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RESEARCH PAPER

Literacy enhances lexical variation, not quantity, in adult oral production

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Abstract Adult language use varies substantially across speakers, with literacy experience emerging as a crucial but understudied factor in creating this variation. While written language exposes speakers to broader, more diverse vocabulary than speech alone, most psycholinguistic research focuses on highly literate populations, leaving gaps in our understanding of how literacy shapes oral production. This study therefore addresses a critical question: Does literacy acquisition affect lexical diversity in spontaneous oral narrative production in Turkish? We compared lexical diversity results between illiterate and literate adult Turkish speakers during a structured storytelling task. Using Root Type-Token Ratio analyses across six parts of speech, we found that literate speakers consistently demonstrated significantly higher lexical diversity than illiterate speakers (d = 1.18–2.08 for most categories). Crucially, this occurred without increased word production, indicating that literacy enhances vocabulary variation rather than quantity. The largest effects emerged for elaborative categories: conjunctions, adverbs, and adjectives. These findings reveal that literacy fundamentally affects lexical organization and deployment in oral productions.

Keywords Literacy · Frog story · Narration · Lexical diversity · Turkish · Oral production

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Introduction

Despite being native speakers of the same language, adult individuals vary substantially in their linguistic knowledge and language use. A growing body of research suggests that one major source of this variation is literacy experience—that is, the extent to which individuals have been exposed to and engaged with written language throughout their lives (e.g., Dąbrowska, 2012; Gedik, 2025). Among the areas most affected by literacy, vocabulary knowledge stands out: speakers show particularly large individual differences in their lexical repertoire. Several previous studies (see below) show a relationship between differing levels of reading experience and individual differences in vocabulary knowledge, however, in this study we treat literacy as a categorical variable rather than a continuous one.

This variation in lexical repertoire stems in part from differences in input. Written language tends to contain a far richer and more diverse vocabulary than everyday speech. For instance, Hayes and Ahrens

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(1988) found that children's books contained significantly more rare words than even the speech of college graduates (see Table 1 below). Similarly, Cunningham and Stanovich (1998) demonstrate that written texts consistently surpass spoken ones in lexical richness, suggesting that non-basic vocabulary is often acquired incidentally through print exposure, especially in adulthood (see Dąbrowska, 2009). Since there is only so much vocabulary that can be acquired through oral input alone, sustained engagement with written language becomes a key driver of vocabulary expansion. However, one important note is that some subgenres of oral language (e.g., podcasts, audiobooks, texts that were written to be spoken) may provide vocabulary input similar to written genres. In this case, print exposure (or literacy experience) would refer to all of these types of genres (i.e., both written, and written to be spoken).

Indeed, numerous studies report robust correlations between reading experience and vocabulary knowledge, with coefficients ranging from 0.40 to 0.80, even after controlling for reading comprehension and nonverbal IQ (Dąbrowska, 2018; Cunningham & Stanovich, 1998; Mol & Bus, 2011; Gedik, 2024). These findings suggest that reading itself, but also arguably having exposure to texts that were written to be spoken (see above, see also Huettig & Pickering, 2019) contributes directly to vocabulary growth, rather than being merely a byproduct of other cognitive abilities such as inference-making.

Yet, literacy shapes more than just vocabulary size. Research in cognitive neuroscience and psycholinguistics shows that literacy acquisition restructures multiple domains of linguistic and cognitive processing, including phonological awareness, memory, syntactic parsing, and lexical access (Dehaene et al., 2010; Dąbrowska, 2012; Huettig & Mishra, 2014; Kosmidis et al., 2006; Morais et al., 1979). Despite these wide-ranging effects, most psycholinguistic research is based on highly literate speakers from WEIRD populations (Blasi et al., 2022; Henrich et al., 2010), overlooking the fact that limited literacy remains widespread: UNESCO (2024) estimates that over 770 million adults lack basic reading and writing skills worldwide.

Importantly, education, literacy, and vocabulary knowledge are entangled for at least two reasons. First, education can improve reasoning abilities, increase exposure to written materials, and expand topic knowledge, all of which lead to richer vocabulary knowledge (Denervaud et al., 2021; Ritchie & Tucker-Drob, 2018; Sternberg, 1987). On the other hand, acquisition of a writing system alters the structure and function of the brain (Dehaene et al., 2010; Huettig & Mishra, 2014), especially in areas connected to language, and promotes cognitive functions like working memory and lexical access that may be indirectly relevant to improving vocabulary acquisition.

Although prior studies have shown that print exposure and education support receptive vocabulary knowledge (e.g., Dabrowska, 2018), far less is known about how literacy acquisition shapes speakers' ability to deploy diverse lexical items in real-time communication. To date, only three studies have directly examined the effect of literacy on vocabulary knowledge, broadly speaking (Eme et al., 2010; Kim et al., 2013; Kosmidis et al., 2006). Eme et al. (2010) investigated oral narrative skills in adults who are illiterate compared to literate controls, using picture-

Table 1 Richness of vocabulary across selected written and spoken modalities (adapted from Hayes & Ahrens, 1988)

	Proportion of text from 5000 basic lexicon	Rank of median word	Number of rare words per 1000 tokens
College graduates in conversation with friends and spouses	0.94	496	17.3
Popular prime time tv	0.94	490	22.7
Children's books	0.92	627	30.9
Adult books	0.88	1058	52.7
Newspapers	0.84	1690	68.3
Scientific articles	0.70	4389	128.0

elicited storytelling to assess several linguistic features, including lexical diversity, quantified through the type–token ratio. In Eme et al. (2010), lexical diversity did not differ significantly between illiterate and literate adults, despite the former producing shorter narratives. While their results suggest that illiterate and literate speakers' lexical diversity do not differ, their method of quantifying type-token ratio is known to be sensitive to text length. Therefore, the underlying differences in lexical diversity may be masked by the significant differences of narrative length between the two groups.

In a different study, Kim and colleagues (2013) tested L1 Korean speakers from varying literacy levels (illiterate, semi-literate, literate), and tested them using the Boston Naming Test. They found that the purely illiterate group performed the lowest and literacy level was the best predictor of performance. Importantly, literacy does not operate in isolation. It is deeply intertwined with factors such as years of education, socioeconomic background, and the richness of linguistic environments, all of which contribute to vocabulary knowledge. For instance, Kosmidis et al. (2006) found that education was the strongest predictor of lexical processing performance, over and above literacy itself. This suggests that literacy experience, formal schooling, and broader life experience likely act in concert to shape both receptive and productive vocabulary. In the present study, we treat literacy as a central explanatory factor, while recognizing that it co-varies with educational exposure and related experiential differences.

There are other studies that suggest that the two groups may differ in their semantic fluency knowledge, which may be an indicator of the number of items available in a particular semantic category. Nielsen and Waldemar (2016) and da Silva et al. (2004), for instance, discovered that illiterate speakers fared worse on animals but better on supermarket items in a semantic fluency task. These results imply that familiarity may have an impact on performance (i.e., the results are a function of being familiar with a particular topic). However, a recent study conducted by Gedik and De La Garza (2025) shows that literate speakers outperform illiterate speakers even in experientially familiar categories such as household objects in a semantic fluency task, suggesting that the cognitive and linguistic differences literacy acquisition make are an important factor in lexical knowledge and how efficiently this knowledge is organized and can be accessed.

In light of this, productive vocabulary offers a complementary and arguably more dynamic measure of lexical competence, as it captures not just recognition but the ability to retrieve and use words appropriately in real-time language production. This can be systematically assessed using metrics that quantify the diversity of vocabulary used in spontaneous speech (i.e., lexical diversity). One such widely used metric is the type–token ratio (TTR), which has been suggested[1] to correlate with receptive vocabulary (Hess et al., 1984) and arguably reflects how flexibly speakers draw on their lexical resources.

