Empirical Article

WPPSI-IV and NEPSY-II performance in mono- and bilingual 5–6-year-old children: Findings from The FinSwed Study

EMMA KORPINEN,[1,2,3] SUSANNA SLAMA,[1,4] JOHANNA ROSENQVIST[1,5,6,†] and ANU HAAVISTO[1,7,†]

[1]*Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki, Helsinki, Finland*
[2]*Faculty of Arts, Psychology and Theology, Åbo Akademi University, Turku, Finland*
[3]*Expert Services, Turku University Hospital, Turku, Finland*
[4]*Niilo Mäki Instituutti, Jyväskylä, Finland*
[5]*Division of Neuropsychology, HUS Neurocenter, Helsinki University Hospital and University of Helsinki, Helsinki, Finland*
[6]*Mehiläinen Therapy Clinic, Helsinki, Finland*
[7]*Department of Women's and Children's Health, Karolinska Institute, Stockholm, Sweden*

Korpinen, E., Slama, S., Rosenqvist, J. & Haavisto, A. (2023). WPPSI-IV and NEPSY-II performance in mono- and bilingual 5–6-year-old children: Findings from The FinSwed Study. *Scandinavian Journal of Psychology.*

Children's language background relates to their neurocognitive development. Knowledge of this relationship is important as bilingualism is common. However, research regarding language background in relation to performance on cognitive tests such as the WPPSI-IV and NEPSY-II is scarce. The present study compared WPPSI-IV and NEPSY-II performances between 5- and 6-year-old Swedish-speaking monolingual (n = 45) and Swedish-Finnish-speaking simultaneous bilingual (n = 34) children in Finland. The participants were gathered by stratified sampling and were assessed with the Swedish versions of the tests. In profile analyses, a significant monolingual advantage was found in some WPPSI-IV subtests and indexes requiring expressive vocabulary (Vocabulary, Similarities, Picture Naming, and Vocabulary Acquisition Index) and visuospatial skills (Object Assembly and Visual Spatial Index). No group differences were found between mono- and bilingual children in receptive language, visual memory, or fluid intelligence. Additionally, no differences were found on the Full Scale IQ. The performance on the WPPSI-IV Similarities subtest improved in a subgroup of bilinguals when answers in both Swedish and Finnish were accounted for, instead of accepting only answers in Swedish. No significant differences were found between mono- and bilinguals on the language and memory tasks of NEPSY-II. These findings highlight the importance of considering the child's language background when assessing expressive language in young children, as well as the benefits of assessing bilinguals in both of their languages.

Key words: Bilingualism, cognitive performance, WPPSI-IV, NEPSY-II, children.

Anu Haavisto, Department of Psychology and Logopedics, Faculty of Medicine, University of Helsinki, Helsinki, Finland. Email: anu.haavisto@helsinki.fi

Children's neurocognitive development is related to multiple factors in their home environments, the language background of the child being one of them. As compared with monolingualism, a bilingual background has been associated with disadvantages, such as lower performance on vocabulary or other basic verbal tasks when assessed in one of the languages (e.g., Carlson & Meltzoff, 2008), as well as to advantages in executive performance, albeit the latter finding has been disputed (Gunnerud, ten Braak, Reikerås, Donolato & Melby-Lervåg, 2020; Lehtonen *et al.*, 2018; Lowe, Cho, Goldsmith & Morton, 2021). Such findings may contribute to theoretical models of how bilingualism develops, in addition to being highly relevant in clinical practice when interpreting outcomes of cognitive assessments.

The present study is a substudy of The FinSwed Study, the Finland-Swedish minority study of cognition in children, which gathered data from 5–16-year-old children during 2019–2021. Overall, the project aimed to examine how Swedish-speaking Finnish children perform on the Swedish versions of commonly used cognitive tests. Bilingualism, especially in the form of early simultaneous bilingualism (i.e., being exposed to two languages since birth or very early on), is quite common among the Swedish-speaking minority in Finland. The Finland-Swedish setting, thus, also provides excellent opportunities for investigating different aspects of simultaneous bilingualism.

This study was conducted in Finland and investigated Swedish-speaking monolingual vs. Swedish-Finnish-speaking simultaneous bilingual children's performance in the Swedish versions of the Wechsler Preschool and Primary Scale of Intelligence–Fourth Edition (WPPSI-IV; Wechsler, 2012, 2014) and parts of NEPSY-II (Korkman, Kirk & Kemp, 2007, 2011). These tests have not been normed specifically for the Swedish-speaking minority in Finland. This minority group consists of both monolingual Swedish-speaking and bilingual, often Swedish-Finnish speaking, individuals. Therefore, the Swedish versions are commonly in use with this cultural group.

Recently, it was shown among the Finland-Swedish minority that monolingual Swedish- and bilingual Swedish-Finnish-speaking school-aged children's performance on cognitive tasks did not differ on the Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV; Wechsler, 2010) and NEPSY-II (Karlsson *et al.*, 2015), whereas some differences had earlier been reported for younger children on the WPPSI-R and NEPSY (Korkman *et al.*, 2012; Westman, Korkman, Mickos & Byring, 2008). To our knowledge, no studies have been conducted investigating possible cognitive performance differences between 5–6-year-old mono- and bilingual children on the newest Scandinavian versions of WPPSI-IV and NEPSY-II.

†The senior authors contributed equally.

This is an age at which rapid neurocognitive development occurs (Korkman, Kemp & Kirk, 2001; Korkman, Lahti-Nuuttila, Laasonen, Kemp & Holdnack, 2013; Rosselli, Ardila, Navarrete & Matute, 2010) and a time when important educational decisions are made based on clinical assessments. WPPSI-IV and NEPSY-II are now in wide use in Swedish-speaking Finland, stressing the clinical importance of outlining how children representing different language groups perform on these tests. Thus, the focus of this study was performance differences in mono- and bilingual 5–6-year-old children in these new test versions.

SIMULTANEOUS BILINGUALISM AND THE EDUCATIONAL SYSTEM IN FINLAND

Finland has two national languages, Finnish and Swedish (FINLEX® – Language Act 423/2003, n.d.). Finnish is the majority language in Finland, but 5.2% of the population in Finland belong to the Swedish-speaking minority, called Finland-Swedes (Statistics Finland, 2020). However, many Finland-Swedish homes have a mixed (Finnish and Swedish) language background resulting in a large group of simultaneous Finnish and Swedish speakers. Although it is common among Swedish-speaking Finns to be bilingual (Saarela, 2021), the inhabitants of Finland are registered with only one language (Tallroth, 2012). Hence, no official statistics exist about the number of Finland-Swedish bilinguals in Finland, but a rough estimate is that around 40% of the Swedish speakers are bilingual (Saarela, 2021). In the present study, simultaneous bilingualism was defined as the home language of the child being both Swedish and Finnish, as well as the child having been exposed to both Swedish and Finnish since the first year of life, as reported by the parents.

In Finland, education can be completed in Finnish- or Swedish-speaking public schools. Starting in the fall of the year children turn 6, they attend a one-year pre-primary education before they start basic education the year they turn 7 (Finnish National Agency for Education, 2020). Thus, due to the Finnish education system, the age range of 5–6 years is particularly relevant for cognitive assessments that address educational decisions for a child, as it coincides with the transition to pre-primary class or first grade.

THE PUTATIVE BILINGUAL COGNITIVE ADVANTAGE AND BILINGUAL LANGUAGE DEVELOPMENT

Largely based on the initial findings of a bilingual executive advantage by Bialystok and colleagues (Bialystok, 2017; Bialystok, Craik, Green & Gollan, 2009), the possible role of language background on children's cognitive performance, particularly executive functions (EF), has received considerable research interest. The putative bilingual executive advantage has been reported in, for instance, task switching, monitoring, and inhibition (Bialystok, 2017; Gunnerud, ten Braak, Reikerås, Donolato & Melby-Lervåg, 2020; Lowe, Cho, Goldsmith & Morton, 2021). However, publication bias has been shown to play a role in the reported results (Gunnerud, ten Braak, Reikerås, Donolato & Melby-Lervåg, 2020; Lowe, Cho, Goldsmith & Morton, 2021). In a study by Lehtonen *et al.* (2018), no bilingual executive advantage was found in adults when publication bias was considered. Further, it has also been hypothesized that differences in visual working memory (WM), rather than in language background, could explain performance differences in a visual controlled attention task in 4–5-year-old children (Namazi & Thordardottir, 2010). However, some evidence for a bilingual advantage in cognitive control has been found in children, with even more convincing findings reported in adults (Van Den Noort *et al.*, 2019).

