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The Dynamics of Word Reading Fluency in Young German Language Learners: The Role of Pseudoword Reading

In transparent orthographies, decoding is typically acquired early, driven by phonological awareness and phoneme–grapheme mapping, independent of L1 or L2 status. However, among 193 L1 and 211 L2 German-speaking children, L2 learners showed delayed word reading but slightly superior pseudoword reading, likely due to weaker lexical representations; this inhibitory effect remained stable, affirming pseudoword reading as a valid fluency measure.

Keywords: Reading fluency, second language reading, primary school, pseudoword reading.

Die Dynamik der Wortleseflüssigkeit bei jungen Deutschlernenden: die Rolle des Pseudowortlesens

In transparenten Orthografien wird das rekodierende Lesen meist früh erworben, basierend auf phonologischer Bewusstheit und der Phonem-Graphem-Zuordnung, unabhängig vom Status der Erst- oder Zweitsprache. Unter 193 Kindern mit Deutsch als L1 und 211 als L2, zeigten sich die L2-Kinder leicht überlegen im Pseudowortlesen, im Wortlesen aufgrund schwächerer lexikalischer Repräsentationen jedoch unterlegen. Der Hemmeffekt war stabil und stützt das Pseudowortlesen als valides Maß für die Leseflüssigkeit.

Schlüsselwörter: Leseflüssigkeit, Lesen in einer Zweitsprache, Grundschulstufe, Pseudowortlesen

1 Introduction

In Western countries, the migrant population has grown steadily in recent years, including Switzerland, where 40 % of the permanent residents have a migrant background. A distinctive feature of the Swiss migration population is its linguistic heterogeneity, with a significant number of migrants from West Asian and North African countries, along with traditional sources such as Italy, Spain, and Portugal. This lingual diversity brings both benefits and challenges in language use (Bialystok 2007). Children with German as a second language (GL2) are often socialized in several languages (Krüsi 2021), with Swiss German typically used in everyday oral communication and Standard German serving as the language of schooling and literacy instruction. This diglossic context creates an additional challenge for reading acquisition in Standard German, because children must develop reading skills in the school language that differs from the variety used in many everyday interactions. It is thus crucial to investigate the interactions between reading variables and vocabulary in order to provide children with the necessary skills for decoding and reading fluency in primary school, thereby enabling the understanding of complex texts in later years. In the present study, children with German as a first language (GL1)

serve as the institutional reference group that is commonly used in German-speaking educational systems.

2 Reading Acquisition

2.1 The Foundations of Reading

Reading fluency is a multi-layered construct that includes accurate and efficient recognition of letters and words as well as the ability to read connected text with appropriate speed and prosody. It is a crucial prerequisite for successful text comprehension (Sappok et al. 2020). The foundation of fluent word reading is decoding, i.e., the ability to systematically assign speech sounds to letters and combine them into higher linguistic units (e.g., Nation 2008). A key factor for successful decoding is phonological awareness, that is, the ability to identify and manipulate the sound structure of spoken words, which has repeatedly been shown to predict early word and pseudoword reading in German and other alphabetic orthographies (e.g., Goswami et al. 2001; Landerl & Wimmer 2008; Pikulski & Chard 2005). In the triangular model of word reading, phonological, orthographic, and semantic representations are tightly interconnected, so that fluent reading emerges from efficient mappings between print, sound, and meaning (Plaut et al. 2020). According to the simple view of reading (Gough & Tunmer 1986), reading comprehension can be conceptualized as the product of word recognition and oral language comprehension, which both build on fluent decoding. In the present study, word and pseudoword reading fluency are therefore used as indicators of technical decoding efficiency, whereas reading comprehension captures how successfully decoded print is integrated with oral language skills and background knowledge.

2.2 Reading Acquisition in Second Language Learners

Theoretical accounts underline the role of first-language proficiency and the phonological, orthographic, and syntactic structure of the first language in second-language reading acquisition (Bialystok 2007). Factors such as exposure duration, family education level, and socioeconomic status influence first-language proficiency (Hußmann et al. 2017). Early bilinguals typically have different educational backgrounds than late bilinguals (defined as individuals who acquire a second language from around the age of four onward; Kovelman et al. 2008) and usually perform comparably to monolingual children in reading (Lesaux et al. 2006). Previous research has reported an increased relative risk for diminished reading outcomes for specific groups of late bilinguals compared to monolingual peers in the respective school language (e.g., Bonifacci & Tobia 2016; Melby-Lervåg & Lervåg 2014). These group-level trends, however, often mask substantial individual variability and may reflect differences in early exposure and instruction rather than underlying deficits.

