

NORWEGIAN CDIs IN RESEARCH

HANNE GRAM SIMONSEN¹, NINA GRAM GARMANN², KRISTIAN EMIL KRISTOFFERSEN^{3,4}

¹University of Oslo, Norway

²Oslo Metropolitan University, Norway

³National Centre for Rare Disorders, Frambu, Norway

⁴Nord University, Norway

Corresponding author: Nina Gram Garmann, e-mail: nigrag@oslomet.no

Received: 30.10.2025

Accepted: 12.01.2026

REVIEW ARTICLE

UDK: 81'23:811.113.5

DOI: <https://doi.org/10.31299/hrri.62.si.13>

Abstract: *The Norwegian CDI-I, CDI-II, and CDI-III have been used in research on typical and atypical acquisition of mono- and multilingual children who speak Norwegian. The studies on typical acquisition have examined the influence of linguistic, family, and environmental factors on lexical development, the relationship between lexical and grammatical development, lexical development in bilingual children, and the correlation between CDI reports from different raters. The papers on atypical acquisition have addressed reliability, validity, and correlation between raters regarding language acquisition in children with autism, and lexical and grammatical acquisition in children with 5p– syndrome.*

Keywords: *CDI; Norwegian; lexical development; typical/atypical acquisition; mono-/bilingual*

INTRODUCTION

In addition to the studies mentioned in the vignette (Simonsen et al., this issue), Norwegian CDI data have been used in studies on typical acquisition examining the following topics: 1) the effects of phonological and psycholinguistic factors on lexical acquisition, 2) the relationship between lexical and grammatical development, 3) lexical development in bilingual children, 4) influence of family factors, such as sibling status, on lexical acquisition, 5) the effect of environmental factors, such as book reading, screen time, and pacifier use, on lexical acquisition, and 6) the correlation between CDI reports from different raters, including preschool teachers and parents. The papers on atypical acquisition have addressed 1) reliability, validity, and correlation between raters regarding language acquisition in children with autism, and 2) lexical and grammatical acquisition in children with 5p– (5p deletion, Cri du chat) syndrome. Furthermore, CDI data have been used as control data or as matching criteria in experimental studies focusing on, for example, infant-directed speech, early vocabulary comprehension, and dialect exposure, which will not be covered here.

Typical acquisition

Influence of phonological and psycholinguistic factors on lexical acquisition

What are the phonological characteristics of children's first words? Based on norming data from CDI-I, Garmann et al. (2019a) studied the phonological characteristics of the first words acquired in Norwegian, comparing them with those of early words in Swedish, Danish, British English, and Italian, as well as with Norwegian adult-directed speech (ADS) and Norwegian child-directed speech (CDS). The study focused on word-initial bilabials and word length in syllables.

The analyses revealed that, independent of language, all children acquired a higher proportion of words with word-initial bilabials than other word-initial sounds. However, word length in syllables was language-dependent, and Norwegian children acquired a balanced proportion of monosyllabic and disyllabic words. While children had a higher proportion of shorter words and words with word-initial bilabials than both ADS and CDS, CDS was better adapted to children's speech. These findings indicate that children's lexical acquisition depends on both nature and nurture.

What makes a word easy to acquire? Based on norming data from CDI-I and CDI-II, Hansen (2017) investigated the psycholinguistic factors that affect the acquisition of a particular word, and whether age of acquisition (AoA) or vocabulary size of acquisition (VSA) best indicates when a word is acquired.

While the AoA and VSA were correlated, VSA was more evenly distributed and more sensitive to lexical effects. Frequency and imageability (the degree to which a word evokes sensory associations such as a mental image or a smell), as well as word length were the main factors that explained most of the lexical acquisition, i.e., shorter, more frequent, and more imageable words were acquired earlier. Social words were acquired first. Nominals were acquired earlier than predicates, which is explained by imageability. In summary, a word's form, function, and usage pattern seem critical in children's early vocabulary development, in accordance with a usage-based view of language acquisition.

Relationship between lexicon and grammar

What is the relationship between lexical and grammatical skills? Frank et al. (2021; chapter 13.4) examined the relationship between scores for vocabulary size and grammatical complexity in two sets of longitudinal data from Wordbank: 247 children aged 18-30 months who were acquiring American English, and 1,141 Norwegian-acquiring children aged 18-36 months.