Recently, a possible bilingual advantage in WM has been reported. Grundy and Timmer (2017) found a small to moderate WM advantage for simultaneous bilinguals (children, and young and older adults) in their meta-analysis, with the largest effect size in children. They hypothesized that switching between two languages may demand more WM capacity than just speaking one language. However, not all studies have found a bilingual WM advantage for simultaneous bilingual children (Gunnerud, ten Braak, Reikerås, Donolato & Melby-Lervåg, 2020). Interestingly, a bilingual disadvantage in nonverbal WM was found in children after controlling for publication bias (Lowe, Cho, Goldsmith & Morton, 2021). All in all, the results regarding the relationship between WM capacity and bilingualism are mixed.

The relationship between bilingualism and general language abilities has also been studied. According to Bialystok, Craik, Green, and Gollan (2009), children who have been exposed to two languages since birth achieve early milestones with a timing and order that are comparable to monolingual children's language development. However, the vocabulary is smaller when looking at the bilingual children's languages separately, as compared with the vocabulary of monolinguals (Bialystok, Craik, Green & Gollan, 2009). More specifically, when only one of the bilinguals' languages was considered, 5-year-old monolinguals had a significantly larger expressive vocabulary than balanced simultaneous bilinguals of the same age-group (Thordardottir, 2011).

Regarding receptive vocabulary, Bialystok, Luk, Peets, and Yang (2010) found in a large study that 3–10-year-old bilinguals who spoke a non-English language at home, but who were also fluent in their school language (English), had lower English receptive vocabulary performance than monolinguals, especially in words that relate to home life, as compared with words relating to school. However, when looking at bilinguals with a balanced exposure to the test language, Thordardottir (2011) found no significant differences in receptive vocabulary as compared with monolinguals.

Thus, language ability is also related to the amount of exposure to the language. Increased parent-reported exposure to a language has been shown to be strongly related to increased vocabulary performance in that language (Thordardottir, 2011). Five-year-old bilinguals needed a general exposure of 40% to 60% in both languages to perform in line with monolinguals in receptive vocabulary, but for expressive vocabulary, more exposure was needed (Thordardottir, 2011). Other factors may also relate to vocabulary performance. For instance, general cognitive ability has been shown to predict receptive vocabulary development in the majority language, but not in the minority/home language of kindergarten-aged second- and third-generation immigrants (Blom, 2019).

Regarding verbal fluency, the relationship between receptive vocabulary and verbal fluency in mono- and bilinguals has recently been studied. With respect to category/semantic fluency, where the child is asked to list objects of a certain category (the task included in the present study), studies have had mixed results. When receptive vocabulary size has been taken into account, some studies have found no significant differences between mono- and bilinguals (Zeng, Kalashnikova & Antoniou, 2019; Friesen, Luo, Luk & Bialystok, 2015), while others have found a bilingual advantage (Friesen, Edwards & Lamoureux, 2021; Pino Escobar, Kalashnikova & Escudero, 2018), when category fluency was assessed in one of the bilingual's languages. In contrast, when receptive vocabulary size was not controlled for, a bilingual disadvantage in semantic fluency in the majority language has been reported in children in Grade 3 (mean age 8.9 years), but not in Grade 1 (mean age 6.8 years; Brandeker & Thordardottir, 2022).

Concerning phonological awareness and bilingualism, Bialystok, Majumder, and Martin (2003) reported that on a phoneme segmentation task, Spanish-English-speaking bilingual children performed better than English-speaking monolinguals, but this was not true for the other language groups (Chinese-English and French-English). No other significant differences in phonological awareness between mono- and bilingual children were found, and it was concluded that bilinguals do not have an advantage in developing phonological awareness (Bialystok, Majumder & Martin, 2003). This has been confirmed in other studies, finding no significant bilingual advantage in phonological tasks (Goriot, Unsworth, Van Hout, Broersma & Mcqueen, 2021; Lesniak, Myers & Dodd, 2014). In fact, Lesniak, Myers, and Dodd (2014) reported that 5–6-year-old bilinguals performed equally (e.g., in syllable awareness) or worse (e.g., in phoneme awareness) as compared with monolinguals. In another study, 4–7-year-old simultaneous bilinguals and children learning a second language early in school had neither an advantage nor a disadvantage in phonological awareness in their school language as compared with monolingual children (Goriot, Unsworth, Van Hout, Broersma & Mcqueen, 2021). Still, it is possible that similar phonological structures between two languages could enhance phonological awareness more than if the languages are phonologically different, as discussed by both Bialystok, Majumder, and Martin (2003) and Lesniak, Myers, and Dodd (2014).

In sum, recent research has not found much support for the bilingual executive advantage hypothesis in children. Regarding the relationship between language background and WM or verbal fluency, the evidence is mixed. Further, despite mastering two languages, bilinguals do not seem to have an advantage in developing phonological awareness compared with monolinguals. On the contrary, when the bilinguals' languages are tested separately, there is evidence for a monolingual advantage in expressive vocabulary, but not for receptive vocabulary between monolinguals and balanced bilinguals.

WPPSI AND NEPSY IN THE ASSESSMENT OF MONO- AND BILINGUAL CHILDREN

The Wechsler scales are among the most frequently used intelligence tests (Carr, 2015; Gibbons & Warne, 2019). Since the first versions, the Wechsler scales have been revised several times. One version of the Wechsler scales, WPPSI-IV, assesses general cognitive ability in 2–7-year-old children (Wechsler, 2012, 2014). In the present study, the most recent version of the test in Swedish, with a Scandinavian normative sample (Wechsler, 2014), was used. Additionally, the Swedish version of NEPSY-II (Korkman, Kirk & Kemp, 2011), a neuropsychological test assessing specific neurocognitive functions in 3–16-year-old children, was used. The Swedish version of NEPSY-II utilizes U.S. normative data. These assessment tools were chosen, as they are commonly used with Swedish-speaking Finnish children. At present, some studies comparing the performance between mono- and bilingual children using different versions of WPPSI as well as NEPSY-II or its prior version, NEPSY, have been published.

diSibio and Whalen (2000) studied the relationship between 3:0–7:3-year-old mono- and bilingual children's cognitive performance, using data gathered for the American normative sample of the WPPSI-R. The results showed a significant monolingual advantage on the verbal intelligence factor, but not on the nonverbal intelligence factor (diSibio & Whalen, 2000). In addition, Garratt and Kelly (2008) explored the relationship between bilingualism and NEPSY scores (Korkman, Kirk & Kemp, 1998) in 6–7-year-old children in the United Kingdom. A significant monolingual advantage was found on the subtests Visual Attention, Comprehension of Instructions, and Speeded Naming. On the subtests Imitating Hand Positions and Design Copying, the bilinguals' scores were significantly higher than those of the monolinguals (Garratt & Kelly, 2008).

Looking at previous studies with Swedish-speaking Finnish children, the cultural and linguistic group investigated in the present study, Westman, Korkman, Mickos, and Byring (2008) found, when studying 6-year-olds with and without risk of language impairment, that simultaneous bilingual children had significantly poorer results in a short version of the WPPSI-R verbal IQ as well as in the NEPSY subtests Body Part Naming and Sentence Repetition as compared with monolinguals. On the contrary, Korkman *et al.* (2012) found no significant differences between 5c7-year-old simultaneous bilinguals and monolinguals with and without Specific Language Impairment (Developmental Language Disorder) in verbal or performance scores on a short version of the WPPSI-R. The bilinguals had significantly lower test scores than monolinguals in only one subtest from NEPSY, namely Body Part Naming, which assesses expressive vocabulary (Korkman *et al.*, 2012). Similarly, Karlsson *et al.* (2015) found no significant differences in auditory attention, language functions, or verbal memory, as assessed with NEPSY-II, between Finland-Swedish mono- and bilingual 7- and 10–11-year-old children.

To summarize, findings regarding differences in performance on different versions and revisions of the WPPSI and NEPSY between mono- and bilingual children are mixed. Studies conducted in the United Kingdom and the United States using WPPSI-R and NEPSY indicated a need for separate norms for the verbal factors in WPPSI-R for mono- and bilinguals (diSibio & Whalen, 2000) and proposed that the NEPSY Language domain is sensitive for language background (Garratt & Kelly, 2008). In the Finland-Swedish context, a monolingual advantage for WPPSI-R verbal scores was reported by Westman, Korkman, Mickos, and Byring (2008). In contrast, other Finnish studies have reported only a few or no differences between mono- and bilinguals for the Wechsler tests and/or NEPSY/NEPSY-II (Karlsson *et al.*, 2015; Korkman *et al.*, 2012; Westman, Korkman, Mickos & Byring, 2008). Accordingly, Karlsson *et al*. (2015) suggested that no separate norms are necessary when assessing Swedish-Finnish bilinguals in Finland with NEPSY-II (Korkman, Kirk & Kemp, 2008).