However, findings across individual studies vary considerably. Some studies report that second-language learners develop word reading fluency (measured as pseudoword reading pace) and comprehension skills similar to their monolingual peers (Lesaux et al. 2006; Raudszus et al. 2021), whereas others report disadvantages. Babayiğit et al. (2022), for instance, found that nine-year-olds with English as a second language showed weaker reading comprehension than monolinguals despite comparable cognitive abilities and

word reading. In German-speaking contexts, large-scale assessments and longitudinal studies likewise document gaps in reading comprehension and related components between L1 and L2 learners (e.g., Duzy et al. 2014; Hußmann et al. 2017; Limbird et al. 2014; Sauerborn & Schottorf 2026; von Goldammer et al. 2021). At the same time, these studies highlight considerable within-group variability among L2 learners, underlining the need for more fine-grained analyses of multilingual reading development. However, these findings stem from different languages, orthographies, and educational settings, and they vary in the extent to which they control for background factors such as socioeconomic status and length of exposure to the school language. Thus, results from L1 and L2 learners cannot be considered fully equivalent across studies, and cross-study comparisons need to be interpreted with caution.

2.3 The Role of Vocabulary

Vocabulary knowledge is closely linked to reading fluency (Nation & Snowling 2004). The simple view of reading becomes more complex when oral vocabulary is considered, which significantly impacts text-level reading comprehension (Ouellette & Beers 2010). Vocabulary encompasses not just receptive breadth, but also expressive vocabulary and vocabulary depth, which integrate phonological, orthographic, semantic, and grammatical information (Read 2004). Expressive vocabulary requires sufficiently consolidated word representations in these domains so that words can be actively retrieved and used productively in oral and written language (Ricketts et al. 2007). Vocabulary depth in the form of semantic word knowledge is also fundamental for reading comprehension (Nation 2008; Ouellette 2006) and enables coherent text comprehension (Perfetti 2007). Semantic word knowledge refers to how well a word's meaning is represented, ranging from general or context-bound knowledge to differentiated knowledge of its meaning.

Both vocabulary breadth and depth have been shown to predict reading comprehension in children learning the school language as an additional language, typically in comparison to monolingual peers in that language (e.g., Verhoeven 2014; Proctor et al. 2012). These group-level findings are based on monolingual norms and do not capture multilingual children's full lexical repertoires across their languages. Limbird et al. (2014) therefore recommend tailored models for the specific vocabulary characteristics of L2 children. Lervåg and Aukrust (2010) found that vocabulary alone predicted the development of reading comprehension. Röthlisberger et al. (2021, 2023) found that vocabulary depth – operationalized as semantic and relational word knowledge – has a stronger impact on L2 children's reading comprehension than breadth.

2.4 Learning to Read in (More or Less) Transparent Orthographies

Learning to read begins with phoneme-grapheme mapping (phonological recoding). The efficiency of this strategy depends on orthographic transparency, i.e., the consistency of grapheme-to-phoneme mapping. In relatively transparent orthographies such as German, and even more so in Italian and Finnish, where many but not all grapheme–phoneme correspondences (GPCs) are consistent, this strategy is particularly effective in early reading acquisition (Ziegler & Goswami 2006). Cross-linguistic studies show that first graders in transparent orthographies read more words correctly after one year of

instruction than their peers in non-transparent orthographies and demonstrate advantages in pseudoword reading (Seymour et al. 2003). In a comparison of German- and English-speaking primary school children, English-speaking children up to nine years of age made more errors when decoding pseudowords and low-frequency words than German-speaking children, even when word recognition ability was controlled (Frith et al. 1998). A longitudinal study with German-speaking children showed that by the end of Grade 1, they already demonstrated very high accuracy in reading words and pseudowords and that, from Grade 4 to Grade 8, reading speed reliably predicted text reading fluency (Landerl & Wimmer 2008). Thus, children who learn to read in a relatively transparent orthography, such as German, exhibit better decoding skills in word and pseudoword reading than children learning to read in non-transparent orthographies. This raises the question of whether the same holds for children who learn to read in a second language with a transparent orthography. However, comparable studies on children learning German as a second language are lacking.