While some studies have begun to explore the effects of literacy on morphology and syntax (Dąbrowska et al., 2023; Gedik & Dąbrowska, 2024), the impact of literacy on productive vocabulary use, particularly lexical diversity in oral production, remains poorly understood.

To address this gap, the current study examines whether and how literacy influences lexical diversity in narrative speech. Since freestyle oral production introduces many confounding variables (i.e., length, discourse, topic), which can influence the qualities of the output, structured narrations emerge as a viable candidate to elicit oral production. Narrative production offers an ecologically valid and linguistically rich context for assessing lexical diversity, as it elicits extended, connected speech that closely mirrors natural language use (Berman & Slobin, 1994; Fergadiotis et al., 2013). Unlike constrained elicitation formats such as picture naming or sentence completion, narrations require speakers to organize events, introduce and maintain reference, and select vocabulary appropriate to unfolding story contexts, thereby engaging a wide range of lexical and discourse-level skills (Berman, 2008; Schneider et al., 2006). Because storytelling involves both conceptual and linguistic planning, it provides a sensitive window into how individuals deploy lexical resources to construct meaning. We recognize, however, that narrative tasks are not neutral with respect to literacy: familiarity with story structure and narration may themselves be

[1] It was not simple TTR but a different TTR "calculated by dividing the total number of different words in an entire sample by the square root of twice the total number of words in that sample" (Hess et al., 1984, pp. 52-53).

influenced by literacy experience and early exposure to shared reading activities (Lever & Senechal, 2011). Therefore, literate adults are likely more accustomed to the conventions of storytelling (e.g., temporal sequencing, formulaic openings, detailed descriptions), whereas illiterate adults may adopt a more event-descriptive mode. Thus, group differences in lexical diversity need to be interpreted with caution, as they may reflect both lexical access and familiarity with narrative conventions.

Another concern is that illiterate speakers find it difficult to name 2 dimensional black and white drawings, (Reis et al., 2001), but not colored 2 dimensional objects. Illiterate speakers perform well within their literate age matched counterparts when the 2 dimensional objects are colored (Reis et al., 2006). Therefore, to address this and minimize its influence on our results, we used a colored, high definition version of our task (see Sect. 2).

Although previous research has linked print exposure to vocabulary breadth in literate populations (e.g., Gedik, 2024; Mol & Bus, 2011), little is known about how this knowledge is mobilized in oral production by individuals with different literacy profiles. To our knowledge, this is the first study to systematically compare lexical diversity in narrative production between illiterate and literate adults. We ask: Are there measurable differences in lexical diversity between the two groups? If so, what form do these differences take?

While overall lexical diversity is a useful index of expressive range, examining lexical diversity by part of speech may yield more diagnostic information about the discourse functions that literacy may influence, and to the researcher's knowledge, no previous study has investigated this aspect. Different word classes play distinct roles in narrative construction: nouns and verbs primarily supply referential and predicative content, whereas adjectives, adverbs and conjunctions contribute elaboration, temporal sequencing and clause linking that underlie narrative coherence and causal structure (e.g., Berman & Slobin, 1994). Therefore, a lexical diversity analysis of various parts-of-speech may help provide further insight into the role of literacy and its concomitant effects.

To answer this, we elicited narratives from age-matched, cognitively healthy adult Turkish speakers using a wordless picture book. The choice of Turkish speakers was based on availability, and the task was designed to be accessible across literacy levels for a controlled yet naturalistic comparison of productive lexical diversity.

Methodology

Participants

We gathered data from 24 illiterate adult native Turkish speakers (all female, mean age = 51.54, SD = 12.95) and 24 age-matched literate adults (all female, mean age = 45.33, SD = 12.44). The literate group included participants with at least a secondary school education, distributed as follows: 7 associate degree holders, 7 bachelor's degree holders, 7 master's degree holders, and 3 PhD holders. The illiterate participants were attending literacy classes at an adult education center in Ankara, Turkey, where they had been enrolled for an average of 4 months (SD = 0.20). Some were repeating the course for a second or third time. The curriculum, covering around 80 teaching units of 40 min each, included basic literacy alongside mathematics, Turkish language, and introductory history. Successful completion of the program grants a certificate equivalent to a primary school diploma in Turkey. At the time of the study, the illiterate participants had been learning literacy skills for about 5 months (mean = 5.33, SD = 6.95) and could read real words (mean = 7.45, SD = 8.87), and Turkish looking, sounding pseudowords (mean = 2.29, SD = 3.05), measured by a 1 min word reading task (see Gedik, forthcoming, and Gedik & De la Garza, 2025 for details).

The illiterate participants of this study were similar to the ones recruited by Gedik (forthcoming). They were illiterate due to sociocultural reasons. As reported in Gedik (forthcoming), Gökçe (2016), and Gökçe and Yıldız (2018), Turkish women who are illiterate cited oral tradition, a lifestyle that does not need reading, and expected household responsibilities including childrearing and housekeeping as causes of their illiteracy. Other reasons included: the idea that sending daughters to school is not necessary or beneficial, certain cultural or religious beliefs that a male teacher should not teach young female students, child brides (i.e., families forcing their underage daughters to marry someone), and the idea that young

females should assist their mothers from an early age are additional reasons (Özaydınlık 2014).

Before enrollment, illiterate participants were screened by the literacy center in collaboration with health professionals from local hospitals for speech, communication, or cognitive impairments such as dyslexia. Individuals with such conditions were not admitted to the literacy program, and consequently, were excluded from this study. Ethical approval for the study was obtained from Bilkent University (Bilkent Üniversitesi Etik Kurulu, approval number: 2022_12_21_01, dated December 22, 2022).

Materials

Narrations

Narratives were elicited using a modified edition of *Frog, Where Are You?* (Mayer, 1969), a 24-page wordless picture book. The Frog Story has been widely used in linguistic research because it offers several practical advantages for eliciting spoken narratives. Visual prompts allow researchers to avoid potential interference from a participant's second language or literacy level, since no reading is required. The storybook format also encourages speakers to produce extended, connected speech rather than isolated sentences, making it suitable for examining discourse-level features. Its accessibility and ability to generate rich linguistic data make it especially useful in contexts where literacy cannot be assumed.

To accommodate illiterate participants, who may find black-and-white illustrations challenging to interpret, we presented a colored, high definition version of the story; aside from the addition of color, no other changes were made. This particular book was chosen because its clear narrative arc naturally encourages storytellers to reflect on the characters' feelings and thoughts, creating a structured yet open-ended context to observe lexical choices, and was used in several previous studies, especially with children (e.g., Friend & Bates, 2014; Küntay & Nakamura, 2004).

Participants, who gave consent to partake in the study, were first told that the book contains no words and follows the story of a boy, a dog, and a frog. They were then asked to examine each page in sequence and narrate the events to the experimenter in their own words while viewing the illustrations. The experimenter reminded them to describe not just what happened but also what the characters might be experiencing or thinking. Except for clarifying their questions about unfamiliar characters (e.g., identifying animals like the deer or gopher, *is this a bee or a bird?*), the experimenter refrained from guiding or interrupting the storytelling. Once the narratives were complete, participants were thanked for their time.

Transcriptions

All recordings of the Frog Story narrations were transcribed verbatim by two native Turkish speakers with degrees in linguistics. Each transcript was first prepared by one transcriber and then reviewed independently by the second. Inter-rater agreement between the two transcribers before reconciliation was assessed using Cohen's kappa ($\kappa = 0.96$). Any disagreements of words were discussed and resolved collaboratively. The transcriptions captured all elements of spontaneous speech, including repetitions, hesitations, and fillers, in order to preserve the natural structure of the narratives. To ensure the transcripts focused solely on the participants' storytelling, any interactions with the experimenter (such as the experimenter clarifying participants' questions, brief comments, their responses when their clarifying questions were answered) were removed. While the transcripts reflected what speakers actually said, spelling and word forms followed the conventions of standard written Turkish, rather than phonetic transcription, to allow for consistent lexical analysis. Each transcript was first prepared by one transcriber and then reviewed by the second. Any differences were discussed and resolved collaboratively, based on an agreed-upon set of transcription conventions for marking pauses, self-corrections, and unintelligible segments. All transcripts were anonymized by removing personally identifying information and saved in UTF-8 encoded plain text format for further analysis.