At present, clinical assessments with Finland-Swedes are often conducted using the newest Swedish test versions, WPPSI-IV and NEPSY-II (Rosenqvist, Slama & Haavisto, 2022). The previous Finland-Swedish studies using WPPSI or NEPSY/NEPSY-II with children below school age used older test versions, assessed cognition with abbreviated versions, or assessed clinical groups. In order to understand the full picture of younger simultaneous bilingual children's cognitive test performance and to add to the clinical utility of the findings, more research is needed with typically developing children, as well as studies comprehensively assessing cognitive functions using the most recent tests. In children below school age, general language ability is still developing. Therefore, it is important to investigate possible performance differences between mono- and bilinguals, when different linguistic functions, including active and passive vocabulary, phonological skills, and verbal fluency, as well as different aspects of verbal reasoning and memory are measured. The present study provides an opportunity to explore the relationship between young mono- and bilingual children's language skills and cognitive performance.

AIMS OF THE STUDY

The present study investigated possible mono- vs. bilingual performance differences in WPPSI-IV and NEPSY-II among Swedish- and Swedish-Finnish-speaking 5–6-year-old children in Finland who attended Swedish-speaking daycare. Our first aim was to investigate the relationship between language background (mono- vs. simultaneous bilingualism) and performance on two commonly used cognitive tests, as assessed in Swedish. As some studies have indicated a monolingual advantage for expressive vocabulary when comparing performance using only one of the bilinguals' languages (diSibio & Whalen, 2000; Korkman *et al.*, 2012; Thordardottir, 2011), we hypothesized that some performance differences in favor of the monolinguals would emerge in verbal subtests requiring expressive language. Parental education level, as a measure of SES, was included as a covariate in the analyses. The importance of including possible confounding variables, such as parents' socioeconomic status (SES), when exploring children's language development and cognition has previously been highlighted (e.g., Lowe, Cho, Goldsmith & Morton, 2021).

Our second aim was to investigate the possible benefits of considering both of the bilinguals' languages in cognitive assessments, as earlier suggested by, for instance, Bialystok, Craik, Green, and Gollan (2009), Freeman and Schroeder (2022), Peña, Bedore, and Kester (2016), and Thordardottir, Rothenberg, Rivard, and Naves (2006).

Besides adding to the research field of bilingualism, this study is also clinically important, as it explores the clinical utility of the Swedish versions of the WPPSI-IV and NEPSY-II when used with bilinguals in Finland. To the authors' knowledge, the relationships between simultaneous bilingualism and the Swedish versions of the WPPSI-IV and NEPSY-II have not been studied.

METHOD

Participants

The participants in this study were 5–6-year-old children attending Swedish-speaking daycare centers in Finland. The sample consisted of 79 children, of whom 34 (43%) were bilingual (speaking Swedish and Finnish at home) and 45 (57%) were monolingual (speaking only Swedish at home). The parents stated on a background questionnaire whether the children were mono- or bilingual, as well as the first language of each parent. All bilingual children had heard both home languages during the first year of life, as reported by the parents. On the background questionnaire, the parents also stated information regarding the parents' educational level and possible developmental support the child had received. No significant differences were found between the language groups (mono- vs. bilinguals) regarding age, $t(77) = -0.48$, $p = 0.631$; sex, $\chi^2(1, N = 79) = 0.66$, $p = 0.498$; maternal education level, $\chi^2(2, N = 79) = 1.21$, $p = 0.541$; or paternal education level, $\chi^2(2, N = 77) = 1.59$, $p = 0.496$. A significant correlation between the maternal and paternal education levels was found, $r = 0.47$, $p < 0.001$. For demographic information of the sample, see Table 1.

During the recruitment process, only typically developing children of a specified birth year range from 2013 to 2015 were included (5:0–6:11). In total, 253 children below school age were considered for eligibility. Of these, 107 did not meet criteria for inclusion. Children were excluded from the study if their home language was other than Swedish or bilingual Swedish-Finnish ($n = 47$) and if they had a neurological, psychiatric, or developmental diagnosis or a need for psychological assessment, support, or treatment ($n = 60$). A total of 146 children were invited to participate in the study, of which an additional 9 (6.2%) fulfilled exclusion criteria based on the information given by the parents. Further, 22 families (15.1%) declined participation and 25 (17.1%) were assessed with the WISC-V (Wechsler, 2016) for another substudy within the larger study, The FinSwed Study. Due to the COVID-19 pandemic, the assessments of 7 children (4.8%) were postponed and they no longer fulfilled the age criteria for the present substudy. Further, 4 families (2.7%) who initially accepted later declined participation.

Measures

WPPSI-IV. In the present study, the Swedish version of the WPPSI-IV (Wechsler, 2014) was used. In the age range 4:0–7:7, the WPPSI-IV consists of 15 subtests (Wechsler, 2014). From these subtests, the test generates a Full Scale Intelligence Quotient (IQ) and five primary indexes: the Verbal Comprehension Index, Visual Spatial Index, Fluid Reasoning Index, Working Memory Index, and Processing Speed Index (see Table 2 for index distribution). The mean scaled score for the Full Scale IQ and the indexes is 100 (SD = 15) and for the subtests 10 (SD = 3) (Wechsler, 2014). This study included all the core subtests and all the optional verbal subtests, hence 14 subtests of 15 possible were used (see Table 2). The assessments were conducted and primarily scored only regarding answers given in Swedish. However, answers in Finnish were also recorded, even though they were not encouraged or included in the official score. If answering in Finnish, the child was asked to repeat the response in Swedish.

Minor changes in wording were made for some items in the WPPSI-IV. In addition, in the WPPSI-IV, three items with country-specific questions about Sweden were changed to country-specific questions about Finland in the Information subtest. These changes were comparable to the adaptations used in the Scandinavian samples (Sweden, Norway, and Denmark). All changes were made according to Statement of Work No. 296412-2 to Master License Agreement No. LSR-111089 with NCS Pearson.

Table 1. *Demographic information for the mono- (n = 45) and bilingual (n = 34) children included in the study*

Characteristic	Monolinguals *M* (*SD*)	Bilinguals *M* (*SD*)
Age	6.08 (.64)	6.15 (.57)
	n (%)	*n* (%)
Sex		
Girls	24 (53.3)	15 (44.1)
Mothers' first language		
Swedish	45 (100.0)	16 (47.1)
Finnish		18 (52.9)
Fathers' first language[a]		
Swedish	44 (100.0)	19 (55.9)
Finnish		15 (44.1)
Language spoken between parents[a]		
Swedish	42 (95.5)	8 (23.5)
Finnish		21 (61.8)
Swedish & Finnish	2 (4.5)	5 (14.7)
Language spoken between siblings		
Swedish	38 (84.4)	12 (35.3)
Finnish		6 (17.6)
Swedish & Finnish		15 (44.1)
Data missing or no sibling	7 (15.6)	1 (2.9)
Level of education, mother		
Level 1	12 (26.7)	6 (17.6)
Level 2	13 (28.9)	13 (38.2)
Level 3	20 (44.4)	15 (44.1)
Level of education, father[a]		
Level 1	18 (40.9)	9 (26.5)
Level 2	10 (22.7)	10 (29.4)
Level 3	16 (36.4)	14 (41.2)
Data missing		1 (2.9)

Note: In cases in which the parent was bilingual, or in which both of a bilingual child's parents' official languages were Swedish ($n = 11$), the parents' first languages were recategorized into Swedish or Finnish in accordance with the reported language spoken to the child. Level 1 = Degree from a comprehensive school, upper secondary education, or vocational education. Level 2 = University of applied science degree or bachelor's degree. Level 3 = Master's or doctoral degree.
[a]$n = 78$, since one monolingual child had only one caregiver.

NEPSY-II. The Swedish version of the neuropsychological test NEPSY-II (Korkman, Kirk & Kemp, 2011) was also used in the present study. The test aims to measure more specific cognitive functions (Korkman, Kirk & Kemp, 2011). NEPSY-II consists of 32 subtests, with a mean scaled score of 10 (*SD* = 3), divided into six domains (Korkman, Kirk & Kemp, 2011). In this study, subtests from the Language domain as well as subtests with a linguistic character from the Memory and Learning domain were used (see Table 3). The used subtests measure the ability to process words phonologically (subtest Phonological Processing), fluently produce words by category (Semantic Word Generation), follow instructions (Comprehension of Instructions), retell a story (Narrative Memory – Free and Cued Recall), and repeat sentences (Sentence Repetition). As with the WPPSI-IV assessments, answers were primarily received and scored in Swedish. Spontaneous answers in Finnish were, however, also recorded but not included in the official score.