In Italian, with its even more transparent orthography, pseudoword reading predicts reading accuracy in late bilingual children, whereas word reading speed is related to vocabulary (Bonifacci & Tobia 2016). The authors suggest that orthographic transparency does not imply that L2 children primarily rely on decoding words. Thus, phonological decoding alone may not be sufficient for successful reading comprehension. This likely applies to German as a second language as well.

2.5 Pseudoword Reading

Pseudoword reading relies primarily on phoneme-grapheme mapping and the phonological route (Share 1995), which is practiced early in reading acquisition and is strongly influenced by phonological awareness. Over time, children form orthographic word representations that support fluent reading, and the influence of phonological awareness on word reading decreases, but it remains important for pseudoword reading (e.g., Castles & Nation 2006; Vaessen & Blomert 2010). However, pseudoword reading is highly sensitive to stimulus properties. Pseudowords with a high degree of word similarity elicit lexical effects similar to those observed in word reading, with reduced reliance on phonological awareness and increased use of orthographic representations.

Word similarity is determined by the number of lexical neighbors and syllabic frequency (e.g., Arduino & Burani 2004). Novice monolingual readers show lexical influences on pseudoword processing (Martinet et al. 2004). Similar lexical effects have been found in 8- to 10-year-old Italian children. In that study, children read pseudowords derived from high-frequency words more slowly and with more errors, due to rapid activation of the base word (Marcolini et al. 2009).

In German, pseudoword reading is likewise influenced not only by grapheme–phoneme correspondences but also by internalized regularities at the level of syllable structure and orthographic patterns, as emphasized in German-language research on the syllabic and orthographic principles of German (e.g., Eisenberg 1988; Prinz & Wiese 1990).

Pseudoword reading is therefore not free from lexical–semantic influences that may decrease performance. In children with larger vocabularies, pseudowords derived from

high-frequency words may be particularly difficult because the corresponding real words are rapidly activated and interfere with decoding. By contrast, second-language learners with more restricted vocabularies may activate these base words less reliably, which can reduce lexical competition and make such pseudowords relatively easier to read.

2.6 The Present Study

The present study focuses on whether reduced lexical–semantic activation in German L2 learners (GL2) leads to a relative advantage in pseudoword reading but a disadvantage in word reading, and on how this pattern is influenced by the link between reading fluency and vocabulary. Prior research indicates that pseudoword reading relies more on phonological decoding, whereas word reading increasingly recruits lexical–semantic knowledge (Job et al. 1998). In L2 learners with restricted vocabularies, reduced activation of word representations may decrease lexical interference in pseudoword reading, whereas unfamiliar lexical items can increase semantic demands in word reading. For GL1 children, the rapid activation of familiar lexical semantics may interfere particularly with pseudoword reading, whereas GL2 children experience less lexical competition. Based on these considerations, we formulate the following hypotheses.

- (H1) GL2 children show higher performance in pseudoword reading than in word reading
  (H1a) at each time point
  (H1b) in their development from Grade 2 to Grade 3.
- (H2) Phonological awareness has a strong relation to pseudoword reading in both groups.
- (H3) Vocabulary-related semantic inhibition is stronger
  (H3a) in GL2 than in GL1 children,
  (H3b) for word reading fluency than for pseudoword reading.

3 Method

3.1 Participants

A sample of 404 children was assessed in Grade 2 (t1) and Grade 3 (t2). The sample was composed of 202 girls and 202 boys, with a mean age at t1 8 years, 6 months, SD = 5.8 months, range = 4.3 years, at t2 9 years, 5 months, SD = 5.6 months, range = 4.0 years. Informed consent was obtained from the parents of all children. Along with the consent forms, the parents completed a short survey on family language use. Based on the survey, the 404 children were assigned to two groups: a group speaking German as a first language (GL1; 90 boys, 103 girls, mean age at t1 8 years, 4 months, SD = 4.6 months, at t2 9 years, 4 months, SD = 4.5 months, range = 2.2 years) and a group speaking German as a second language (GL2; 112 boys, 99 girls, mean age at t1 8 years, 6 months, SD = 6.6 months, at t2 9 years, 6 months, SD = 6.4 months, range = 4.3 years).