Extraction of linguistic indices and Type-Token Ratio

To extract lexical diversity measures from the narrative transcripts, we used Sketch Engine (Kilgarriff et al., 2014), a corpus analysis tool that provides automated part-of-speech tagging and frequency analysis capabilities for many languages. Sketch Engine was selected for several methodological advantages:

(1) it offers robust morphological analysis specifically designed for Turkish, a morphologically rich language where accurate POS tagging requires sophisticated handling of complex inflectional and derivational processes; (2) it provides standardized tokenization procedures that ensure consistent identification of word boundaries across all transcripts; (3) its automated POS tagging reduces potential human coding errors and eliminates inter-rater reliability concerns that would arise from manual classification; and (4) it enables systematic extraction of both type (unique lexical items) and token (total word instances) counts across six major word classes: adjectives, adverbs, conjunctions, nouns, pronouns, and verbs. Finally, Sketch Engine is the only publicly available tool that can do lemmatization and POS tagging for Turkish for personal corpora.

We used Sketch Engine for tokenization, automated POS-tagging and lemmatization because it provides an integrated pipeline (token → POS tag → lemma) and supports a pre-trained Turkish tagset and parser (Kilgarriff et al., 2014). In Sketch Engine each token is stored with a wordform, a POS tag and a lemma (base form) field; its Turkish pipelines rely on a pre-trained model optimized for Turkish morphology (see the Sketch Engine Turkish POS tagset documentation). The tagger assigns POS labels using local context and statistical disambiguation rules, which reduces spurious multiple counts of simple inflectional variants (for example, *geldim/geliyorum/gelecegim* are all mapped to the lemma *gelmek* 'to come' where appropriate). Because Turkish is morphologically rich, lemmatization produces a cleaner estimate of unique lexical entries (lemmas) than raw surface forms.

Sketch Engine's pipeline resolves many ambiguous forms (e.g., homophones or homographs) through context-sensitive tagging; where forms are homographic but functionally different, the POS tag distinguishes them (so the same spelling counted as different POS categories if used differently), and the lemma field groups inflectional variants. However, automatic tagging is not infallible.

All transcripts were uploaded to the Sketch Engine platform, where they underwent automatic morphological parsing and POS tagging using the Turkish language model. The resulting frequency counts were extracted for each participant and word class, providing the raw data for subsequent RootTTR calculations and statistical analyses.

To measure lexical diversity, we employed RootTTR (Root Type-Token Ratio), calculated as the number of unique words (types) divided by the square root of the total number of words (tokens). While more sophisticated measures such as MATTR (Moving Average Type-Token Ratio) or MTLD (Measure of Textual Lexical Diversity) theoretically provide more robust control for text length effects, these measures require specialized software implementations that are not currently available for Turkish morphological analysis. We also considered logTTR (logarithmic Type-Token Ratio), which applies a logarithmic transformation to reduce length dependency, but RootTTR provides improved length normalization compared to simple TTR, though more sophisticated measures such as MTLD may offer superior length independence (Koizumi & In'nami, 2012; Fergadiotis et al., 2013).

RootTTR was selected as the most appropriate available measure for several reasons: (1) it provides better length normalization than simple TTR by reducing the mathematical dependency between type-token ratios and text length; (2) it has been successfully employed in cross-linguistic research and is widely recognized in the lexical diversity literature; (3) it can be reliably calculated from the frequency data extracted through Sketch Engine without requiring additional software dependencies; and (4) most importantly, the potential limitations of RootTTR's length sensitivity are minimal in our dataset since narrative lengths did not differ significantly between groups (Mean = 286.16 words for illiterate vs. Mean = 338.66 words for literate participants, $p = 0.28$). This non-significant length difference ensures that any observed RootTTR differences between groups reflect genuine lexical diversity rather than text length artifacts, making RootTTR an appropriate and valid measure for our comparative analysis.

Procedure

Illiterate participants were tested individually in a quiet, familiar room within the adult education centers, and each session was audio recorded. Before starting, the experimenters explained the study to participants and ensured they felt at ease. For illiterate participants, the experimenter read the consent form

aloud, obtained oral consent, and marked the form with a plus sign in the appropriate space before beginning the recording. Literate participants were tested individually in a quiet office at the university; they read and signed the consent form themselves before recording began.

Given that illiterate adults are considered a vulnerable population, special care was taken to support their comfort and well-being during the study. The experimenter provided frequent positive feedback, for example, by saying "Yes, amazing" or "You're doing very well", and regularly checked whether participants were comfortable. Most participants were highly engaged and interacted actively with the experimenter, with nearly all reporting that they enjoyed the experience. A few even asked to take part again.

At the beginning of each session, demographic information was collected, including age, length of time spent learning to read (for literate participants, this referred to how long they had been literate), years of formal education, highest educational qualification, and any previous literacy instruction before joining the adult education program. Following this, participants completed the Frog Story task. Each testing session took around 10–15 min.

Statistical analyses

After preprocessing data for statistical analyses, we imported the data to R (2024). We first obtained descriptive statistics. Then, to investigate the first research question, we coded group as literate vs. illiterate and ran two-tailed t.tests using the t.test() function in R to test the reliability of the differences between the literate and illiterate group. We used the lsr package (Navarro, 2015) to calculate effect sizes. The t-tests were carried out on each variable individually so as to minimize statistical interference effects of simultaneous multiple comparisons. Data, and the R code are available at the following link: https://osf.io/n725u/overview?view_only=c524030727e44ac3be33773bbcd77b34

Results

Table 2 provides data on age, number of years spent in formal schooling, and the length of narrations. As can be seen, the two groups differ significantly only in years spent in formal education. The average educational attainment of the illiterate speakers in this study was 0.04 years (roughly 4 months), while literate speakers had, on average, about 17 years of schooling. The difference in narrative length between the two groups was not statistically significant, with each group producing narrations of similar length (literate speakers: 338 words per narration on average, illiterate speakers: 286 words per narration on average). The literate corpus consisted of 9613 tokens while the illiterate corpus had 8935 tokens, totaling 18.548 tokens.

In Fig. 1, we analyzed the effect of literacy on lexical production by comparing illiterate and literate participants in terms of both the number of types (unique lexical items) and tokens (total instances of word use) across six parts of speech: adjectives, adverbs, conjunctions, nouns, pronouns, and verbs. For each category, we report mean differences, statistical significance, and effect sizes using Cohen's d.

In terms of types, literate speakers consistently produced a greater variety of words than illiterate speakers. This difference was statistically significant for adjectives ($p < 0.001$, $d = 1.07$), adverbs ($p < 0.001$, $d = 1.34$), conjunctions ($p < 0.001$, $d = 1.16$), and nouns ($p < 0.001$, $d = 1.15$), with effect sizes indicating large differences in lexical diversity. The difference in verb types approached significance ($p = 0.087$) and showed a moderate effect size ($d = 0.50$). For pronouns, no difference was found between groups ($p = 1$, $d = 0$).

As for the token data, literate speakers produced significantly more adjective tokens ($p = 0.0086$, $d = 0.79$), and adverb tokens ($p = 0.0098$, $d = 0.77$), all with medium to large effect sizes. However, the differences in noun token counts were not statistically significant ($p = 0.17$, $d = 0.40$), conjunction tokens ($p = 0.47$, $d = -0.21$), and there was no reliable difference in the number of pronouns ($p = 0.19$, $d = -0.38$) or verb tokens ($p = 0.94$, $d = -0.02$) between the groups.

