | Conjunction (Conj) | A word or group of words used to connect clauses with meaningful relationships. | O menino leva o cachorro para casa e (o menino) esconde ele no armário. (The boy takes the dog home and (the boy) hides it in the closet.) |
| 11 | Ellipsis (Elí) | Elements not emitted due to their redundancy, which refers specifically to preceding sentences or words. | Bom, o menino está caminhando na rua. (Well, the boy is walking on the street.) |
| 12 | Structural (Est) | A non-propositional element that contributes to the continuity of the emitted text, without aggregating meaning. | O menino e o cachorro. Ele vai para casa. (The boy and the dog. He goes home.) |
| 13 | Cohesive errors (CohEs): | Elements, present or absent, that disrupt the continuity of meaning in the discourse. | Aqui é o menino para falar com a moça. (Here is the boy to talk to the girl.) |
| 14 | No reference (Eref) | A referring item is present, but the item to which it refers is not specified or evident from the immediate context. | O menino está dando comida para o cachorro. (The boy is feeding the dog.) |
| 15 | Conjunction error (Econj) | The use of an inappropriate conjunctive element. | Aqui o menino está (elemento faltante). [Here the boy is missing element:] |
| 16 | Information error (Einfo) | An element that causes a misstatement of the story content. | Os menino construíram uma casinha para o cachorro. (The boys built a little house to the dog.) |
| 17 | Missing element (Emissing) | An absent element that causes errors in cohesion between words, clauses, or propositions. | O menino viu o cachorro e o levou para casa. (The boy saw the dog and took it home.) |
| 18 | Inappropriate sentence (Esent) | The omission or misuse of an element that contributes to maintaining the grammar structure of the discourse, mainly the verbal or nominal concordance. | |
| 19 | Appropriated local coherence (LCoH) | The frequency of complete or incomplete propositions that are conceptually related to the immediately previous proposition. | |

Bold words represent the target linguistic item for each variable of interest.

Microstructure

In the first step of the regression analysis, neither age nor socioeconomic status significantly predicted microstructure score \( R^2 = 0.037, F_{(2,109)} = 2.112, p = 0.125 \). However, the addition of education in step 2 accounted for a significant increase in the variance of microstructure beyond that explained...
by the previous sets of predictors \( R^2 = 0.108, \Delta R^2 = 0.071, F_{(3,108)} = 4.397, p = 0.005 \). Education significantly contributed to the change in the microstructure level \( \beta = 0.315, t(108) = 2.944, p = 0.003 \), indicating that the higher the education, the better their performance at the microstructure level. In step 3, the addition of RWH did not account for a significant amount of variance in microstructure score (Figure 1).

**DISCUSSION**

This study aimed at investigating the effects of education and RWH on oral discourse production in typical adults. These factors are known to increase cognitive reserve during aging (Stern et al., 2020). We hypothesized that higher education levels and frequency of RWH would be positively associated with better performance on the macro- and microstructure dimensions of oral discourse production, as well as with fewer modalizations. Our results indicate that higher education explained the production of higher macro and microstructure scores. Moreover, our results indicate that higher frequency of RWH explained the production of fewer modalizations.

While the study developed by Lira et al. (2018) showed significant differences between AD participants and healthy controls regarding the macro- and microstructure dimensions, mainly macropropositions, global coherence, and the ellipsis subtype of cohesive devices [regarding modalizations, Lira et al. (2018) did not find differences between AD and healthy controls groups], our results demonstrate variations in oral discourse production as a function of education and frequency of RWH present in typical adults. Taken together, our results corroborate previous studies that support the positive effects of education (Ardila and Rosselli, 1996; Juncos-Rabadán, 1996; le Dorze and Bédard, 1998; Ardila et al., 2000; MacKenzie, 2000; Duong and Ska, 2001; Bennett et al., 2003; Hong et al., 2011; Nogueira et al., 2016) and frequency of RWH (Pawlowski et al., 2012; Moraes et al., 2013; Cotrena et al., 2016; Kochhann et al., 2018; Sörman et al., 2018; Tessaro et al., 2020) on human cognition. Our findings are discussed below in terms of (a) modalizations, (b) macrostructure, and (c) microstructure.

**Modalizations**

Our results showed that as the frequency of RWH increases, the number of modalizations—participants’ comments about their performance during the task—decreases. Studies investigating modalizations in AD patients found that they produced a higher amount of modalizations than healthy participants [Duong et al., 2003; Toledo et al., 2018; but see Cardebat et al., 1993; Lira et al., 2018 for contrasting results]. Regarding typical adults and older adults, le Dorze and Bédard (1998) found that older adults

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**TABLE 3** | Standardized βs, \( R^2 \)s, and \( \Delta R^2 \)s for the three hierarchical regression analyses (macrostructure, microstructure, and modalizations).

| Dependent variables | Macrostructure | Microstructure | Modalizations |
|---------------------|----------------|----------------|--------------|
| **Step 1**          |                |                |              |
| Age                 | -0.083         | 0.026          | 0.202        |
| Socioeconomic status| 0.234*         | 0.195          | -0.017       |
| \( R^2 \)           | 0.068          | 0.037          | 0.042        |
| **Step 2**          |                |                |              |
| Education           | 0.371***       | 0.315**        | -0.186       |
| \( R^2 \)           | 0.167          | 0.108          | 0.067        |
| \( \Delta R^2 \)    | 0.099***       | 0.071**        | 0.024        |
| **Step 3**          |                |                |              |
| Reading and writing habits | -0.019      | -0.024         | -0.252*      |
| \( R^2 \)           | 0.167          | 0.109          | 0.106        |
| \( \Delta R^2 \)    | < 0.001        | < 0.001        | 0.038*       |

Columns refer to the different regression models and their titles show the dependent variable of the model. \( \Delta R^2 \) is the incremental increase in the model \( R^2 \) that results from the addition of a predictor or set of predictors in a new step of the model.