In the GL2 group, 23 children were classified as bilingual (L1 and German) based on information provided by their parents. A multivariate analysis of variance showed that

these children did not differ from the 188 second-language children in terms of their performance in word and pseudoword reading fluency, neither at t1 nor at t2, all $F < 3.45$, all $p > .07$. Because they did not differ from the other 188 second-language children in word and pseudoword reading fluency at either t1 or t2, they were not analyzed as a separate subgroup. The subsequent division of the total sample into two groups ensured the comparability of the participants in terms of age, schooling, and socioeconomic status. Within the GL2 group, children differed with respect to first language and migration history (e.g., being born in Switzerland or having attended kindergarten in Switzerland). Still, these background characteristics were not used to define further subgroups in the present analysis.

Children diagnosed with a language acquisition disorder were not included in the sample. The children were distributed across 34 classes in 18 schools, most of which were located in urban ($N = 14$) or suburban ($N = 17$) areas, with only three classes from a rural area. All schools were situated in the canton of Bern, Switzerland. The classes were recruited via the school administration, with the support of the Department of Education and Culture of the Canton of Bern. The study was approved in advance by the university's internal review board.

3.2 Materials

All children were tested with the same test battery (see below). Vocabulary and phonological awareness were assessed at t1 (Grade 2). Receptive vocabulary breadth was initially assessed with the German adaptation of the Peabody Picture Vocabulary Test (PPVT-4). However, because this measure did not show unique predictive contributions in the latent change score model, it was excluded from the final analyses and is not discussed further.

3.2.1 Reading Fluency

The word and pseudoword reading subtests of the “Salzburger Lese- und Rechtschreibtest SLRT-II” (Salzburg reading and spelling test, Moll & Landerl 2014) were used as measures of reading fluency. In these tests, the children were asked to read aloud correctly as many items as possible from lists of 156 words and pseudowords within one minute. Accuracy was determined by the number of items read correctly, whereas speed was determined by the total number of items read.

3.2.2 Reading Comprehension

Reading comprehension was assessed using the standardized German reading test “ELFE II, Ein Leseverständnistest für Erst- bis Siebtklässler” (a reading comprehension test for children from grade 1 to 7; Lenhard et al. 2017). The ELFE-II consists of three parts: a word-level task (75 pictures paired with five words, including one target item, three minutes), a sentence-level task (36 cloze sentences with five response options, including one target item, three minutes), and a text-reading part (26 short texts followed by questions with four response options, including one target item, seven minutes).

3.2.3 Expressive Vocabulary (Grade 2)

Expressive vocabulary was measured using the expressive subtest (abbreviated version for children aged 7 to 9 years) of the "Wortschatz- und Wortfindungstest WWT 6-10" (vocabulary and word finding test, Glück 2011). In the WWT, children were asked to produce the precise names of objects, actions, antonyms, and hypernyms with the help of pictures. For the expressive vocabulary measure, antonyms and hypernyms were excluded, resulting in a total of 20 items. The test provides a measure of expressive vocabulary, reflecting how precisely children are able to retrieve and produce words for pictured concepts.

3.2.4 Vocabulary Depth (Grade 2)

Since there is no specialized test instrument for measuring semantic word knowledge in German, the 15 odd items of the definition task for measuring verbal intelligence from the German "Hamburg Wechsler Intelligence Test HAWIK-IV" (Petermann & Petermann 2007) were administered. The children were presented with a spoken word and asked to describe its meaning. The responses were scored according to the HAWIK scoring system with zero points (obviously incorrect, trivial, or based on a misunderstanding), one point (basically correct, but insufficient or imprecise description), or two points (naming a synonym or appropriate characteristics or classification). The definition task captures semantic word knowledge by indicating how well the meanings of familiar words are differentiated and articulated.

3.2.5 Phonological Awareness (Grade 2)

Three subtests from the German phonological awareness test "Basiskompetenzen für Lese-Rechtschreibleistungen BAKO1-4" (basic competences in reading and spelling, Stock et al.2017) were used as measures of phonological awareness: Vowel replacement (all /a/ sounds in eight words and four pseudowords had to be replaced by /i/), word remainder (the first phoneme of three words and four non-words had to be deleted), and phoneme blending (the first and second phonemes of five words and six pseudowords had to be exchanged).