To evaluate the effect of literacy on lexical diversity, in Table 3 we compared RootTTR scores across six parts of speech using independent t-tests: adjectives, adverbs, verbs, pronouns, conjunctions, nouns, as well as overall. Across most categories, literate speakers demonstrated significantly higher

Table 2 Descriptive statistics for the variables per group, standard deviation in parentheses, t-tests and effect sizes (Cohen's d)

	Illiterate		Literate			
	Mean (SD)	Range	Mean (SD)	Range	Group comparison	Cohens d
Age	51.54 (12.95)	28–80	45.33 (12.44)	21–68	t(45.92) = 1.69, p = 0.09	0.48
Years spent in formal education	0.04 (0.20)	0–1	17.95 (4.50)	12–27	t(23.09) = −19.45, p < 0.001	5.61
Narrative length (in words)	286.16 (145.89)	128–812	338.66 (189.14)	87–845	t(43.21) = −1.07, p = 0.28	0.31

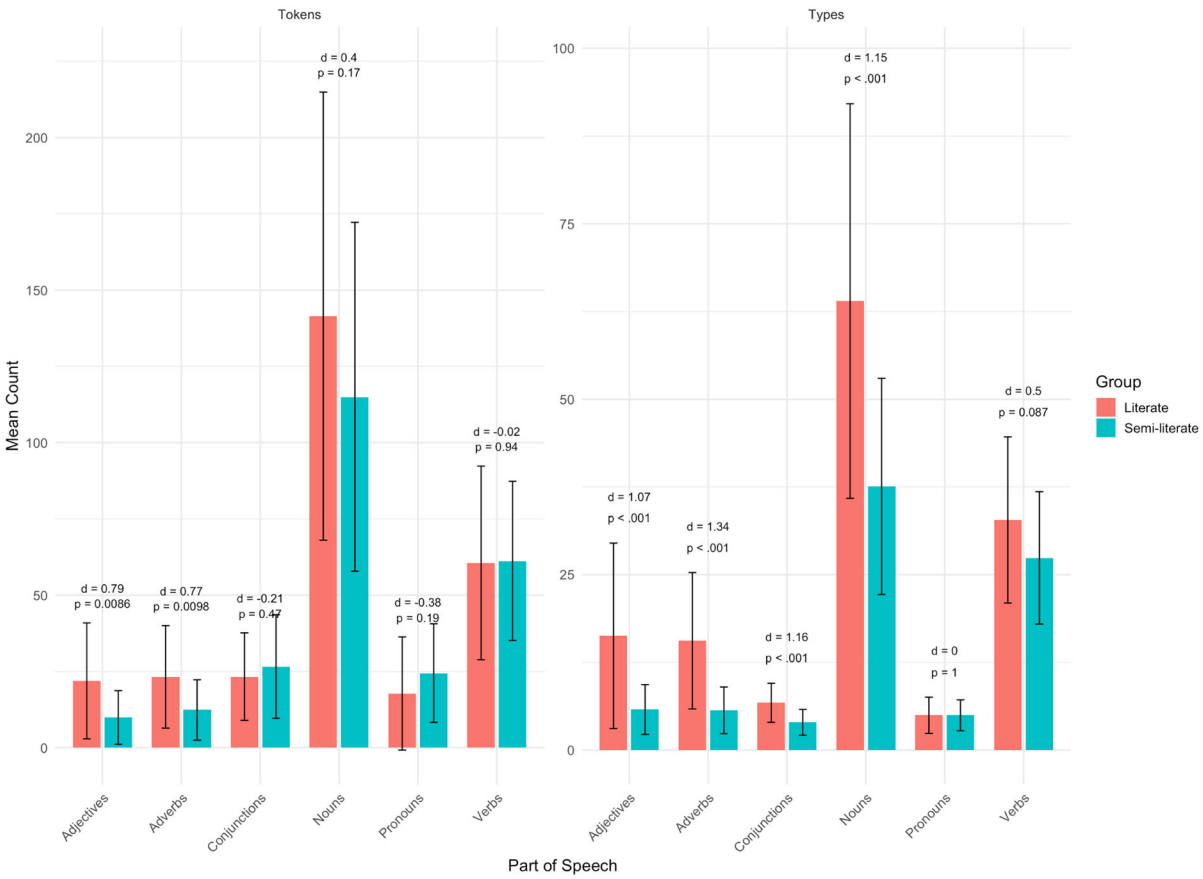

Fig. 1 Token and type count per group and per part-of-speech

RootTTR values than illiterate speakers, indicating more diverse lexical production.

The RootTTR for adjectives was significantly higher in the literate group (Mean = 3.26) than in the illiterate group (Mean = 1.82), t(30.65) = –4.93, $p < 0.001$, with a large effect size (d = 1.42). A similar pattern emerged for adverbs, where literate speakers again outperformed illiterate speakers (Means = 3.19 vs. 1.62), t(40.62) = −7.07, $p < 0.001$, with a very large effect (d = 2.04). For verbs, the literate group also showed higher RootTTR values (Mean = 4.24) compared to the illiterate group (Mean = 3.51), t(45.31) = −4.11, $p < 0.001$, d = 1.18.

Table 3 Descriptive statistics for RootTTR values of parts-of-speech and overall narration per group, standard deviation in parentheses, t-tests and effect sizes (Cohen's d)

	Illiterate		Literate			
RootTTR values	Mean (SD)	Range	Mean (SD)	Range	Group comparison	Cohens d
Adjectives	1.82 (0.54)	0.57–3.05	3.26 (1.32)	1.15–6.12	$t(30.65) = -4.93$, $p < 0.001$	1.42
Adverbs	1.62 (0.61)	0–2.75	3.19 (0.89)	1.73–5.16	$t(40.62) = -7.07$, $p < 0.001$	2.04
Verbs	3.51 (0.57)	2.60–4.83	4.24 (0.65)	2.93–5.67	$t(45.31) = -4.11$, $p < 0.001$	1.18
Pronouns	1.09 (0.36)	0.26–1.75	1.27 (0.31)	0.70–1.78	$t(45.10) = -1.75$, $p = 0.08$	0.50
Conjunctions	0.82 (0.29)	0.30–1.45	1.50 (0.35)	1–2.26	$t(44.11) = -7.25$, $p < 0.001$	2.08
Nouns	3.49 (0.78)	2.37–5.29	5.35 (1.02)	3.79–8.15	$t(43.18) = -7.05$, $p < 0.001$	2.03
Overall	7.43 (1.33)	5.38–9.68	10.86 (2.47)	5.38–15.30	$t(38.33) = -6.63$, $p < 0.001$	1.91

Overall RootTTR means the RootTTR values of entire texts, without looking into POS categories

The contrast in pronouns was less pronounced. While the literate group had slightly higher RootTTR values (Mean = 1.27) than the illiterate group (Mean = 1.09), the difference did not reach conventional levels of statistical significance, $t(45.10) = -1.75$, $p = 0.08$, with a moderate effect size ($d = 0.50$).

For conjunctions, RootTTR was significantly greater in the literate group (Mean = 1.50) than in the illiterate group (Mean = 0.82), $t(44.11) = -7.25$, $p < 0.001$, yielding a very large effect ($d = 2.08$). A similarly strong effect was observed for nouns, where literate speakers (Mean = 5.35) showed significantly higher RootTTR values than illiterate speakers (Mean = 3.49), $p < 0.001$, with Cohen's $d = 2.03$. RootTTR overall differed significantly between the groups, with literate speakers outperforming illiterate speakers, $t(38.34) = -6.64$, $p < 0.001$.