Procedure

The FinSwed Study was conducted at the University of Helsinki. In June 2019, ethical approval for the project was obtained from the Ethical Review Board in the Humanities and Social and Behavioral Sciences at the University of Helsinki. Written consent was obtained from the heads of Early Childhood Education in each participating city and municipality, as well as from the principals of each daycare center participating in the study. Parents gave written consent for participation.

A stratified sampling procedure was conducted according to the geographical distribution of the Swedish-speaking population in Finland. The participants came from four bilingual regions in Finland: Ostrobothnia, Southwest Finland, the capital region, and the coastal areas east and west of the capital region. Municipalities were selected to match the number of Swedish-speaking children living in rural and urban areas as well as in cities in these four regions. Furthermore, the parents' highest level of education was considered when selecting participating municipalities. The participants were not stratified by language (mono- or bilingualism).

For practical reasons, the daycare centers participating in this study were chosen by the psychologists in each municipality or city that was part of the project. The psychologists and trained research assistants followed a specific protocol when selecting the participants, in order to secure a randomized sample and an even sex distribution.

The participants were assessed by clinical psychologists as well as trained and supervised psychology students with the Swedish versions of the WPPSI-IV and NEPSY-II. The length of each assessment was on average 2.63 h (*SD* = 0.70, range = 1.67–6.00, data missing $n = 7$) and was typically divided into three sessions (Mode = 3, range = 1–6). Three of the children were assessed with a long break between sessions (*M* = 4.64 months, range = 2–6 months), due to the COVID-19 pandemic. In these cases, a new test age was calculated for the subtests that were administered after the break and the new test age was used when converting these scores to scaled scores ($n = 3$ bilinguals; age before the break: *M* = 6.06 years, range = 5.42–6.92; age after the break: *M* = 6.44 years, range = 5.92–7.08). However, the ages presented in Table 1 are reported according to the age at the first assessment. In addition, also due to the COVID-19 pandemic effects, two monolingual children were not assessed with NEPSY-II, only with WPPSI-IV.

Statistical analyses. Statistical analyses were conducted using SPSS version 26.0. Before the main analyses, potential demographic differences between the two language groups (mono- vs. bilingual) were investigated using exact χ^2-tests and independent *t*-tests. Some subtest values were missing, mainly due to administration errors (e.g., a premature termination of a subtest). Out of the total of 19 subtests administered from the WPPSI-IV and NEPSY-II, 11 subtests had missing data. The missing values were on the item (total $n = 8$ subtests) and/or subtest levels (total $n = 5$). Data were missing for one to four participants per subtest (1.3%–5.1% of the participants per subtest). Out of the 79 participants, a total of 13 had missing data, on one to four subtests per individual. The missing values were replaced using expectation maximation imputation. Mahalanobis distance showed no extreme multivariate outliers.

For the main analyses, three profile analyses using multivariate analysis of covariance (MANCOVA) were conducted (Tabachnick & Fidell, 2014). Scaled scores were examined instead of raw scores, as profile analysis requires that all subtests use the same scaling techniques (Tabachnick & Fidell, 2007). Moreover, the use of scaled scores is motivated due to the clinical utility of the results. Language background (mono- vs. bilingual) was defined as the between-subjects variable in all three analyses. In the first 2×14 MANCOVA, the WPPSI-IV subtest scaled scores were used as the within-subjects variables. In the second 2×6 MANCOVA, the WPPSI-IV index scores (primary indexes and the ancillary index Vocabulary Acquisition) were used as the within-subjects variables. For the third 2×5 MANCOVA, the NEPSY-II subtest scaled scores were used as the within-subjects variables. Bonferroni-corrected post hoc tests were performed. Additionally, an analysis of covariance (ANCOVA) was conducted regarding the relationship between the Full Scale IQ and language background. In all analyses, the highest parental level of education was used as a covariate. In two cases, maternal level of education was used, as data on the paternal level of education was missing.

After the main analyses, exploratory follow-up analyses were conducted in order to examine the influence of accepting answers given in Finnish. Wilcoxon matched-pairs signed-rank tests were performed to explore possible differences between the scaled scores in the WPPSI-IV and

Table 2. *Means, measures of spread, and p-values for indexes/scales and subtest scaled scores of WPPSI-IV between mono- (n = 45) and bilinguals (n = 34)*

		Monolinguals		Bilinguals		
Indexes/scales	Subtests	*M* (*SD*)	Range	*M* (*SD*)	Range	*p*
Verbal Comprehension Index		107.60 (19.71)	66–147	100.24 (18.89)	60–132	0.073
	Similarities	**12.60 (3.27)**	**7–18**	**10.97 (2.84)**	**3–15**	**0.015**
	Information	**10.27 (3.76)**	**2–18**	**9.44 (3.97)**	**3–18**	**0.303**
	Vocabulary	10.71 (2.74)	5–16	9.53 (2.11)	6–14	0.025
	Comprehension	11.44 (3.20)	4–19	11.12 (2.69)	6–17	0.647
Visual Spatial Index		108.80 (10.42)	85–133	103.00 (14.11)	70–136	0.041
	Block Design	**11.11 (2.56)**	**7–18**	**10.53 (2.96)**	**4–18**	**0.357**
	Object Assembly	**11.80 (2.09)**	**8–16**	**10.47 (2.45)**	**5–15**	**0.012**
Fluid Reasoning Index		106.93 (14.25)	74–131	106.65 (11.86)	83–134	0.923
	Matrix Reasoning	**11.09 (2.82)**	**4–17**	**10.97 (2.50)**	**6–15**	**0.854**
	Picture Concepts	**10.89 (3.21)**	**2–18**	**10.91 (2.69)**	**4–16**	**0.982**
Working Memory Index		104.87 (11.85)	84–141	104.21 (13.64)	75–132	0.806
	Picture Memory	**11.09 (2.49)**	**7–16**	**10.85 (2.98)**	**5–16**	**0.675**
	Zoo Locations	**10.87 (2.20)**	**8–19**	**10.88 (2.73)**	**6–17**	**0.971**
Processing Speed Index		108.20 (16.98)	81–150	101.21 (13.50)	60–126	0.054
	Bug Search	**11.84 (3.13)**	**6–19**	**10.62 (2.70)**	**3–17**	**0.071**
	Cancellation	**11.22 (3.12)**	**6–19**	**10.12 (2.33)**	**4–14**	**0.092**
Vocabulary Acquisition Index		104.38 (15.06)	66–146	94.62 (13.66)	72–128	0.004
	Receptive Vocabulary	**10.73 (2.41)**	**5–17**	**9.94 (2.67)**	**4–15**	**0.171**
	Picture Naming	**10.67 (3.30)**	**4–19**	**8.38 (2.82)**	**4–17**	**0.001**
Full Scale IQ		108.96 (13.38)	82–134	103.79 (14.25)	72–128	0.090

Note: The subtests included in the index scores are bolded. The *p*-values for the subtests and index scores were derived from two multivariate analyses of covariance with Bonferroni-corrected post hoc tests. For Full Scale IQ, an analysis of covariance was undertaken. Highest parental level of education was included as a covariate in all analyses.

Table 3. *Means and measures of spread for verbal and memory subtest scaled scores of NEPSY-II between mono- (n = 43) and bilinguals (n = 34)*

	Monolinguals		Bilinguals	
Subtests	*M* (*SD*)	Range	*M* (*SD*)	Range
Phonological Processing	11.26 (2.90)	3–19	10.50 (2.38)	7–18
Comprehension of Instructions	13.05 (2.56)	6–17	12.71 (2.78)	6–18
Narrative Memory Free & Cued Recall	9.95 (3.24)	4–15	9.91 (3.33)	3–16
Semantic Word Generation	12.00 (3.27)	4–19	11.50 (3.60)	4–19
Sentence Repetition	12.05 (3.12)	4–19	10.59 (2.60)	6–15

Note: The *p*-values are not presented, since the NEPSY-II main analysis, using a multivariate analysis of covariance controlling for highest parental level of education, did not meet the criteria for pairwise comparisons.

NEPSY-II verbal subtests in those bilinguals who had also given answers in Finnish. These children's answers given in Swedish were compared with their answers given in both languages. Included in these analyses were subtests with ≥4 participants where the scaled scores were higher when answers in Finnish were accounted for.

The significance level was set at $p < 0.05$ for all analyses. Partial eta squared (η_p^2) was used when reporting effect sizes. Small, medium, and large effects were defined as 0.01, 0.06, and ≥ 0.14, respectively (Cohen, 1988). Due to the unequal group sizes of the mono- and bilinguals, Pillai's trace was reported (Field, 2013).

RESULTS

Descriptive statistics

Tables 2 and 3 present means, standard deviations, and ranges for the mono- and bilinguals' performance on the WPPSI-IV and NEPSY-II.