3.3 Procedure

A total of 435 children participated in the first wave of data collection in Grade 2. Of these 435 children, 404 were still participating in Grade 3, corresponding to a dropout rate of 7%. These 7% had either moved or been assigned to a class that was not part of the study, as in Berne, there is a teacher change between Grade 2 and 3, and some classes are reorganized. The data collection in Grade 2 (t1) and 3 (t2) took place at approximately the same time of the school year, between the end of February and mid-June 2023 and 2024. Care was taken to ensure that the classes were attended roughly at the same time as in the previous year.

The data were collected at the schools by project staff and trained student assistants. Reading comprehension was assessed in a group setting, and all other measures, such as vocabulary, were applied in an individual setting. Divided into two blocks, each testing session lasted about 20 minutes.

3.4 Data Analysis

Data analysis was conducted using R packages psych (Revelle 2024), emulator (Hankin 2005), and lavaan (Rosseel 2012) for the latent change score model (LCSM). LCSM has several advantages over traditional methods, such as analysis of variance. It reduces measurement errors, allows to compare different domains – such as reading and vocabulary – and explicitly focuses on change (Kievit et al. 2018). However, to avoid spurious effects due to regression to the mean, the association between the initial measurements (t1) and delta was defined as a covariance instead of a regression effect (Sorjonen et al. 2023).

4 Results

4.1 Descriptive Statistics

Table 1 contains the mean values of the dependent and independent variables as well as the group differences based on *t*-tests. Notably, the groups did not differ significantly on any of the reported reading fluency measures, whereas the GL1 children showed significantly higher scores on all other measures. Interestingly, the GL2 children outperformed their monolingual peers in pseudoword reading.

Tab 1: Descriptive Statistics and *t*-Tests Between Language Groups in Grade 2 and 3

	Grade 2				Grade 3			
Group	All	GL1	GL2	Diff.	All	GL1	GL2	Diff.
Measure	*M* *(SD)*	*M* *(SD)*	*M* *(SD)*	*t* (*d*)	*M* *(SD)*	*M* *(SD)*	*M* *(SD)*	*t* (*d*)
Word Reading	40.57 (17.63)	41.56 (17.83)	39.67 (17.43)	1.08 (17.62)	54.58 (19.20)	55.92 (19.91)	53.36 (18.50)	1.34 (19.19)
Pseudoword Reading	30.87 (10.50)	30.33 (10.15)	31.37 (10.81)	-1.00 (10.50)	38.00 (11.39)	37.38 (10.87)	38.57 (11.85)	-1.05 (11.39)
Reading Comprehen-sion (T-Value)	46.01 (10.79)	49.76 (10.88)	42.58 (9.50)	7.03*** (10.18)	49.53 (9.54)	52.51 (9.47)	46.80 (8.77)	6.30*** (9.11)
Expressive Vocabulary	5.58 (4.65)	8.98 (4.07)	2.46 (2.44)	19.32** (3.32)	-	-	-	-
Semantic Word Knowledge	8.52 (4.45)	11.47 (3.53)	5.83 (3.75)	16.43** (3.44)	-	-	-	-
Phonological Awareness	16.55 (6.68)	18.23 (6.06)	15.01 (6.86)	5.00*** (6.49)	-	-	-	-

Notes: GL1: German as first language, *N* = 193; GL2: German as second language, *N* = 211; Mean number of correct items with standard deviations in parentheses; *t*-values with Cohen's *d* in parentheses; * $p < .05$, ** $p < .01$, *** $p < .001$. Vocabulary and phonological awareness were tested at t1.

4.2 Correlations

Kolmogorov-Smirnov tests showed for all variables in both groups a deviant distribution. Therefore, non-parametric Spearman correlations were calculated. The correlations for both groups at t1 are presented in Table 2, whereas Table 3 contains the correlations at t2.

Children in the GL2 group exhibited slightly weaker correlations between reading fluency, reading comprehension, and receptive vocabulary, but not between reading fluency and expressive vocabulary or semantic word knowledge. These correlations also remained stable across the two timepoints in both groups. In the GL1 group, the correlations between reading fluency and vocabulary measures were considerably lower. Phonological awareness yielded similar patterns of results in both groups.