Discussion

General discussion

The present study investigated how literacy acquisition affects lexical diversity in adult L1 Turkish speakers by comparing illiterate and literate participants' output in a narrative production task. To investigate this, we elicited narrations from illiterate and literate L1 Turkish speakers on a wordless picture book (Frog Story), and conducted a lexical diversity analysis by comparing types and tokens as well as RootTTRs of various parts-of-speech (POS) using SketchEngine. The absence of a group difference in total word count indicates that both literate and illiterate participants were equally willing or able to participate in the narrative task. Given that the Frog Story has been used with young children to elicit narrations (e.g., Ögel Balaban & Hohenberger, 2020), we contend that the task did not pose cognitive demands. Moreover, participants had ample time to familiarize themselves with the story before beginning their narration, and were allowed to look at the pictures while speaking, which further supported the accessibility of the task. Nevertheless, the internal lexical diversity profiles of their stories diverged sharply between groups.

The type-token comparison analysis revealed a consistent pattern across word classes: while both groups produced comparable quantities of words (tokens) per POS (except for adverbs and adjectives), literate participants demonstrated significantly greater lexical variety (types) in their vocabulary choices. This pattern was most pronounced for nouns, where despite using similar numbers of noun tokens ($\sim$ 140 each), literate participants employed significantly more distinct nouns ($d = 1.15$, $p < 0.001$), suggesting they varied their referential expressions rather than repeatedly using the same terms. A similar trend emerged for the rest of the POS categories except for pronouns, indicating that literate speakers consistently drew from a broader lexical repertoire across word classes. The fact that there was no difference in pronouns is expected, since there is only a small number of pronouns, which need to be used in both written and spoken language. Thus, there is no reason

to expect literacy-related advantages in pronoun usage in terms of lexical diversity.

Given the robust and widespread differences in lexical types across parts of speech, it was especially compelling to examine type–token ratios as an index of productive vocabulary. Our findings revealed a systematic advantage for literate speakers in RootTTR scores across nearly all categories. The most pronounced disparities were observed for conjunctions and adverbs, categories which are crucial for linking, elaborating, and structuring discourse. Substantial differences in adjectives ($d = 1.42$) and verbs ($d = 1.18$), the descriptive and predicative core of narrative, further suggest that literacy contributes to deeper lexical precision and semantic range.

Before we explain our group differences and propose accounts for them, we first need to address that literacy is not an isolated factor. As will be discussed below and mentioned in the introduction, it is closely intertwined with education, cognitive development, and broader life experience, including opportunities for social interaction, autonomy in communication, and exposure to diverse linguistic registers (e.g., Fingeret, 1983; Gökçe & Yıldız, 2018). The differences observed in RootTTR may therefore reflect the cumulative impact of these intersecting factors. Therefore, we interpret literacy as a central explanatory variable because it encapsulates many of these life experiences and reflects the availability of written language as a persistent linguistic resource.

In this vein, literacy and its concomitant effects appear to enhance productive vocabulary by reducing lexical repetition and facilitating access to more diverse and precise vocabulary. The consistent pattern across multiple POS categories supports a domain-general effect, in line with theories that posit richer, more abstract lexical representations among speakers with regular exposure to written language (e.g., Bybee, 2010). This interpretation also resonates with cognitive and neuropsychological work showing that lexical diversity is sensitive to constraints in lexical access and selection, rather than just storage (e.g., Arslan et al., 2016; Maviş et al., 2014). Overall, these findings reinforce the view that literacy, understood as both a linguistic and socio-cognitive resource, broadens the lexicon and shapes the way speakers access and deploy vocabulary in narrative discourse.

Literacy effects on lexical diversity

In practice, literacy and education are deeply intertwined, those who spend more years in school are more exposed to written language and are more likely to engage in sustained reading. This relationship is reflected in our sample: group membership (literate vs. illiterate) is strongly correlated with years of education ($r = 0.94$, $p < 0.001$), confirming that the two variables are tightly coupled. Prior research has also documented this association, showing that time spent in formal education predicts reading habits and literacy outcomes (Dąbrowska, 2018; Gedik, 2024). While we refer to literacy as the primary explanatory factor in the discussion below, the effects may also reflect, or be amplified by, broader differences in educational and experiential backgrounds. These interconnected influences, such as socioeconomic status, gendered restrictions on mobility, and the richness of communicative environments, deserve closer investigation in future work. However, given the correlational nature of these factors with illiteracy, and given the theoretical implications of literacy experience on the structure and accessibility of linguistic knowledge, the present study focuses specifically on literacy as a central variable in understanding individual differences in vocabulary use and representation, as the illiterate/literate distinction also draws on these other factors explained above.

Why should literacy and its concomitant effects be an important predictor in lexical diversity in oral narrations? First, literacy acquisition has been shown to fundamentally restructure cognitive architecture as mentioned in the introduction. Dehaene and colleagues (2010) demonstrated that learning to read leads to measurable changes in brain function, including enhanced working memory, phonological processing, and abstraction. These general cognitive effects of literacy can make lexical access more efficient and flexible, especially under the demands of spontaneous speech while looking at pictures. In the present study, literate participants used a wider range of lexical types despite producing a comparable number of tokens, suggesting that literacy supports the dynamic retrieval and deployment of vocabulary during real-time language use.

Second, literacy changes the nature of linguistic input by exposing speakers to a lexically richer variety

of language. Written texts, including children's books, consistently contain more rare and diverse vocabulary than spoken conversation (Cunningham & Stanovich, 1998; Hayes & Ahrens, 1988). This enriched exposure enables the acquisition and entrenchment of low-frequency words that rarely occur in speech. Dąbrowska (2009) argues that most adult vocabulary is acquired through reading, and studies have repeatedly shown that print exposure is a strong predictor of receptive vocabulary size (e.g., Dąbrowska, 2018; Gedik, 2024; Mol & Bus, 2011). However, the effects observed in this study go beyond mere exposure to more types. If frequency alone explained the pattern, we would expect increases in both types and tokens across all categories. Instead, the selective enhancement of elaborative categories (e.g., adjectives, adverbs, conjunctions) suggests that written input not only expands the lexicon, but shapes its structure and usage in nuanced ways.

Third, sustained engagement with written language may promote discourse-level strategies that prioritize explicitness, precision, and coherence in communication, i.e., being explicit. Although the Frog Stories were delivered orally with help from pictures, the task itself is relatively decontextualized: it presents new content and requires speakers to construct a narrative from scratch. In such tasks, speakers may prefer more explicit reference strategies, such as repeating full noun phrases, instead of relying on pronouns that assume shared contextual knowledge. This pattern is reflected in our data: both groups used pronouns at comparable rates, consistent with their role in spoken, contextually embedded discourse. However, literate participants employed a significantly greater variety of nouns, suggesting that they were more likely to vary and elaborate referents using lexical means. This could be interpreted in two ways: 1) This aligns with Norrby and Håkansson's (2007) observation that a higher frequency and diversity of nouns mark a shift toward a more explicit, context-independent style, a tendency associated with written language. 2) This difference is a result of noun use to refer to different types of animals using the same token in the illiterate group (i.e., using the word *animal* to refer to *deer, bees, birds* and so on).

This aligns well with the nature of written language. Written discourse must explicitly mark relationships between events and ideas. As a result, literate individuals receive prolonged practice in how to structure descriptions, introduce referents, and connect clauses in ways that are self-contained and context-independent. While currently, there is little research on this issue, an emerging study provides suggestive evidence that more experience in receiving training to be more explicit in written language may have consequences for being explicit in oral language production (De la Garza et al., under review), among other cognitive skills such as Theory of Mind. In this vein, literate speakers may have used more varied vocabulary to be more explicit and to give more information about the story to their listeners.