Main analyses: Cognitive performance and language background

WPPSI-IV subtests and language background. In the 2 × 14 MANCOVA, a significant main effect with a medium effect size was found for language background, $F(1, 76) = 5.35$, $p = 0.023$, $\eta^2_p = 0.07$, with monolinguals performing overall higher on the WPPSI-IV subtests. Highest parental level of education did not have a significant main effect, $F(1, 76) = 3.19$, $p = 0.078$, $\eta^2_p = 0.04$. A significant interaction with a large effect size between the WPPSI-IV subtests and language background was found, $F(13, 64) = 2.61$, $p = 0.006$, $\eta^2_p = 0.35$, Pillai's trace = 0.35. Pairwise comparisons revealed a significant monolingual advantage in the subtests Similarities, Vocabulary, Object Assembly, and Picture Naming (see Table 2).

WPPSI-IV index scores and language background. In the 2 × 6 MANCOVA, a significant main effect with a medium effect size was found for language background, $F(1, 76) = 5.11$, $p = 0.027$, $\eta^2_p = 0.06$, with monolinguals receiving higher WPPSI-IV index scores. No main effect was found for highest parental level of education, $F(1, 76) = 1.59$, $p = 0.211$, $\eta^2_p = 0.02$. Furthermore, a significant interaction with a large effect size between language background and index scores was found, $F(5, 72) = 3.00$, $p = 0.016$, $\eta^2_p = 0.17$, Pillai's trace = 0.17. Pairwise comparisons illustrated a significant monolingual advantage in the Visual Spatial Index and the Vocabulary Acquisition Index (see Table 2).

For Full Scale IQ, an ANCOVA with highest parental level of education as a covariate was conducted. No significant differences were found between mono- and bilinguals, $F(1, 76) = 2.94$, $p = 0.090$, $\eta^2_p = 0.04$.

NEPSY-II subtests and language background. In the 2 × 5 MANCOVA, no significant main effect was found for language background in the five language and verbal memory subtests of the NEPSY-II, $F(1, 74) = 1.97$, $p = 0.165$, $\eta^2_p = 0.03$. Additionally, no main effect was found for highest parental level of education, $F(1, 74) = 3.14$, $p = 0.081$, $\eta^2_p = 0.04$. No significant interaction effect was found between language background and the subtests, $F(4, 71) = 1.05$, $p = 0.390$, $\eta^2_p = 0.06$, Pillai's trace = 0.06. Table 3 presents NEPSY-II subtest mean values between the mono- and bilinguals.

Follow-up analyses: Bilingual children's answers in two languages

The follow-up analyses explored possible performance differences in the WPPSI-IV and NEPSY-II verbal subtests for the bilinguals, when answers were accounted for in both Swedish and Finnish, instead of solely in Swedish as in the main analyses. The number of participants whose scores changed when answers in both Swedish and Finnish ($n \geq 4$) were accounted for were $n = 7$ for WPPSI-IV Similarities; $n = 4$ for WPPSI-IV Information; $n = 5$ for WPPSI-IV Picture Naming; and $n = 5$ for NEPSY-II Semantic Word Generation. The Wilcoxon matched-pairs signed-rank tests were undertaken for these bilingual participants. The scores in Similarities were significantly higher when answers in both Swedish and Finnish were accepted ($Mdn = 12.00$) compared with accepting only answers given in Swedish ($Mdn = 11.00$, $Z = 21.00$, $p = 0.02$). The performance was not significantly different for the other subtests: Information ($Mdn = 8.50$ vs. $Mdn = 10.00$, $Z = 6.00$, $p = 0.102$), Picture Naming ($Mdn = 6.00$ vs. $Mdn = 7.00$, $Z = 10.00$, $p = 0.059$), and Semantic Word Generation ($Mdn = 12.00$ vs. $Mdn = 13.00$, $Z = 3.00$, $p = 0.157$).

DISCUSSION

The aim of this study was to investigate the relationships between language background and WPPSI-IV and NEPSY-II performance among 5–6-year-old Swedish monolingual and Swedish-Finnish simultaneous bilingual children in Finland. In this age-group, neurocognitive development is rapid (Korkman, Kemp & Kirk, 2001; Korkman, Lahti-Nuuttila, Laasonen, Kemp & Holdnack, 2013; Rosselli, Ardila, Navarrete & Matute, 2010), and important decisions are made concerning the start of school, as Finnish children enter school the year they turn 7. Therefore, clinical cognitive assessments at age 5–6 years are not unusual. The Finland-Swedish minority group provides a unique arena for research on cognitive performance and language background, as simultaneous bilingualism is common among Swedish-speaking Finns and Swedish is one of the official languages in Finland, with separate educational units for Swedish speakers. In addition, to the authors' knowledge, no previous studies have examined the relationship between 5–6-year-old mono- and bilinguals' performances on the newest test versions, WPPSI-IV or NEPSY-II. Earlier versions have been studied to some extent, including, for instance, clinical groups and abbreviated versions of the WPPSI. These studies have generated mixed findings (diSibio & Whalen, 2000; Garratt & Kelly, 2008; Korkman *et al.*, 2012; Westman, Korkman, Mickos & Byring, 2008).

The main finding of this study was a monolingual advantage in some, mainly language-related, subtests of the cognitive measure WPPSI-IV when assessed in Swedish. Moreover, when spontaneous answers in Finnish, produced by small samples of bilinguals, were considered, the performance by these bilinguals on the WPPSI-IV subtest Similarities significantly improved. No differences between mono- and bilinguals were observed on Full Scale IQ or on language or verbal memory subtests of the neurocognitive measure NEPSY-II. Parental level of education was not significantly associated with the cognitive test results.

Language background differences in WPPSI-IV profiles

In this study, some language and visual subtests seemed to be sensitive for bilingualism. Regarding linguistic functions, as hypothesized, the monolinguals performed significantly better than the bilinguals on the WPPSI-IV verbal subtests Similarities, Vocabulary, and Picture Naming. Even though these subtests measure different aspects of verbal abilities, such as verbal concept formation, word knowledge, and memory, they all share a strong emphasis on expressive language ability (Wechsler, 2012). On the index level, a monolingual advantage was found in the ancillary index Vocabulary Acquisition, which was based on the significant finding of the Picture Naming subtest. Additionally, based on mean values, a monolingual advantage of seven points was observed in the Verbal Comprehension Index, but the difference was not statistically significant. There was variation within the index that explains the result, where the significant difference in Similarities was combined with similar group-level performance in the Information subtest.

These results are largely in accordance with earlier research on the cognitive concomitants of language background and with related studies using earlier versions of the WPPSI (diSibio & Whalen, 2000; Korkman *et al.*, 2012). Previously, diSibio and Whalen (2000) found a significant monolingual advantage on WPPSI-R subtests requiring expressive vocabulary as compared with bilinguals, when assessed in one of their languages. Further, the monolingual advantage in the WPPSI-IV subtest Picture Naming found in the present study can be seen as corresponding to previous findings reporting monolinguals outperforming bilinguals on the NEPSY subtest Body Part Naming (Korkman *et al.*, 2012; Westman, Korkman, Mickos & Byring, 2008), as both subtests measure naming ability, although using different stimuli. A suggested slower vocabulary development in bilinguals (Korkman *et al.*, 2012) and an observed difference between monolinguals and balanced bilinguals in the child's expressive vocabulary, when each language is assessed separately (Thordardottir, 2011), could possibly explain the present differences found in tasks requiring expressive vocabulary between the language groups. However, the literature is not consistent, as, for instance, no significant differences between language groups in the WPPSI-R have been reported (Korkman *et al.*, 2012).

There was no significant difference for the subtest Receptive Vocabulary between mono- and bilinguals. This was in accordance with a study by Thordardottir (2011), which reported that mono- and balanced bilingual children performed comparably on receptive vocabulary measures when each language was tested separately. In contrast, a monolingual advantage in receptive vocabulary has been reported compared with bilinguals with separate home and school languages when assessment was undertaken in the school language (Bialystok, Luk, Peets & Yang, 2010). In the present study, amount of language exposure was not thoroughly investigated, but since the bilingual children all had a Swedish-speaking parent and attended a Swedish daycare unit, their exposure to Swedish might be considered high. This might explain why their receptive language performance in Swedish was comparable to that of the monolinguals.