Tab. 2: Grade 2 correlations between reading fluency and independent variables per group

		1	2	3	4	5	6
1	Word Reading Fluency	--	.885***	.765***	.192**	.237***	.460***
2	Pseudoword Reading Fluency	.814***	--	.670***	.135*	.154*	.447***
3	Reading Comprehension (t1)	.848***	.685***	--	.312***	.364***	.436***
4	Expressive Vocabulary (t1)	.099	.059	.299***	--	.652***	.235***
5	Semantic Word Knowledge (t1)	.128	.121	.261***	.500***	--	.280***
6	Phonological Awareness (t1)	.471***	.448***	.411***	.163*	.203**	--

Notes: Spearman rank coefficients of GL1: German as First Language (below the diagonal), N = 193; GL2: German as Second Language (above the diagonal), N = 211; * $p < .05$, ** $p < .01$, *** $p < .001$. All values are *z*-standardized.

Tab. 3: Grade 3 correlations between reading fluency and independent variables per group

		1	2	3	4	5	6
1	Word Reading Fluency	--	.880***	.638***	.201**	.272***	.446***
2	Pseudoword Reading Fluency	.841***	--	.601***	.113	.160*	.434***
3	Reading Comprehension (t1)	.787***	.666***	--			

4	Expressive Vocabulary (t1)	.083	.001	--		
5	Semantic Word Knowledge (t1)	.128	.092		--	
6	Phonological Awareness (t1)	.415***	.368***			--

Notes: Spearman rank coefficients of GL1: German as First Language (below the diagonal), N = 193; GL2: German as Second Language (above the diagonal), N = 211; * $p < .05$, ** $p < .01$, *** $p < .001$. All values are *z*-standardized.

4.3 Latent Change Score Model (LCSM)

In the latent change score model, reading fluency was operationalized as a z-standardized value of accuracy (number of items read correctly). The latent change score factor delta captured individual changes in reading fluency for word reading (delta1) and pseudoword reading (delta2) between the two timepoints. The ordinal variable group was time-invariant and depicted the differences between children with German as L1 and those with German as L2 at both timepoints, as well as differences in development between the two timepoints. Reading comprehension, vocabulary variables, and phonological awareness were all based on t1. Figure 1 illustrates the model, and the estimated coefficients are presented in Table 4 for improved reading ability.

Tab. 4: Estimated and standardized coefficients of the latent change score model

	Word Reading Fluency		Pseudoword Reading Fluency	
	t1	delta1	t1	delta2
Word Reading Fluency (t1)	-	-0.324*** (-0.633)	-	-
Pseudoword Reading Fluency (t1)	-	-	-	-0.308*** (-0.582)
Group	0.161	0.076 (0.148)	0.272**	0.040 (0.076)
Reading Com-prehension	0.859***	0.180*** (0.336)	0.712***	0.183*** (0.346)
Expressive Vocabulary	-0.260***	-0.078 (-0.171)	-0.246***	-0.145** (-0.274)
Semantic Word Knowledge	-0.010	0.075* (0.121)	-0.022	0.045 (0.085)
Phonological Awareness	0.151***	0.063* (0.122)	0.205***	0.055 (0.103)

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$; standardized coefficients in parentheses. Gender was not included due to insignificance. Fit indices: χ^2 (2) = 57.09, $p < .001$; CFI = 0.977; TLI = 0.699; RMSEA = 0.261; SRMR = 0.022