In addition to the third account, sustained engagement with written discourses begin in childhood, often during shared book reading. This activity has been shown to increase narrative skills, as early as pre-kindergarteners (e.g., Lever & Senechal, 2011). Given that illiteracy is oftentimes generational, meaning that our illiterate participants most likely had at least one illiterate parent, as evidenced by Atli (2021) in a similar illiterate population to ours, our illiterate speakers may not have had the opportunity to be exposed to written discourses at an early age due to either (or both) parent(s) being illiterate. Without this early exposure, the illiterate adults might opt to just describe the core events without using adjectives and adverbs to add a level of further depth or connecting the narrated events to each other temporally or referentially because they are not familiar with task demands and how stories are usually narrated. Literate adults, on the other hand, might have more experience with the structure of the stories and structure their stories accordingly (e.g., starting the story with formulaic phrases such as "once upon a time" or naming the characters, linking events and characters together instead of just naming the objects and describing the events in isolation). This might explain the reported reduced variety in adjectives, adverbs, and conjunctions in illiterate adults' performance. Then, the differences in lexical diversity between groups can partly result from poor story narration skills or limited experience with storytelling. This advantage in the literate group may also partially explain the group level differences we observed.

Fourth, literacy fosters more efficient lexical retrieval and enhances semantic organization. Research has shown that literate individuals outperform their non-literate peers on verbal fluency and lexical decision tasks (da Silva et al., 2004; Gedik &

De La Garza, 2025; Kosmidis et al., 2006). This suggests that literacy does not just increase vocabulary size, but improves access to that vocabulary by strengthening semantic networks and reducing reliance on default, high-frequency forms. In the present study, literate participants' ability to draw on more varied lexical items without increasing wordiness may reflect a more efficiently organized lexicon, one that enables them to select precise and varied words for the task at hand.

Fifth, the literate and illiterate groups in this study differ in broader life experience. These life experience factors include the amount and quality of social interaction (e.g., with family, peers, or strangers), the level and duration of formal education, habits of language use such as reading, writing, viewing, and speaking, work-related activities, hobbies and interests, and knowledge of other languages. In Turkey, illiterate individuals often come from low socioeconomic backgrounds (Aktaş, 2007) and are unable to attend formal schooling due to structural and patriarchal barriers (Gökçe & Yıldız, 2018). Illiteracy in this context functions as a cumulative disadvantage, affecting cognitive domains such as nonverbal reasoning and grammatical comprehension (Gedik, forthcoming), and also undermining non-cognitive factors such as self-confidence, autonomy, and communicative independence (Fingeret, 1983; Gökçe, 2016). Women in these communities frequently lead restricted lives; they are perceived as incompetent by others, rely on close relatives to manage bureaucratic or medical appointments, and are often discouraged from engaging in public life without accompaniment (Gökçe & Yıldız, 2018). As a result, their interactions tend to occur within close-knit, esoteric communities where oral culture dominates and social exchanges are confined to familiar interlocutors (Yıldız, 2006; Wray & Grace, 2007; Gökçe, 2016).

Finally, and perhaps most critically, it is plausible that these mechanisms are not isolated or mutually exclusive; rather, they are deeply interconnected and mutually reinforcing. The cognitive restructuring brought about by literacy acquisition, such as enhanced working memory, and phonological awareness, forms a foundation that enables individuals to better process, retain, and manipulate the rich linguistic input available through written language. At the same time, more efficient semantic organization and lexical retrieval, supported by both cognitive and linguistic enhancements as a result of literacy acquisition, can allow literate speakers to select more precise, context-sensitive forms during real-time language use. These efficiencies feed back into discourse planning and narrative production: speakers are better able to anticipate listener needs, maintain coherence, and modulate information flow. In short, the effects of literacy are best understood not as parallel but as cascading, where each domain (i.e., cognition, lexicon, input exposure, and discourse structure) amplifies the development of the others, i.e., the Matthew Effect, Cunningham & Stanovich, 1998). This systemic interaction likely accounts for why literate individuals perform more consistently and with greater flexibility across a wide range of linguistic and communicative tasks, from morphosyntactic processing to narrative elaboration and referential communication. Understanding these mechanisms as mutually reinforcing also underscores the central hypothesis of this research program: that literacy serves not merely as a tool for decoding print, but as a developmental pathway that restructures and refines fundamental aspects of language and thought (Nielsen & Waldemar, 2016).

To our knowledge, this is the first study to examine the effects of literacy on lexical diversity in Turkish adult speakers using a structured narrative production task. While previous research has established that literacy affects receptive vocabulary size and syntactic comprehension (e.g., Kim et al., 2013; Kosmidis et al., 2006; Dąbrowska, 2009, 2018), the current study shows that these effects extend to productive language use, specifically, to the selection and variation of words in oral discourse. By conducting a part-of-speech-specific RootTTR analysis, we provide new, fine-grained evidence that literacy experience influences not just how many words are known, but how lexical resources are organized and deployed during real-time oral production.

What about literate speakers?

As some readers may rightfully point out, there are two issues with the literate group: a) RootTTR levels for POS show large individual differences and b) they differ in their literacy experience as a function of the number of years spent in formal education. While it is not the main focus of this paper, we conducted an exploratory correlational analysis to see if years of

education would correlate with the lexical diversity of various parts of speech. Indeed, years of education correlated positively with RootTTR scores across most categories: adjectives ($r = 0.55$, $p = 0.004$), adverbs ($r = 0.58$, $p = 0.003$), nouns ($r = 0.49$, $p = 0.01$), pronouns ($r = 0.49$, $p = 0.01$), and verbs ($r = 0.42$, $p = 0.03$). The only non-significant relationship was observed for conjunctions ($r = 0.28$, $p = 0.17$). While this is an exploratory analysis, these findings add to the idea that extended educational experience entails needing to engage with more written language (or materials of various kind that resemble the qualities of written language) (e.g., Street & Dabrowska, 2010). This in return arguably improves lexical diversity in open-class categories that contribute descriptive and elaborative content to discourse.

These correlations complement the mechanisms discussed in Sect. 4.2 by showing that extended education amplifies the same literacy-related advantages in lexical elaboration and access. The selective associations for open-class categories (e.g., adjectives, adverbs, nouns, verbs) suggest that sustained schooling and print exposure particularly enhance vocabulary used for description and expansion, supporting the view that literacy and education jointly refine expressive precision rather than simply increasing lexical quantity.

Practical implications

These findings also contribute to efforts to redress the WEIRD bias in psycholinguistics and cognitive science (Blasi et al., 2022; Henrich et al., 2010). Much of what we know about language processing and representation comes from literate, highly educated speakers in industrialized societies. By focusing on illiterate Turkish adults, this study challenges the assumption that native speakers form a uniform baseline of linguistic competence. Instead, our results support a view of language as shaped by developmental experiences such as schooling and literacy, with measurable consequences for everyday communication.

Differences in lexical diversity may have subtle but important implications for real-world communication, particularly for illiterate speakers. The reduced variety in lexical choice, especially in elaborative categories such as adjectives, adverbs, and conjunctions, may pose challenges in more complex communicative situations. In contexts where clarity, precision, and explicitness are crucial, such as healthcare encounters, legal settings, or bureaucratic procedures, limited lexical flexibility could hinder speakers' ability to describe events accurately, formulate questions, or follow instructions. Prior research highlights how speakers with limited linguistic resources may struggle in institutional interactions, particularly when additional barriers such as social stigma, minority status, or low education are present (Eades, 2008; Filipović, 2022). Although our illiterate participants are native speakers of Turkish, the reduced lexical variety may go unnoticed by their interlocutors, potentially leading to misjudgments of communicative intent or competence. This is especially concerning in environments where clarification requests may be discouraged or met with stigma, such as hospitals or administrative offices (Gökçe & Yıldız, 2018). While our study does not claim that lower lexical diversity necessarily results in poorer communication, these patterns highlight the need for greater awareness of how language experience, including literacy, shapes expressive capabilities in ways that may affect individuals' ability to navigate high-stakes interactions.