Previous studies have underscored that the WPPSI-R visual subtests and Performance IQ can safely be used with bilingual children (diSibio & Whalen, 2000; Korkman *et al.*, 2012). Additionally, Niileksela and Reynolds (2019) concluded that the constructs in different versions of the Wechsler scales do not differ, suggesting that the subtests in the WPPSI-R are fairly similar to the ones in the WPPSI-IV. In some studies, although contrary to the current findings, bilinguals were superior to the test norms and to monolinguals on several constructional skills, such as the NEPSY subtest Design Copying (Garratt & Kelly, 2008; Rosselli, Ardila, Navarrete & Matute, 2010). Hence, the present significant results regarding lower performance in the subtest Object Assembly, measuring, for example, visual-perceptual organization and trial-and-error learning (Wechsler, 2012) in the bilingual group, was unexpected. It is possible that this is a chance finding. The finding can also be understood in light of studies showing that performance on visual tasks varies between different cultural groups (e.g., Mulenga, Ahonen & Aro, 2001; Rosenqvist *et al.*, 2017; Rosselli & Ardila, 2003). However, it can be argued that the children in the present study, regardless of language background, belong to the same cultural minority group of Swedish-speaking Finns, as they were all recruited from Swedish-speaking daycare centers in Finland, and, hence, culture-related performance differences would not be expected. Further, the results might also relate to the fact that the subtest Object Assembly has a verbal component: The subtest requires the child to assemble a puzzle of a specified object following verbal instructions (Wechsler, 2012). However, the objects and their names should for the most part be fairly common in the culture at hand, also for young children.

There was also a significant performance difference in the Visual Spatial Index, in which monolinguals outperformed bilinguals. The index includes the subtest Object Assembly, which, thus, partly explains the significance between mono- and bilinguals on this index score. The visual spatial subtest Block Design, also included in the Visual Spatial Index, is robust when used with mono- and bilinguals according to the present results.

There was a seven-point difference between mono- and bilinguals on the Processing Speed Index, with a monolingual advantage; however, the difference was not statistically significant. Also, the language groups in the present study had very similar performances on the Fluid Reasoning and Working Memory Indexes. Particularly strong evidence for a bilingual working memory advantage has not been found (Grundy & Timmer, 2017; Gunnerud, ten Braak, Reikerås, Donolato & Melby-Lervåg, 2020), and the present finding adds to this research field.

Generally, it is possible that the observed cognitive performance differences between 5–6-year-old mono- and bilinguals found in this study might diminish after school start, as Karlsson *et al.* (2015) found no significant differences between Finland-Swedish 7- and 10–11-year-old children concerning language background and performance on the WISC-IV (Wechsler, 2010). Perhaps attending a Swedish-speaking educational environment (daycare and formal education) leads to such language-related cognitive differences evening out with increasing age. Additionally, it should be noted that on a group level, the Finland-Swedish children in the present study had higher mean values compared with the Swedish WPPSI-IV norms. The difference between the current results and the Swedish WPPSI-IV norms might relate to several factors, for example cultural differences between the countries or differences between participant groups. Further research, conducted as part of The FinSwed Study, will explore these relationships.

Language background and NEPSY-II profiles

No main or interaction effects on the language or verbal memory subtests of NEPSY-II were found between mono- and bilingual children. Specifically, regarding the Phonological Processing subtest, which measures phonological awareness, the present non-significant finding is in line with previous research. The bilinguals' continuous use of two language systems could be considered an advantage in developing phonological awareness (Verhoeven, 2007). Yet, no bilingual advantage in the development of phonological awareness (Bialystok, Majumder & Martin, 2003; Goriot, Unsworth, Van Hout, Broersma & Mcqueen, 2021; Lesniak, Myers & Dodd, 2014) or in the NEPSY/NEPSY-II subtest Phonological Processing has previously been found (Garratt & Kelly, 2008; Karlsson *et al.*, 2015; Westman, Korkman, Mickos & Byring, 2008).

Also, in accordance with the present results, previous studies in the Swedish-speaking population in Finland have reported no significant differences on the Comprehension of Instructions subtest (Karlsson *et al.*, 2015; Korkman *et al.*, 2012; Westman, Korkman, Mickos & Byring, 2008). However, a study conducted in the United Kingdom using the previous assessment version, NEPSY, found a significant difference between mono- and bilinguals on this subtest, in favor of the monolinguals (Garratt & Kelly, 2008). Since these studies have been conducted in very different contexts, the differing results may relate to cultural aspects. In contrast to our study participants, the bilinguals studied by Garratt and Kelly (2008) had varying home languages and levels of bilingualism. Most importantly, some bilinguals did not speak English before school start and all had received extra support in English during their first year of school. Since the bilinguals in Garratt and Kelly's (2008) study were assessed in English at the age of 6–7 years, in their third year of education, the amount of exposure to the assessment language is an important difference. In our study sample, all bilinguals had exposure to both languages since birth, and none had a history of extra support in daycare.

In the present study, there was no significant language group difference in category verbal fluency, as assessed with the Semantic Word Generation task from NEPSY-II, and the mono- and bilinguals showed a similar performance on receptive vocabulary. As such, the present finding on category fluency is in line with previous results in 6–10- and 7- and 10-year-old children, respectively, which reported similar category fluency between language groups in one of the bilingual children's languages when receptive vocabulary was controlled for (e.g., Friesen, Luo, Luk & Bialystok, 2015; Zeng, Kalashnikova & Antoniou, 2019). However, a bilingual advantage on this task has also been reported, when groups were matched for receptive vocabulary (Friesen, Edwards & Lamoureux, 2021; Pino Escobar, Kalashnikova & Escudero, 2018). In contrast, a recent study found a bilingual disadvantage in semantic verbal fluency for children in Grade 3, although not in Grade 1 (Brandeker & Thordardottir, 2022). The monolinguals in Brandeker and Thordardottir (2022) had a larger receptive vocabulary size, but this was not controlled for. The authors discussed the possibility that it with time would become increasingly difficult for bilinguals to access words for semantic fluency (Brandeker & Thordardottir, 2022). Thus, as the present study included only 5–6-year-old children, it is possible that semantic verbal fluency differences between mono- and bilinguals could emerge in older age-groups of Finland-Swedes. This will be further explored in The FinSwed Study. In addition, in the present study, the groups were fairly homogeneous, as the bilinguals all spoke the same two languages (Swedish and Finnish) and the language groups performed equally on a task of receptive vocabulary. This may account for some differences to previous studies consisting of more heterogeneous bilingual samples.

Regarding tasks requiring verbal memory, a monolingual advantage was reported by Westman, Korkman, Mickos, and Byring (2008) for the NEPSY Sentence Repetition subtest. The authors attributed this to the greater vocabulary of the monolinguals. This finding was not confirmed in the present study, perhaps due to differing methodologies used, as the previous study by Westman and colleagues included children at risk for language impairment and used an earlier test version with different norms (Westman, Korkman, Mickos & Byring, 2008). Nevertheless, in the present study, Sentence Repetition was the NEPSY-II subtest with the greatest difference between the groups, with the bilinguals performing 1.5 scaled scores, or 0.5 *SD*, lower than the monolinguals. Finally, in accordance with the present study, differences in Narrative Memory between mono- and bilinguals has previously not been found (Garratt & Kelly, 2008).

Overall, when considering the present cultural setting of Swedish speakers in Finland, the non-significant differences between mono- and bilinguals on the NEPSY-II language and memory subtests in the present study suggest that the test is robust to use with both mono- and bilingual children. A similar conclusion has been stated in another Finland-Swedish study with older children (Karlsson *et al*., 2015).

Differences within the bilingual group

In the present study, some bilinguals also spontaneously gave answers in Finnish on some verbal tasks and, thus, possible answers in Finnish were recorded and scored separately. These bilinguals significantly improved their performance on the WPPSI-IV subtest Similarities, measuring verbal concept formation (Wechsler, 2012), when answers in both Swedish and Finnish were accounted for. It should be noted that the number of bilinguals spontaneously giving Finnish answers in the considered subtests was small (4–7 children/subtest), as was the difference in mean scores (≤1.2 scaled scores). In fact, children were not encouraged to use Finnish during the assessment; on the contrary, they were asked to repeat Finnish answers in Swedish.

In the subtest Similarities, one specific word is usually asked for (although longer explanations are also allowed) and, therefore, the subtest relies on vocabulary. Thus, the present result can be seen as a confirmation of previous findings reporting that the complete picture of a bilingual child's vocabulary skills may not be seen unless assessed in both languages. However, due to the small sample sizes, this finding can be viewed only as indicative and should be confirmed with larger studies. Still, as a whole, and as also previously suggested (e.g., Bialystok, Craik, Green & Gollan, 2009; Freeman & Schroeder, 2022; Peña, Bedore & Kester, 2016; Thordardottir, Rothenberg, Rivard & Naves, 2006), it is important to consider both languages of bilingual children in clinical assessments and, for instance, accept responses in both languages. Doing so may result in more accurate test results as well as in greater knowledge of the child's cognitive abilities.