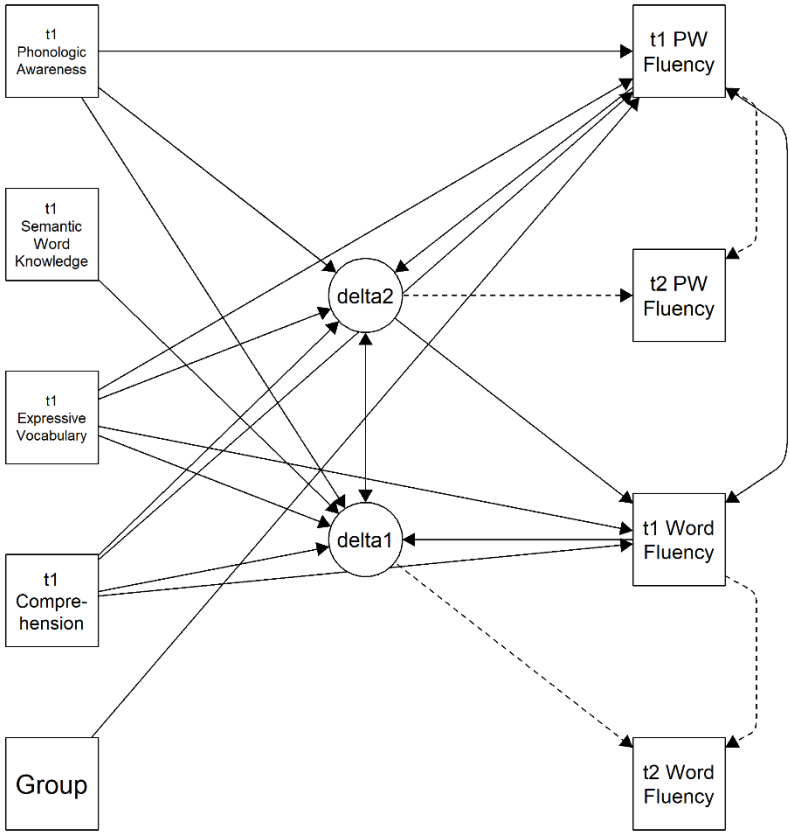

Fig. 1: Latent change score model. Rectangles depict observed variables, circles latent variables. Solid edges indicate regression effects; dashed edges indicate paths between manifest and latent variables. Double-headed arrows indicate covariances.

5 Discussion

5.1 General Discussion

This study investigated how word and pseudoword reading fluency develops from Grade 2 to Grade 3 and how it differs between children with German as a first language (GL1) and children with German as a second language (GL2). The focus was on the contributions of word and pseudoword reading as well as on the roles of phonological awareness and vocabulary. The hypotheses were that GL2 children would show better performance in pseudoword than in word reading at both time points and over time (H1a, H1b), that phonological awareness would exert comparable effects on pseudoword reading in both

groups (H2), and that vocabulary would interfere with GL2 children's reading performance, especially in word reading (H3a, H3b).

H1 was partially confirmed. GL2 children showed lower mean scores than GL1 children in word reading but slightly higher scores in pseudoword reading at both time points, in line with the idea that reduced lexical–semantic activation lessens interference in pseudoword reading while impeding word reading (H1a). In the latent change score model, group status significantly predicted pseudoword reading fluency at Grade 2, but no additional group effects emerged for changes in either word or pseudoword reading, indicating comparable gains from Grade 2 to Grade 3 (H1b was not supported). Controlling for phonological awareness (Goswami et al. 2001; Landerl & Wimmer 2008), vocabulary measures were negatively associated with reading fluency, particularly expressive vocabulary in relation to pseudoword reading, suggesting an inhibitory influence of stronger lexical–semantic representations on decoding (H3; see Bonifacci & Tobia 2016). However, these interpretations draw mainly on models and findings developed for English and Italian, and their transfer to German should be treated with caution, given the specific syllabic structure and orthographic characteristics of German. In particular, syllable-based and morphologically shaped orthographic regularities in German may contribute to group differences in pseudoword reading beyond lexical–semantic interference. Moreover, group differences in pseudoword reading necessarily depend on children's knowledge of German grapheme–phoneme correspondences; our interpretation of the GL2 advantage therefore assumes broadly comparable levels of GPC competence in both groups.

H2 was fully supported. Phonological awareness was strongly associated with both word and pseudoword reading fluency in GL1 and GL2 children, although these effects became somewhat weaker from Grade 2 to Grade 3 (see also Limbird et al. 2014). This pattern indicates similar developmental trajectories and parallel growth in phonological decoding skills in both language groups, consistent with the view that phonological awareness depends only to a limited extent on the specific language and its orthographic transparency.