While this study was not designed to evaluate educational or communicative interventions directly, the findings may offer preliminary insights for applied domains. The observed differences in lexical diversity between illiterate and literate speakers suggest that sustained literacy experience may support not only vocabulary growth, but also the flexible use of language in communicative contexts. This has potential relevance for adult education programs, particularly those focused on enhancing oral communication skills alongside reading instruction. In contexts such as healthcare, legal settings, or bureaucratic interactions, where individuals are often required to describe situations clearly and understand complex spoken or written information, greater lexical flexibility and precision could plausibly support more effective communication. Although further research is needed to establish causal relationships and test applicability in specific domains, the current findings contribute to a growing body of evidence suggesting that literacy acquisition may enhance communicative competence in ways that extend beyond decoding written text. These findings may also inform policy discussions about adult literacy by highlighting the broader

cognitive and linguistic benefits associated with access to reading and writing instruction.

In this context, policy-level interventions that improve communicative accessibility may be valuable. For example, German public institutions increasingly provide information in both standard and simplified German (*Leichte Sprache*), allowing for more inclusive access to essential services. Currently, there are no comparable guidelines or standardized practices for simplified Turkish. Developing accessible Turkish communication strategies, especially in institutional settings, may help reduce the burden on speakers whose struggles often go unnoticed and improve equitable access to services and information.

Several limitations should be noted. First, the illiterate group had very limited formal education (0.04 years on average). Future research should examine populations with intermediate literacy levels to better understand the gradient relationship between literacy, education and lexical diversity. Second, type-token ratio (and its derivatives) is useful but is prone to errors due to text length. Researchers (e.g., Fergadiotis et al., 2013) argue that other forms of lexical diversity such as the Measure of Textual Lexical Diversity, the Moving-Average Type-Token Ratio, D, and the Hypergeometric Distribution are much more sensitive in documenting differences in lexical diversity. Because these measures are calculated using specific software tools which are not yet available for Turkish with clear guidelines, it was not possible in this study to measure them (though see Daller (2020) for an analysis of frog stories using D). Third, the narration task may place literate speakers in an advantageous position since they are familiar with task demands (see the third account in 4.2). Future studies should consider this in replicating this study. Fifth, we did not collect information on our participant's foreign language knowledge as well as their daily reading activities. These factors may be confounding variables in the results we observed in this paper. Finally, since automatic POS tagging and lemmatization are not infallible, there may be a small margin of error in the POS categories.

Considering this was an initial attempt at documenting lexical diversity differences between illiterate and literate speakers, future research could examine several other aspects. First, future research should use these more sensitive methods of measuring lexical diversity when software tools for Turkish are available. Second, considering good Theory of Mind skills improve reading others' mental states, and what interlocutors do not know, higher Theory of Mind skills may improve lexical diversity. Third, investigating whether literacy-related differences in lexical diversity hold across other genres, such as conversation, explanation, or argumentation, would test the generality of these effects, since different spoken registers may necessitate the use of various vocabulary items. Finally, longitudinal studies of adults acquiring literacy later in life could provide valuable insight into how lexical diversity evolves with increased print exposure and formal language use.

Conclusion

This study provides the first suggestive evidence that literacy acquisition fundamentally reshapes the lexical knowledge of adult language use in narrations. By analyzing the oral narratives of literate and illiterate Turkish speakers, we demonstrated that literacy and its concomitant effects significantly enhance lexical diversity across nearly all parts of speech, not by increasing output quantity, but by enabling greater variation and precision in vocabulary use. These findings extend prior research on vocabulary size and syntactic comprehension by showing that literacy also affects the organization and deployment of lexical resources in spontaneous, discourse-level production.

Our part-of-speech-specific RootTTR analysis revealed that literacy and its concomitant effects particularly enhances the use of elaborative and connective word categories—those most crucial for structuring explicit and coherent narratives. These patterns support usage-based accounts of language that emphasize the role of input frequency, cognitive restructuring, and discourse conventions in shaping linguistic competence. They also challenge the assumption that native speaker grammars are uniform across populations, highlighting literacy as a key factor in explaining individual variation.

By centering a illiterate population in a non-WEIRD context, this study contributes to a more inclusive and ecologically valid understanding of adult language. It emphasizes that literacy is not merely a tool for reading and writing, but a developmental experience that leaves deep and lasting imprints on how language is processed, structured,

and used—even in oral domains. As such, literacy must be recognized as a critical variable in models of language acquisition, representation, and use.

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Declarations

Conflict of interest The authors declare no competing interests.

References

Aktaş, A. M. (2007). Türkiye'de kadın sağlığını etkileyen sosyo-ekonomik faktörler ve yoksulluk [Socio-economic factors affecting women's health and poverty in Turkey]. Sosyal Politika Çalışmaları Dergisi, 12(12), 65-72. https://doi.org/10.21560/spcd.70435

Arslan, S., Bamyacı, E., & Bastiaanse, R. (2016). A characterization of verb use in Turkish agrammatic narrative speech. *Clinical Linguistics & Phonetics, 30*(6), 449–469. https://doi.org/10.3109/02699206.2016.1144224

Atli, A. (2021). Illiterate mothers and their daughters: "My daughter should be educated, not be like me." *Family Relations, 70*(5), 1485–1497.

Berman, R. A. (2008). The psycholinguistics of developing text construction. *Journal of Child Language, 35*(4), 735–771.

Berman, R. A., and Slobin, D. I. (1994). Relating events in narrative: A crosslinguistic developmental study. Erlbaum.

Blasi, D. E., Henrich, J., Adamou, E., Kemmerer, D., & Majid, A. (2022). Over-reliance on English hinders cognitive science. *Trends in Cognitive Sciences, 26*(12), 1153–1170.

Bybee, J. (2010). Language, usage and cognition. Cambridge University Press. https://doi.org/10.1017/CBO9780511750526

Cunningham, A. E., & Stanovich, K. E. (1998). What reading does for the mind. *American Educator, 22*, 8–17.

da Silva, C. G., Petersson, K. M., Faísca, L., Ingvar, M., & Reis, A. (2004). The effects of literacy and education on the quantitative and qualitative aspects of semantic verbal fluency. *Journal of Clinical and Experimental Neuropsychology, 26*(2), 266–277.

Dąbrowska, E. (2009). Words as constructions. In V. Evans & S. Pourcel (Eds.), *Human cognitive processing* (pp. 201–223). John Benjamins Publishing Company.

Dąbrowska, E. (2012). Different speakers, different grammars: Individual differences in native language attainment. *Linguistic Approaches to Bilingualism, 2*(3), 219–253.

Dąbrowska, E. (2018). Experience, aptitude and individual differences in native language ultimate attainment. *Cognition, 178*, 222–235. https://doi.org/10.1016/j.cognition.2018.05.018

Dąbrowska, E., Pascual, E., Macías-Gómez-Estern, B., & Llompart, M. (2023). Literacy-related differences in morphological knowledge: A nonce-word study. *Frontiers in Psychology, 14*, 1136337. https://doi.org/10.3389/fpsyg.2023.1136337

Daller, M. (2020). Turkish heritage speakers in Germany: vocabulary knowledge in German and Turkish. In F. Bayram (Ed.), *Studies in Turkish as a Heritage Language* (pp. 17–38). John Benjamins Publishing Company.

De la Garza, V., Gedik, T. A., & Dąbrowska, E. (under review). Mind over print: Cognitive predictors of the ability to communicate referentially.

Dehaene, S., Pegado, F., Braga, L. W., Ventura, P., Filho, G. N., Jobert, A., Dehaene-Lambertz, G., Kolinsky, R., Morais, J., & Cohen, L. (2010). How learning to read changes the cortical networks for vision and language. *Science, 330*(6009), 1359–1364.

Denervaud, S., Christensen, A. P., Kenett, Y. N., & Beaty, R. E. (2021). Education shapes the structure of semantic memory and impacts creative thinking. *Science of Learning, 6*(1), 35.

Eades, D. (2008). Language and disadvantage before the law. *Dimensions of forensic linguistics* (pp. 179–195). John Benjamins Publishing Company.

Eme, E., Lacroix, A., & Almecija, Y. (2010). Oral narrative skills in French adults who are functionally illiterate: Linguistic features and discourse organization. *Journal of Speech, Language, and Hearing Research, 53*(5), 1349–1371.