\*p < 0.05, **p < 0.01, and ***p < 0.001.
made more comments about their difficulties during a picture description task as compared to younger adults. To the best of our knowledge, the present study is the first one to address the variations in modalizations in oral discourse production as a function of the frequency of RWH in typical adults and older adults. It is possible that individuals who maintain a high frequency of RWH have less difficulty in understanding the story and, therefore, are less susceptible to distractions and to the production of irrelevant information.

Indeed, modalizations can be interpreted as a rupture in the discursive macrostructure, since when individuals discuss their performance they tend to deviate from the theme of the narrative (Cardebat et al., 1993; Lira et al., 2018). In addition, from a pragmatic point of view, the presence of modalizations might reflect the awareness of their difficulties to maintain the central theme of the discourse (Lira et al., 2018; Toledo et al., 2018).

In our study, RWH contributed to explaining variation in modalizations, but did not explain variation at the macro and microstructure levels. Indeed, in previous studies with typical adult and older adult populations, the habit of reading books was associated with higher levels of verbal fluency (Sörman et al., 2018) and the frequency of RWH was associated with the total number of words produced in the phonemic verbal fluency task (Tessaro et al., 2020). Based on this evidence, it could be possible to postulate that individuals who maintain a frequency of RWH in their lives may have a richer vocabulary. Further studies need to address the issue of the relationship between the frequency of RWH and discourse production, which is a complex linguistic ability that goes beyond the word level. Besides, future studies could analyze the impact of RWH in other discourse tasks, as well as analyze picture sequences, like in our study, by adopting automatic language analysis, such as speech connectedness (Mota et al., 2018), to bring more conclusive evidence on the role of frequency of RWH at the discourse level.

Macrostructure

According to van Dijk (2010), the macrostructural dimension of the discourse refers to the structure of an individual proposition and its internal relations. Our results indicate that as education increases, the performance at the microstructure dimension increases as well. Mackenzie et al. (2007) found that participants with lower educational levels produced more tangential sentences in their narratives than participants with higher educational levels. In another study, Mackenzie (2000) found that participants with a lower level of education produced shorter and less complete narratives in comparison with the more educated participants. Other studies of cohesion in healthy adults and older adults have reported similar findings (Juncos-Rabadán, 1996; le Dorze and Bédard, 1998). Juncos-Rabadán (1996) found that older adults with a higher level of education used more cohesive links in their narratives, while older adults with a lower level of education used a greater number of descriptive sentences and deictic elements in their narratives. These results may indicate that picture-based tasks are sensitive to the level of education and might also provide a sensitive indicator of the linguistic competence of healthy adults. In such tasks, participants are limited to the content of the pictures and cannot resort to compensatory strategies as, for example, in a rehearsed autobiography of a family narrative (Wright et al., 2011). Overall, these results stress the importance of education in the macrostructural dimension of the discourse.

It is important to note that age did not predict any of the dependent variables, unlike other similar studies that addressed this effect, such as Capilouto et al.’s (2016). However, Capilouto, Wright, and Maddy used a single picture description task. Another difference between our study and Capilouto, Wright, and Maddy’s study that could explain the contrasting results is the age range of participants. Capilouto et al. (2016) divided their participants into three groups according to their age, ranging from 20 to 89. In our study, age ranged from 51 to 82 years old.

The fact that age did not predict any of the linguistic measures may indicate that the most important factors for oral discourse production are social factors and not the age when considering adult and older adult populations. Previous studies have revealed that, as age increases, there are discursive gains. Marini et al. (2005) found that the productions of participants aged 40–74 years presented more main ideas in the task based on a single figure than the productions of participants aged 20–39 and between 75 and 84 years. This can be interpreted as an improvement in the narrative capacity related to aging, which decreases only in older people. Thus, middle-aged groups may have discursive gains, and education plays one of the most important roles in discourse production.

Considering that the present study aims to investigate language at the level of individual differences, one limitation of the study is that it does not consider the overall intellectual or any other measure of general functioning. Therefore, future studies should analyze the impact of general intelligence together with social variables in the oral discourse production of older adults.
In sum, our results demonstrate the positive effect of education on the macro- and microlinguistic aspects of oral discourse production during typical aging, as well as the positive effects of frequently engaging in RWHs. Moreover, the use of narrative tasks based on a sequence of pictures seems to be valid to detect differences in oral production between healthy adult and older adult populations regarding their schooling and RWHs, showing its efficiency as a tool to be used in the clinics and in research. Oral narrative productions represent an ecologically valid way to elucidate discourse, which goes beyond the word and sentence levels, therefore favoring the analyses of coherence, cohesion, together with other aspects at the micro- and macrostructural levels, present in daily conversations. Finally, based on our results, which showed the impact of education and RWHs on oral narrative production in healthy adulthood and aging, greater attention should be paid to education and RWHs, since these can prevent or delay the development of neurodegenerative diseases, such as AD. This is especially relevant in underdeveloped or developing countries, where the increase of dementia in the near future is associated with low socioeconomic status and low educational level.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the PUCRS University Research Ethics Committee (report number 560.073, CAAE registry number 21006913.0.0000.5336). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BM contributions to included analysis, interpretation of the data, writing, and drafting the submitted material. MW supervised the data analyses and performed a critical revision of the manuscript. LS performed a critical revision of the manuscript. LH supervised the data collection and performed a critical revision of the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.740337/full#supplementary-material

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