Concerning H3, a more differentiated picture emerged across vocabulary domains (Nation 2008), although GL2 children performed worse than GL1 children on all three measures. Table 2, Table 3, and the latent change score model show that the relations between reading fluency and vocabulary vary by domain and outcome. Expressive vocabulary and semantic word knowledge showed hardly any correlations with reading fluency in GL1 children, but consistently stronger (and partly negative) associations with reading fluency and its development in GL2 children, especially in pseudoword reading. H3a and H3b are therefore at least partially supported for expressive vocabulary and semantic word knowledge. GL2 children seem to exhibit a certain degree of semantic interference, likely driven by inadequate or unstable lexical representations rather than by the sheer number of receptively known words (Röthlisberger et al. 2023).

Particularly striking in the GL2 group are the strong and increasing correlations between expressive vocabulary and pseudoword reading. This close relationship may indicate incomplete or imprecise phonological representations (Plaut et al. 2020), in line with the

lower phonological awareness scores. The negative coefficients for expressive vocabulary in the LCSM predicting pseudoword reading suggest slower gains in pseudoword reading among children with higher vocabulary growth. As semantic representations become more important, reliance on phonological cues decreases, which appears to impair pseudoword reading more than word reading, especially in GL2 children. At first glance, this contrasts with Ouellette (2006), who found that only vocabulary breadth predicted decoding skills, but his sample consisted exclusively of monolingual children. The influence of different vocabulary measures may therefore differ between L2 and L1 learners.

Finally, reading comprehension showed a strong positive association with both word and pseudoword reading fluency at Grade 2, indicating that better decoding skills are related to superior text comprehension. The corresponding coefficients were of similar size in the word and pseudoword components of the model. There was no interaction with group status, suggesting that the link between decoding and reading comprehension does not differ meaningfully between GL1 and GL2 children. Although GL2 children generally show lower levels of reading comprehension (Babayiğit et al. 2022; Duzy et al. 2014; Lervåg & Aukrust 2010; Limbird et al. 2014; Melby-Lervåg & Lervåg 2014), this appears to be due less to technical decoding difficulties than to limited vocabulary.

In summary, the findings suggest that children acquiring literacy in a second language with a transparent orthography exhibit lexical–semantic interference, particularly in word reading, despite proficient decoding skills. This interference appears to emerge from incomplete or inaccurate lexical representations. At the same time, GL2 children showed a slight stable advantage in pseudoword reading proficiency, although this advantage did not increase over time. Pseudoword reading may therefore be a suitable measure of technical decoding skills in L2 children, although it may not fully capture their developmental progress, whereas word reading seems to reflect the technical decoding abilities of L1 children more accurately. In terms of literacy development, our results indicate that limited or unstable lexical representations may constitute a more critical bottleneck for L2 learners than basic decoding skills. This highlights the importance of systematically integrating vocabulary breadth and depth into early reading instruction. However, these findings need to be interpreted in light of the monolingual reference norms used in this study.

5.2 Limitations

Our use of monolingual German speakers as a reference group reflects current assessment practices and curricular expectations in German-speaking school systems. However, such monolingual norms capture only part of multilingual children's linguistic repertoires, and future research needs assessment approaches and norms that better account for multilingual trajectories and within-group heterogeneity among L2 learners of German. It is important to note that the group of children learning German as an additional language is highly heterogeneous with regard to factors such as first language, length of exposure, and educational background. These group–internal differences could not be modeled in the current design and therefore limit the generalizability of our findings to all L2 learners of German. A further limitation is that we did not include a direct measure of knowledge

of German grapheme–phoneme correspondences. Comparisons of pseudoword reading between GL1 and GL2 children are thus based on the assumption of roughly comparable GPC competence in both groups, which cannot be verified with the present data. Moreover, the SLRT-II does not specify lexical neighborhood or word similarity for its pseudoword items, which prevents a more fine-grained analysis of lexical interference effects in pseudoword reading. In addition, potential sources of bias related to cultural background, test familiarity, school context, and the broader social environment were not explicitly modelled. The present design cannot disentangle whether group differences reflect individual competences or differential opportunities to acquire and demonstrate these competences.

For the further development of research and language assessment, it is important to acknowledge and represent the heterogeneity and diversity within L2 learner populations, for instance, by using assessment tools and norming procedures that are explicitly designed for multilingual children and by modelling relevant background factors more systematically. Such approaches may help to avoid stereotypical deficit-oriented attributions and to obtain a more differentiated picture of multilingual learners' reading development.

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