Fergadiotis, G., Wright, H. H., & West, T. M. (2013). Measuring lexical diversity in narrative discourse of people with aphasia. *American Journal of Speech-Language Pathology*. https://doi.org/10.1044/1058-0360(2013/12-0083)

Filipović, L. (2022). Language and culture as sources of inequality in US police interrogations. *Applied Linguistics, 43*(6), 1073–1093.

Fingeret, A. (1983). Social network: a new perspective on independence and illiterate adults. *Adult Education, 33*(3), 133–146. https://doi.org/10.1177/074171368303300301

Friend, M., & Bates, R. P. (2014). The union of narrative and executive function: Different but complementary. *Frontiers in Psychology, 5*, Article 469.

Gedik, T. A. (2024). Development of the Turkish Author Recognition Task (TART) and the Turkish Vocabulary Size Test (TurVoST). *SN Social Sciences, 4*(8), 1–24. https://doi.org/10.1007/s43545-024-00930-9

Gedik, T. A. (2025). The entangled nature of first language learning, education, and literacy. *Cadernos De Linguística, 6*(2), Article e785. https://doi.org/10.25189/2675-4916.2025.v6.n2.id785

Gedik, T. A., & Dabrowska, E. (2024). *When good-enough processing is not good-enough*. Deutsche Gesellschaft für Kognitive Linguistik, Osnabrück.

Gedik, T. A., & De La Garza, V. (2025). Literacy boosts semantic fluency even in ecologically valid categories. *Acta Psychologica, 260*, Article 105735. https://doi.org/10.1016/j.actpsy.2025.105735

Gedik, T. A. (forthcoming). *Literacy at Work: Ultimate Native Language Attainment*. Berlin, Boston: De Gruyter Mouton.

Gökçe, N. (2016). Kadınların Okuma-Yazma Kurslarına Katılmama Nedenleri ve Karşılaştıkları Güçlüklerle Baş Etme Stratejileri [Reasons Why Women Do Not Attend Literacy Courses and Strategies for Coping with the Difficulties They Face] [Master's Thesis]. Ankara Universitesi (Turkey).

Gökçe, N., & Yıldız, A. (2018). Türkiye'de okuma-yazma bilmeyen kadınlar ve okuma-yazma kurslarına katılmama nedenleri: "Ne edeyim okumayı, hayatım mı değişecek?". *Kastamonu Education Journal, 26*(6), 2151–2161.

Hess, C. W., Ritchie, K. P., & Landry, R. G. (1984). The type-token ratio and vocabulary performance. *Psychological Reports, 55*(1), 51–57.

Hayes, D. P., & Ahrens, M. G. (1988). Vocabulary simplification for children: A special case of 'motherese'? *Journal of Child Language, 15*(2), 395–410.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences, 33*(2–3), 61–83. https://doi.org/10.1017/S0140525X0999152X

Huettig, F., & Mishra, R. K. (2014). How literacy acquisition affects the illiterate mind—a critical examination of theories and evidence. *Language and Linguistics Compass, 8*(10), 401–427.

Huettig, F., & Pickering, M. J. (2019). Literacy advantages beyond reading: prediction of spoken language. *Trends in Cognitive Sciences, 23*(6), 464–475.

Kilgarriff, A., Baisa, V., Bušta, J., Jakubíček, M., Kovář, V., Michelfeit, J., Rychlỳ, P., & Suchomel, V. (2014). The Sketch Engine. *Lexicography, 1*(1), 7–36.

Kim, J., Yoon, J. H., Kim, S. R., & Kim, H. (2013). Effect of literacy level on cognitive and language tests in Korean illiterate older adults. *Geriatrics & Gerontology International, 14*(4), 911–917.

Koizumi, R., & In'nami, Y. (2012). Effects of text length on lexical diversity measures: using short texts with less than 200 tokens. *System, 40*(4), 554–564.

Kosmidis, M. H., Tsapkini, K., & Folia, V. (2006). Lexical processing in illiteracy: Effect of literacy or education? *Cortex, 42*(7), 1021–1027.

Küntay, A. C., & Nakamura, K. (2004). Linguistic strategies serving evaluative functions: A comparison between Japanese and Turkish narratives. *Relating events in narrative* (pp. 329–358). Psychology Press.

Lever, R., & Sénéchal, M. (2011). Discussing stories: on how a dialogic reading intervention improves kindergartners' oral narrative construction. *Journal of Experimental Child Psychology, 108*(1), 1–24.

Maviş, İ., Tunçer, M., Üre, I., & Öztürk, S. (2014). The lexical quantification of aphasic spontaneous speech in Turkish: A comparison across discourse types. In: *Proceedings of the 16th International Aphasia Rehabilitation Conference*.

Mayer, M. (1969). *Frog, where are you?* Dial Press.

Mol, S. E., & Bus, A. G. (2011). To read or not to read: A meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin, 137*(2), 267.

Morais, J., Cary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? *Cognition, 7*(4), 323–331.

Navarro, D. (2015). *Learning statistics with R: A tutorial for psychology students and other beginners. (Version 0.6)*. University of New South Wales. https://learningstatisticswithr.com

Nielsen, T. R., and Waldemar, G. (2016). Effects of literacy on semantic verbal fluency in an immigrant population. Aging, Neuropsychology, and Cognition, 23(5), 578–590.

Norrby, C., & Håkansson, G. (2007). The interaction of complexity and grammatical processability: the case of Swedish as a foreign language. *International Review of Applied Linguistics in Language Teaching, 45*(1), 45–68. https://doi.org/10.1515/IRAL.2007.002

Ögel Balaban, H., & Hohenberger, A. (2020). The development of narrative skills in Turkish-speaking children: a complexity approach. *PloS One, 15*(5), Article e0232579.

Özaydınlık, K. (2014). Özaydınlık, K. (2014). Toplumsal cinsiyet temelinde Türkiye'de kadın ve eğitim. [Women and education in Turkey on the basis of gender]. Sosyal Politika Çalışmaları Dergisi, 33.

Reis, A., Faísca, L., Ingvar, M., & Petersson, K. M. (2006). Color makes a difference: two-dimensional object naming in literate and illiterate subjects. *Brain and Cognition, 60*(1), 49–54.

Reis, A., Petersson, K. M., Castro-Caldas, A., & Ingvar, M. (2001). Formal schooling influences two-but not three-dimensional naming skills. *Brain and Cognition, 47*(3), 397–411.

Ritchie, S. J., & Tucker-Drob, E. M. (2018). How Much Does Education Improve Intelligence? A meta-analysis. *Psychological Science, 29*(8), 1358–1369. https://doi.org/10.1177/0956797618774253

Schneider, P., Hayward, D., & Dubé, R. V. (2006). Storytelling from pictures using the Edmonton narrative norms instrument. *Journal of Speech Language Pathology and Audiology, 30*(4), 224.

Sternberg, R. J. (1987). Most vocabulary is learned from context. In M. G. McKeown & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 89–106). Erlbaum.

Street, J. A., & Dąbrowska, E. (2010). More individual differences in language attainment: How much do adult native speakers of English know about passives and quantifiers? *Lingua, 120*(8), 2080–2094.

UNESCO. (2024). *Literacy*. https://www.unesco.org/en/literacy

Wray, A., & Grace, G. W. (2007). The consequences of talking to strangers: evolutionary corollaries of socio-cultural influences on linguistic form. *The Evolution of Language, 117*(3), 543–578. https://doi.org/10.1016/j.lingua.2005.05.005

Yıldız, A. (2006). Türkiye'de Yetişkin Okuryazarlığı: Yetişkin Okuma-yazma Eğitimine Eleştirel Bir Yaklaşım [Adult Literacy in Turkey: A Critical Approach to Adult Literacy Education] [PhD Thesis]. Ankara Universitesi (Turkey).