Implications

The study results indicated that typically developing 5–6-year-old simultaneous bilinguals performed more poorly on some WPPSI-IV subtests and indexes than monolinguals of the same age-group. These results are clinically important in cognitive assessments but also when planning rehabilitation and interventions. Further, the results also add to the field of bilingualism literature.

Even though the cognitive performance between the Finland-Swedish mono- and bilinguals differed to some extent, most subtests in the Swedish WPPSI-IV did not significantly differ between the language groups. Thus, in clinical settings, most subtests seem robust and may safely be used with simultaneous bilingual children. Specifically, this study suggests that with 5–6-year-old simultaneous bilinguals, clinicians can safely use especially the WPPSI-IV subtests measuring receptive language, fluid intelligence, and visual memory, as well as subtests from the NEPSY-II language and memory domains. However, some subtests requiring expressive vocabulary and visuospatial skills were more sensitive for language background, and this should, therefore, be considered in clinical assessments. This is especially important when clinically assessing bilingual children in only one of their languages.

In line with previous studies that have discussed the value of assessing bilinguals in both of their languages in order to gain greater knowledge about their language abilities (e.g., Bialystok, Craik, Green & Gollan, 2009), the present study confirmed, although preliminarily due to the small samples sizes, that considering both languages is important also in clinical cognitive assessments. A small sample of bilinguals spontaneously provided answers in their other home language (Finnish), leading to a significant increase in scores on the WPPSI-IV Similarities subtest for these participants when the answers in Finnish were taken into account. Recording and scoring feasible answers given in the other home language during clinical assessments may lead to a more accurate description of the child's cognitive profile. In all, as mainly linguistic tasks requiring verbal responses showed differences between mono- and bilinguals in the present study, it can be argued that the differences between the groups does not relate to differences in their cognitive reasoning skills, but rather to the bilingual children's ability to answer correctly and comprehensively using only one of their languages. The significant differences found may, for instance, relate to lower vocabulary skills of the bilinguals when measured in only one of their languages, as has previously been shown regarding both expressive and receptive vocabulary, respectively (e.g., Bialystok, Luk, Peets & Yang, 2010; Oller, Pearson & Cobo-Lewis, 2007; Pearson, Fernández & Oller, 1993; Thordardottir, Rothenberg, Rivard & Naves, 2006; Uccelli & Páez, 2007). It is likely that the children's vocabulary size and their ability to answer the questions when using only one of their languages (Swedish) has impacted their performance on the verbal tasks.

Limitations

In the present study, some limitations need to be noted. The number of participants in each language group was relatively small. Therefore, some differences between the groups may have been missed and, alternatively, some observed findings may have been spurious. Additionally, to match the Scandinavian WPPSI-IV norm group, relatively many children were excluded from the study during the participant selection phase.

Moreover, the cognitive assessments were performed by 16 different psychologists/trained research assistants, potentially leading to differences in scoring or protocol keeping during assessments. However, in order to minimize tester effects on the findings, the psychologists/trained research assistants participated in an arranged schooling, and protocols were reviewed and corrected by the research group.

Lastly, defining bilingualism is not straightforward (Gunnerud, ten Braak, Reikerås, Donolato & Melby-Lervåg, 2020). For instance, the parents of two monolingual children in the present study reported using both languages between themselves, even though they reported their child as being monolingual. Such irregularities in our data may perhaps relate to parents being bilingual but choosing to speak Swedish with their child. Also, Swedish is the minority language in Finland, and most Swedish speakers have at least some proficiency in Finnish. In the present study, bilingualism could instead of a categorization into two groups have been defined as a continuum or by the degree of exposure to both languages in different environments. However, due to a limited amount of background information about the children's language background and proficiency, as well as the study including quite a homogeneous sample of bilinguals, only a two-group categorization was possible. Still, the present findings should fairly well represent children belonging to the Finland-Swedish minority who attend Swedish-speaking daycare in Finland, as simultaneous bilingualism is the most common form of bilingualism among Swedish-speaking Finns.

CONCLUSIONS

In conclusion, 5–6-year-old Swedish-speaking monolinguals performed better on some WPPSI-IV subtests and indexes assessing expressive vocabulary and visuospatial skills than Swedish-Finnish-speaking simultaneous bilinguals in the same age-group. No significant differences were observed in the NEPSY-II language and verbal memory tasks. We recommend that clinicians acknowledge the discrepancy in mono- and bilingual children's performance on some WPPSI-IV subtests in clinical assessments and in planning possible rehabilitations and interventions. It is important to recognize that bilingual children's cognitive test performance on verbal tasks may be lower if assessed in only one of their languages. Thus, clinicians are advised to consider the possible benefits of assessing young bilingual children in both of their home languages.

ACKNOWLEDGEMENTS

We thank all participating children and families, as well as the clinical psychologists and research assistants participating in the data collection. The authors also thank Lecturer of Psychometrics Jari Lipsanen for help with the statistical analyses. In the WPPSI-IV assessments, some minor culture-related changes were made in the wording of some verbal questions. All changes were made according to the Statement of Work No. 296412-2 to Master License Agreement No. LSR-111089 with NCS Pearson. The authors of this study have no known conflicts of interest to disclose.

FUNDING INFORMATION

The FinSwed Study was funded by the Swedish Cultural Foundation in Finland, the association Svenska folkskolans vänner, and the foundations Stiftelsen Brita Maria Renlunds minne sr and Oskar Öflunds stiftelse.

DATA AVAILABILITY STATEMENT

Research data are not shared, due to ethical and legal restrictions.

REFERENCES

Bialystok, E. (2017). The bilingual adaptation: How minds accommodate experience. *Psychological Bulletin*, *143*, 233–262.

Bialystok, E., Craik, F.I.M., Green, D.W. & Gollan, T.H. (2009). Bilingual minds. *Sage*, *10*, 89–129.

Bialystok, E., Luk, G., Peets, K.F. & Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism: Language and Cognition*, *13*, 525–531.

Bialystok, E., Majumder, S. & Martin, M.M. (2003). Developing phonological awareness: Is there a bilingual advantage? *Applied PsychoLinguistics*, *24*, 27–44.

Blom, E. (2019). Domain-general cognitive ability predicts bilingual children's receptive vocabulary in the majority language. *Language Learning*, *69*, 292–322.

Brandeker, M. & Thordardottir, E. (2022). Verbal fluency in bilingual school-age children: Looking at switching, clustering, and the effect of language experience. *International Journal of Bilingualism*, 1–20.

Carlson, S.M. & Meltzoff, A.N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science*, *11*, 282–298.

Carr, A. (2015). *The handbook of child and adolescent clinical psychology: A contextual approach*, 3rd edition. London, England: Routledge.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*, 2nd edition. Hillsdale, NJ: Lawrence Erlbaum Associates.

diSibio, M. & Whalen, T. (2000). Using the WPPSI-R with bilingual children: Implications for practice. *The California School Psychologist*, *5*, 5–17.

Field, A. (2013). *Discovering statistics using IBM SPSS Statistics*, 4th edition. London, England: SAGE Publications Ltd.

FINLEX®. Language Act 423/2003.

Finnish National Agency for Education. (2020). Finnish education system. https://www.oph.fi/en/education-system

Freeman, M.R. & Schroeder, S.R. (2022). Assessing language skills in bilingual children: Current trends in research and practice. *Journal of Child Science*, *12*, E33–E46.

Friesen, D.C., Edwards, K. & Lamoureux, C. (2021). Predictors of verbal fluency performance in monolingual and bilingual children: The interactive role of English receptive vocabulary and fluid intelligence. *Journal of Communication Disorders*, *89*, 106074.

Friesen, D.C., Luo, L., Luk, G. & Bialystok, E. (2015). Proficiency and control in verbal fluency performance across the lifespan for monolinguals and bilinguals. *Language, Cognition and Neuroscience*, *30*, 238–250.

Garratt, L.C. & Kelly, T.P. (2008). To what extent does bilingualism affect children's performance on the NEPSY? *Child Neuropsychology*, *14*, 71–81.

Gibbons, A. & Warne, R.T. (2019). First publication of subtests in the Stanford-Binet 5, WAIS-IV, WISC-V, and WPPSI-IV. *Intelligence*, *75*, 9–18.

Goriot, C., Unsworth, S., Van Hout, R., Broersma, M. & Mcqueen, J.M. (2021). Differences in phonological awareness performance - Are there positive or negative effects of bilingual experience? *Linguistic Approaches to Bilingualism*, *11*, 418–451.

Grundy, J.G. & Timmer, K. (2017). Bilingualism and working memory capacity: A comprehensive meta-analysis. *Second Language Research*, *33*, 325–340.