The statistical analyses revealed "cross-lagged influences of vocabulary on grammar, but not grammar on vocabulary". This suggests that, in the first years of life, vocabulary serves as the basis for generalisations of grammatical constructions and rules. The authors indicate that this relationship may change over time and that grammar may have a stronger influence on vocabulary in older children.

Lexical development in bilingual children

Do bilinguals reach linguistic and other milestones at the same age as monolinguals?

Muszyńska et al. (2026) collected CDI data through a mobile app (StarWords) and compared CDI reports from 302 Polish monolinguals, 111 Polish-English bilinguals, 73 Polish-Norwegian bilinguals, and 118 Polish bilinguals with other second languages (German, English spoken outside of the UK, Dutch, French, Spanish, Danish, Swedish, Italian, Faroese, Flemish, Greek and Portuguese). All children were between the ages of 0 and 24 months. Polish bilinguals with a Slavic second language were excluded due to typological closeness. The study looked at the time points of onset of linguistic and other developmental milestones. The bilingual children were matched with monolingual children in terms of characteristics such as age and parental education.

The statistical analyses revealed that bilinguals reached the earliest linguistic (and developmental) milestones at the same time as monolinguals, when both languages were considered. Moreover, bilingual children spoke their first word in both languages at approximately the same time. For the later linguistic milestones, the results were less clear. The authors conclude that bilingual children are similar to monolingual children in the earliest stages of language development, but that later development may depend more on input.

Influence of family factors on lexical acquisition

What is the impact of sibling status on children's early vocabulary development? Based on norming data from CDI-I and CDI-II, Rosslund et al. (2025a) investigated the association between birth order, sibling characteristics, and vocabulary size in 6,163 children between the ages of 8 and 36 months.

The study showed that having older siblings was negatively associated with vocabulary size; however, the analyses showed a U-shaped pattern, indicating that the association with birth order becomes positive at a certain point. The authors suggested that, at a certain age, children take on caregiver roles rather than needing the caregivers' attention, and the data indicated a transition from child to caregiver in early adolescence at 9.5 years for sisters and 12.5 years for brothers in terms of

receptive vocabulary, and at 13.5 years for sisters and 14.5 years for brothers in terms of expressive vocabulary. The authors conclude that the balance between caregivers and children in the household better explains early language development than birth order per se.

Influence of environmental factors on lexical development

How did learning environments during the COVID-19 lockdown – specifically caregiver-child activities such as book reading and screen time – impact children’s vocabulary development? In a large cross-linguistic study across 13 countries and 12 languages (Kartushina et al., 2022), the vocabularies of 1,742 children aged 8-36 months were measured using CDI-I and CDI-II at the beginning and end of the first lockdown period (March–September 2020). Through an online questionnaire, children’s activities (with and without caregivers) were evaluated, including time spent on shared book reading and passive and active screen use.

Results showed that children with lower levels of passive screen exposure and higher levels of caregiver reading time during lockdown had larger gains in their vocabulary sizes, after controlling for socioeconomic status (SES) and other caregiver-child activities. Furthermore, children’s vocabularies increased more during lockdown than expected from pre-lockdown normative CDI data. The authors conclude that this could be related to either increased parental awareness of their children’s vocabulary or more intense caregiver-child interaction during lockdown.

How do shared book reading and screen time affect vocabulary size in infants? Rosslund et al. (2025b) investigated the relationships between shared book reading, screen time (phones and tablets), and vocabulary size (as measured by the CDI-I and CDI-II) in 1,442 Norwegian-speaking children aged 12-24 months. Parents were recruited through postal invitation, and data were collected through online questionnaires. Receptive and productive vocabulary were collected for the 12-month-olds, and productive vocabulary for the

24-month-olds. SES was measured through the mothers’ education level.

Results revealed a positive association between shared book reading and vocabulary size in both age groups. Additionally, there was a negative association between screen time and vocabulary size in 24-month-olds. However, contrary to expectations, this association was not found in the 12-month-olds. Interestingly, the positive association between book reading and productive vocabulary was stronger in the lower-SES group.

Does pacifier use affect children’s vocabularies? Muñoz et al. (2024) cross-sectionally investigated the relationship between pacifier use at 12 and 24 months and vocabulary size. Parents of monolingual Norwegian-speaking children – 452 one-year-olds and 735 two-year-olds – completed online versions of the CDI-I and CDI-II, respectively. The parents retrospectively reported the number of hours per day their child used a pacifier at two-month intervals.

