

Developmental trajectories of decoding skills in bilingual and monolingual children: A cross-sectional study

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Background: Multilingualism has become a widespread phenomenon in Italian classrooms [1]. In this context, monitoring reading development becomes crucial to inform the educational sector to provide inclusive curricula, and clinical centres to ensure equitable service. Decoding abilities in bilingual primary school children are suggested to be either comparable to that of monolinguals or negatively affected by concurrent measures of Socio-Economic Status and vocabulary [2], but systematic analyses across all school years are needed to confirm these trends, particularly in relation to cognitive approaches to bilingualism that would predict either a general or a restricted facilitatory effect [3]. To advance this debate, we employ a cross-sectional design to directly compare single-word reading in monolingual and bilingual children learning to read in Italian.

Method: Five-hundred and sixty-five typically developing primary school children from grades 1-5 (318 females; mean age = 8.7 years, range = 6.2–11.2, SD = 1.28) took part in the study. Of these, 162 were bilingual (28.6%). The children were recruited from primary schools mostly located in northern Italy. The bilingual children spoke a variety of languages, including Arabic, English, and Albanian. The majority of bilingual children were early bilinguals, having attended from at least one to all three years of nursery school in Italy (n = 145, 89.5%). Participants were tested on a computerised Lexical Decision task (LDT) recording accuracy and response times (Italian adaptation of Rapid Online Assessment of Reading [4]). The test randomly selected 170 stimuli (50% Italian words and 50% pseudowords) per participant from a pool of 286 items. Main outcome measures were accuracy (0/1) and Response Times (RT). Standardised measures of vocabulary [5], nonverbal cognition [6], and a parental questionnaire were also administered. From the parental questionnaire, measures of bilingual exposure were extracted (age of acquisition of Italian, years of nursery education in Italy, home language exposure, learning to read in a language other than Italian).

Results: D prime (d') was calculated as a measure of response-bias correct accuracy (Figure 1). A multiple linear regression model revealed an increase in sensitivity (represented by the d' value) across school years ($F(4, 548) = 56.75, p < .001$) after correcting for potential confounds (vocabulary, nonverbal cognition, SES, bilingual variables). Higher vocabulary, nonverbal cognition, and SES were associated with higher sensitivity ($ps < .05$). No significant effect of bilingualism was observed, but higher exposure to Italian at home was associated with higher sensitivity ($F(1, 548) = 5.65, p = .018$). Observed RTs for correct responses (Figure 2) were analyzed using a linear mixed effect model with language status and grade as fixed factors, by-subject and by-item random intercepts, correcting for confounding variables (vocabulary, nonverbal cognition, SES, bilingual variables). Similarly to sensitivity, an effect of grade was reported, with children becoming faster decoders through the years ($F(4, 545.74) = 55.84, p < .001$), and no main effect of bilingualism. However, a significant interaction between language status and grade was reported ($F(4, 546.16) = 3.70, p = .006$), with bilingual children in second grade being significantly faster than monolingual children in the same grade ($p < .001$). This effect for second grade was replicated on a subset of monolingual and bilingual second graders (N = 72) matched for CPM and SES ($F(1, 64.94) = 4.21, p = .044$).

Discussion: Monolingual and bilingual children show comparable sensitivity rates in decoding across school years, and comparable reading times in the late phases of formal reading instruction. These

results suggest that early bilingual children learning to read Italian reach similar academic achievements during primary school in the acquisition of decoding skills. Moreover, the earlier decrease of response times for bilinguals as compared to age-matched monolinguals points to a facilitatory effect in the early stages of bilinguals' reading development, consistent with an advantage during early skill learning.

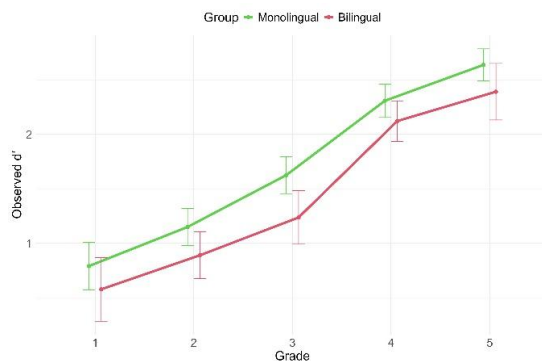


Figure 1: Observed d' values across grades, divided by group.

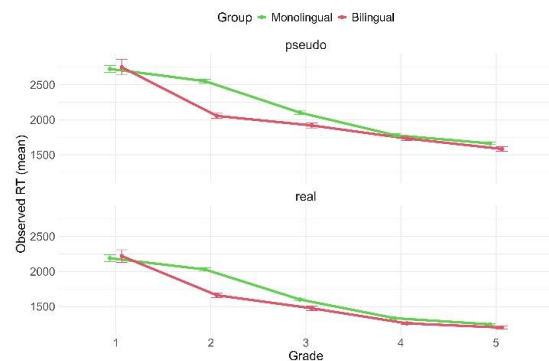


Figure 2: Observed RTs on correct responses across grades, divided by group.

References

- [1] Ministero dell'Istruzione e del Merito (MIM) & Ministero dell'Università e della Ricerca (MUR). (2024). Inserire qui il titolo del decreto o documento [Disponibile all'indirizzo: <https://www.mur.gov.it/it> o <https://www.mim.gov.it/>]. Retrieved June 26, 2026, from <https://www.mur.gov.it/it>
- [2] Bonifacci, P., Ferrara, I., Pedrinazzi, J., Terracina, F., & Palladino, P. (2022). Literacy Acquisition Trajectories in Bilingual Language Minority Children and Monolingual Peers with Similar or Different SES: A Three-Year Longitudinal Study. *Brain Sci*, 12, 563. <https://doi.org/10.3390/brainsci12050563>
- [3] Lehtonen, M., Fyndanis, V., & Jylkkä, J. (2023). The Relationship between Bilingual Language Use and Executive Functions. *Nature Reviews Psychology*, 2, 360–373. <https://doi.org/10.1038/s44159-023-00178-9>
- [4] Yeatman, J., Tang, K., Donnelly, P., Yablonski, M., Ramamurthy, M., Karipidis, I., Caffarra, S., Takada, M., Kanopka, K., Ben-Shachar, M., & Domingue, B. (2021). Rapid online assessment of reading ability. *Scientific Reports*, 11(1), 6396. <https://doi.org/10.1038/s41598-021-85907-x>
- [5] Kaplan, E., Goodglass, H., & Weintraub, S. (2001). *Boston Naming Test*. American Psychological Association (APA). <https://doi.org/10.1037/t27208-000>
- [6] Raven, J., Raven, J. C., & Court, J. H. (1998). *Manual for Raven's Progressive Matrices and Vocabulary Scales. Section 2: The Coloured Progressive Matrices*. Oxford Psychologists Press.