Gunnerud, H.L., ten Braak, D., Reikerås, E.K.L., Donolato, E. & Melby-Lervåg, M. (2020). Is bilingualism related to a cognitive advantage in children? A systematic review and meta-analysis. *Psychological Bulletin*, *146*, 1059–1083.

Karlsson, L.C., Soveri, A., Räsänen, P., Kärnä, A., Delatte, S., Lagerström, E. *et al.* (2015). Bilingualism and performance on two widely used developmental neuropsychological test batteries. *PLoS One*, *10*, 1–11.

Korkman, M., Kemp, S.L. & Kirk, U. (2001). Effects of age on neurocognitive measures of children ages 5 to 12: A cross-sectional study on 800 children from the United States. *Developmental Neuropsychology*, *20*, 331–354.

Korkman, M., Kirk, U. & Kemp, S. (2007). *NEPSY-II Second edition: Clinical and interpretive manual*. San Antonio, TX: NCS Pearson, Incorporated.

Korkman, M., Kirk, U. & Kemp, S. (2011). *NEPSY-II: Manual. Svensk version*. [Manual. Swedish version]. Stockholm, Sweden: NCS Pearson, Incorporated.

Korkman, M., Kirk, U. & Kemp, S.L. (1998). *NEPSY-A developmental neuropsychological assessment*. San Antonio, TX: The Psychological Corporation.

Korkman, M., Kirk, U. & Kemp, S.L. (2008). *NEPSY-II*. Psykologien Kustannus OY: Lasten neuropsykologinen tutkimus.

Korkman, M., Lahti-Nuuttila, P., Laasonen, M., Kemp, S.L. & Holdnack, J. (2013). Neurocognitive development in 5-to 16-year-old north American children: A cross-sectional study. *Child Neuropsychology*, *19*, 516–539.

Korkman, M., Stenroos, M., Mickos, A., Westman, M., Ekholm, P. & Byring, R. (2012). Does simultaneous bilingualism aggravate children's specific language problems? *Acta Paediatrica, International Journal of Paediatrics*, *101*, 946–952.

Lehtonen, M., Soveri, A., Laine, A., Järvenpää, J., de Bruin, A. & Antfolk, J. (2018). Is bilingualism associated with enhanced executive functioning in adults? A meta-analytic review. *Psychological Bulletin*, *144*, 394–425.

Lesniak, A., Myers, L. & Dodd, B. (2014). The English phonological awareness skills of 5;o-6;o-year-old polish-English, Portuguese-English bilingual speakers and English monolingual children. *Speech, Language and Hearing*, *17*, 37–48.

Lowe, C.J., Cho, I., Goldsmith, S.F. & Morton, J.B. (2021). The bilingual advantage in children's executive functioning is not related to language status: A meta-analytic review. *Psychological Science*, *32*, 1115–1146.

Mulenga, K., Ahonen, T. & Aro, M. (2001). Performance of Zambian children on the NEPSY: A pilot study. *Developmental Neuropsychology*, *20*, 375–383.

Namazi, M. & Thordardottir, E. (2010). A working memory, not bilingual advantage, in controlled attention. *International Journal of Bilingual Education and Bilingualism*, *13*, 597–616.

Niileksela, C.R. & Reynolds, M.R. (2019). Enduring the tests of age and time: Wechsler constructs across versions and revisions. *Intelligence*, *77*, 101403.

Oller, D.K., Pearson, B.Z. & Cobo-Lewis, A.B. (2007). Profile effects in early bilingual language and literacy. *Applied PsychoLinguistics*, *28*, 191–230.

Pearson, B.Z., Fernández, S.C. & Oller, D.K. (1993). Lexical development in bilingual infants and toddlers: Comparison to monolingual norms. *Language Learning*, *43*, 93–120.

Peña, E.D., Bedore, L.M. & Kester, E.S. (2016). Assessment of language impairment in bilingual children using semantic tasks: Two languages classify better than one. *International Journal of Language and Communication Disorders*, *51*, 192–202.

Pino Escobar, G., Kalashnikova, M. & Escudero, P. (2018). Vocabulary matters! The relationship between verbal fluency and measures of inhibitory control in monolingual and bilingual children. *Journal of Experimental Child Psychology*, *170*, 177–189.

Rosenqvist, J., Lahti-Nuuttila, P., Urgesi, C., Holdnack, J., Kemp, S.L. & Laasonen, M. (2017). Neurocognitive functions in 3- to 15-year-old children: An international comparison. *Journal of the International Neuropsychological Society*, *23*, 367–380.

Rosenqvist, J., Slama, S. & Haavisto, A. (2022). Användningen av kognitiva test vid psykologiska utredningar av barn och unga på svenska i Finland – en översikt [Using cognitive tests for psychological evaluations of children in Swedish in Finland - an overview]. *NMI Bulletin*, *Special Edition*, *32*, 74–93. https://bulletin.nmi.fi/wp-content/uploads/2022/09/NMI-Bulletin_sve_2022-E-74-93-rosenqvist.pdf.

Rosselli, M. & Ardila, A. (2003). The impact of culture and education on non-verbal neuropsychological measurements: A critical review. *Brain and Cognition*, *52*, 326–333.

Rosselli, M., Ardila, A., Navarrete, M.G. & Matute, E. (2010). Performance of Spanish/English bilingual children on a Spanish-language neuropsychological battery: Preliminary normative data. *Archives of Clinical Neuropsychology*, *25*, 218–235.

Saarela, J. (2021). Finlandssvenskarna 2021 - en statistisk rapport. [The Finland-Swedes 2021 - a statistical report]. *Svenska Finlands Folkting*. https://folktinget.fi/Site/Data/1597/Files/Finlandssvenskarna2021_statistiskrapport_Folktinget_KLAR.pdf.

Statistics Finland. (2020). Population structure. Appendix table 2. Population according to language 1980–2019. https://www.stat.fi/til/vaerak/2019/vaerak_2019_2020-03-24_tau_002_en.html

Tabachnick, B.G. & Fidell, L.S. (2007). Using multivariate statistics. In *Using multivariate statistics: Pearson International edition* (5th ed., pp. 314). Harlow, Esswx: Pearson.

Tabachnick, B.G. & Fidell, L.S. (2014). Profile analysis: The multivariate approach to repeated measures. In *Using multivariate statistics: Pearson new international edition* (6th ed., pp. 356–418). Harlow, Esswx: Pearson.

Tallroth, P. (2012). *Strategy for the national languages of Finland government resolution*. Prime Minister's office publications (Issue 7). Helsinki, Finland: Prime Minister's Office.

Thordardottir, E. (2011). The relationship between bilingual exposure and vocabulary development. *International Journal of Bilingualism*, *15*(4), 426–445.

Thordardottir, E., Rothenberg, A., Rivard, M.-E. & Naves, R. (2006). Bilingual assessment: Can overall proficiency be estimated from separate measurement of two languages? *Journal of Multilingual Communication Disorder*, *4*, 1–21.

Uccelli, P. & Páez, M.M. (2007). Narrative and vocabulary development of bilingual children from kindergarten to first grade: Developmental changes and associations among English and Spanish skills. *Language, Speech, and Hearing Services in Schools*, *38*, 225–236.

Van Den Noort, M., Struys, E., Bosch, P., Jaswetz, L., Perriard, B., Yeo, S. *et al*. (2019). Does the bilingual advantage in cognitive control exist and if so, what are its modulating factors? A systematic review. *Behavioral Sciences*, *9*, 27.

Verhoeven, L. (2007). Early bilingualism, language transfer, and phonological awareness. *Applied PsychoLinguistics*, *28*, 425–439.

Wechsler, D. (2010). *Wechsler intelligence scale for children-fourth edition Finnish*. Helsinki: Psykologien Kustannus OY.

Wechsler, D. (2012). *WPPSI-IV: Technical and interpretive manual*. Incorporated: NCS Pearson.

Wechsler, D. (2014). *Wechsler preschool and primary scale of intelligence- fourth edition. Manual Del 1. Svensk version. [Manual Part 1. Swedish version]*. Bielsko-Biala, PL: NCS Pearson, Incorporated.

Wechsler, D. (2016). *Wechsler intelligence scale for children- fifth edition. Manual Del 1. Svensk version. [Manual Part 1. Swedish version]*. Enschede, NL: NCS Pearson, Incorporated.

Westman, M., Korkman, M., Mickos, A. & Byring, R. (2008). Language profiles of monolingual and bilingual Finnish preschool children at risk for language impairment. *International Journal of Language and Communication Disorders*, *43*, 699–711.

Zeng, Z., Kalashnikova, M. & Antoniou, M. (2019). Integrating bilingualism, verbal fluency, and executive functioning across the lifespan. *Journal of Cognition and Development*, *20*, 656–679.

Received 28 July 2021, Revised 15 September 2022, accepted 14 December 2022