The authors found that children who used a pacifier more frequently throughout their lifespan had a smaller vocabulary. In addition, later pacifier use was more strongly negatively associated with vocabulary than early pacifier use. They concluded that, since pacifier use constrains articulator movement, it may negatively affect children’s vocabularies.

Correlation between CDI reports from different raters

What happens when persons other than the child’s parents complete the CDI? Garmann et al. (2019b) collected CDI-III data from 28 monolingual Norwegian-speaking three-year-olds by comparing the data collected through the completion of the CDI-III by preschool teachers and parents. The results showed that although preschool teachers generally reported that children knew fewer words than their parents, the reports could be compared for all parts of the form. There was a particularly high correlation for the reports on pronunciation.

The study indicates that preschool teachers may report on children's language skills through the CDI-III. However, if one would like to compare (e.g.,) a CDI report from a parent on a home language with a CDI report from a teacher on the language used in preschool, one should be aware that parents may over-report as compared to teachers.

Atypical acquisition

Reliability, validity, and correlation between reports on children with autism

Is the CDI-I reliable and valid when assessing young children with autism? Nordahl-Hansen et al. (2013; 2014) used an early translation of the CDI-I into Norwegian (Smith, 1996) to investigate the use of this tool to assess vocabulary development in 55 children with autism. The results showed high agreement between CDI ratings and scores from two standardised language tests, as well as high agreement between CDI ratings from parents and preschool teachers, without over-reporting from parents.

They concluded that parental reports are a valuable supplement to direct testing for children with low-level language skills, and that both parents and teachers can complete the forms reliably.

Lexical and grammatical development in children with 5p- deletion (5p-) syndrome

How does vocabulary development in a child with 5p- syndrome compare to that of typically developing (TD) children? Kristoffersen (2020) collected longitudinal data using the Norwegian CDI-I from a boy with 5p- syndrome, a rare congenital condition resulting from a deletion of parts of the short arm of chromosome 5. The boy's cognitive and motor skills were measured between the ages of 4;10 and 7;5 and found to be comparable to those of TD children aged 18-36 months.

The boy's parents completed 15 CDI-I forms over five years, between the ages of 2;4 to 7;4 years. The results showed that the development of receptive and productive lexical skills was severely delayed compared to that of TD children, but

that the developmental trajectories were similar to those of TD children. In conclusion, the CDI may be a helpful tool in assessing vocabulary skills in children with 5p- syndrome, as a first step towards an intervention programme.

How do vocabulary and grammar develop in children with 5p- syndrome? Kristoffersen & Simonsen (2025) collected CDI-I and CDI-II data longitudinally to investigate the development of lexical and grammatical skills, and the relationship between them, in two children with 5p- syndrome. Their language development was monitored over the following age range: 2;0 to 7;3 years (P1) and 1;11 to 7;1 (P2). At age 6, their linguistic and cognitive skills were assessed to be significantly below average for TD children.

The data showed that the children followed developmental trajectories similar to those of TD children, but their vocabulary developments were significantly delayed. There was a close relationship between the size of productive vocabulary and grammar, but when the first grammatical markers appeared, their vocabulary sizes were larger than that of TD children. Word combinations appeared earlier than inflections and morphosyntactic complexity.

Assuming that grammatical patterns, in particular inflections, are dependent on a critical mass of exemplars, generalisation in children with 5p- syndrome may require an even larger critical mass than in TD children. These findings can be interpreted as follows: the children's grammatical development is further delayed than their vocabulary development.

CLOSING REMARKS

The Norwegian CDI-I and CDI-II were published in 2012, comprising norming data from more than 6,500 children (Kristoffersen & Simonsen, 2012). These data were later added to the Wordbank database (Frank et al., 2021), which increased the availability of the Norwegian CDI-I and CDI-II data for research and created new opportunities for a wide range of CDI studies. The norming data have also served as the basis of the development of short versions of the CDI-II.

In addition, the forms have facilitated the collection of new datasets in which CDI reports have been used for specific populations, both individually and in combination with other parental reports, with analyses of spontaneous speech (children and adults), and with experimental data. The development of the CDI-III form has extended the use of CDI in research involving children aged 3-4 years, and this form has been used to compare reports from different raters on the same child; this approach has also been applied with an older version of CDI-I.

While the Norwegian CDIs have been widely used in studies of typical monolingual acquisition,

there are fewer studies of multilingual children using CDIs. As for atypical acquisition, the CDIs in Norwegian have been used only for two populations. Furthermore, there is potential for broader use of the CDI-III in future studies.

The EUNM-CDI network has been invaluable in motivating the adaptation of the original American English CDI forms into several languages, as well as in inspiring the adaptations of the Swedish innovation of the CDI-III, and in providing a basis for fruitful collaboration in cross-linguistic and multilingual studies.

REFERENCES

- Frank, M. C., Braginsky, M., Yurovsky, D., & Marchman, V. A. (2021). *Variability and Consistency in Early Language Learning: The Wordbank Project*. MIT Press.
- Garmann, N. G., Hansen, P., Simonsen, H. G., & Kristoffersen, K. E. (2019a). The phonology of children's early words: Trends, individual variation, and parents' accommodation in child-directed speech. *Frontiers in Communication*, 4, 10. doi: 10.3389/fcomm.2019.00010
- Garmann, N. G., Romøren, A. S. H., Flygstad, N., Milder, N., Pedersen, I., Simonsen, H. G., & Torkildsen, J. v. K. (2019b). Språkkartlegging i norske barnehager – en pilotundersøkelse av foreldres og barnehageansattes rapportering av norsktalende tre-åringers språkferdigheter ved hjelp av CDI III. *RASK: Internasjonalt Tidsskrift for Sprog og Kommunikation*, 49, 87–103.
- Hansen, P. (2017). What makes a word easy to acquire? The effects of word class, frequency, imageability and phonological neighbourhood density on lexical development. *First Language*, 37(2), 205-225. DOI: 10.1177/0142723716679956
- Kartushina, N., Mani, N., Aktan-Erciyas, A., Alaslani, K., Aldrich, N. J., Almohammadi, A., ... & Mayor, J. (2022). COVID-19 first lockdown as a window into language acquisition: Associations between caregiver-child activities and vocabulary gains. *Language Development Research*, 2(1). 10.34842/abym-xv34. halshs-03814773
- Kristoffersen, K. E. (2020). Lexical and gestural development in 5p deletion syndrome – a case report. *Journal of Communication Disorders*. doi: 10.1016/j.jcomdis.2019.105949
- Kristoffersen, K. E. & Simonsen, H. G. (2012). *Tidlig språkutvikling hos norske barn: MacArthur-Bates foreldrerapport for kommunikatív utvikling*. Novus.
- Kristoffersen, K. E. & Simonsen, H. G. (2025). The relationship between vocabulary and grammar in two children with 5p deletion syndrome. *Clinical Linguistics and Phonetics*, 39 (6-8), 704-720. <https://doi.org/10.1080/02699206.2024.2359461>
- Muñoz, L. E., Kartushina, N., & Mayor, J. (2024). Sustained pacifier use is associated with smaller vocabulary sizes at 1 and 2 years of age: A cross-sectional study. *Developmental Science*, 27(4), e13477. DOI: 10.1111/desc.13477
- Muszyńska, K., Krajewski, G., Dynak, A., Garmann, N. G., Romøren, A. S. H., Łuniewska, M., ... & Haman, E. (2026). Bilingual children reach early language milestones at the same age as monolingual peers. *Journal of Child Language*, 53, 365–388. doi:10.1017/S0305000924000655
- Nordahl-Hansen, A., Kaale, A., & Ulvund, S. E. (2013). Inter-rater reliability of parent and preschool teacher ratings of language in children with autism. *Research in Autism Spectrum Disorders*, 7(11), 1391–1396. doi.org/10.1016/j.rasd.2013.08.006
- Nordahl-Hansen, A., Kaale, A., & Ulvund, S. E. (2014). Language assessment in children with autism spectrum disorder: Concurrent validity between report-based assessments and direct tests. *Research in Autism Spectrum Disorders*, 8(9), 1100–1106. doi.org/10.1016/j.rasd.2014.05.017
- Rosslund, A., Kartushina, N., Serres, N., & Mayor, J. (2025a). Early Vocabulary Acquisition: From Birth Order Effect to Child-to-Caregiver Ratio. *Child Development*, 96(4), 1343–1353. <https://doi.org/10.1111/cdev.14251>
- Rosslund, A., Kartushina, N., & Mayor, J. (2025b). Associations between shared book reading, daily screen time and infants' vocabulary size. *Journal of Child Language*, 52(4), 971–983. <https://doi.org/10.1017/S0305000924000291>
- Simonsen, H. G., Garmann, N. G., Kristoffersen, K. E. (this issue). The Norwegian CDIs.
- Smith, L. (1996). *Norwegian translation of the MacArthurs CDI*. Unpublished manuscript.