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Bilingualism in autism: Language learning profiles and social experiences

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Abstract

Bilingualism changes how people relate to others, and lead their lives. This is particularly relevant in autism, where social interaction presents challenges. Understanding the overlap between the social variations of bilingualism and autism could unveil new ways to support autistic people. This research aims to understand the language learning and social experiences of mono-, bi- and multilingual autistic people. A total of 297 autistic adults (mean age = 32.4 years) completed an online questionnaire including general demographic, language history and social life quality self-rating items. The sample included 89 monolingual English speakers, 98 bilinguals, and 110 multilinguals, with a wide range of language profiles. Regression models were used to analyse how bilingualism variables predicted social life quality ratings. In the full sample, age negatively predicted social life quality scores while the number of languages known positively predicted social life quality scores. In the multilingual subset, age negatively predicted social life quality scores, while third language proficiency positively predicted social life quality scores. This is the first study describing the language history and social experiences of a substantial sample of bilingual and multilingual autistic adults. It provides valuable insight into how autistic people can learn and use a new language, and how their bilingualism experiences shape their social life.

Lay abstract

Bilingualism changes the way people relate to others. This is particularly interesting in the case of autism, where social interaction presents many challenges. A better understanding of the overlap between the social variations of bilingualism and autism could unveil new ways to support the social experiences of autistic people. This research aims to understand the language learning and social experiences of autistic people who speak one, two or more languages. A total of 297 autistic adults (aged between 16 and 80 years) completed an online questionnaire that included general demographic questions, social life quality self-rating questions, language history questions, and open questions about the respondents' bilingualism experience. Respondents had a wide range of language experiences: there were 89 monolingual English speakers, 98 bilinguals, 110 respondents knew three languages or more, all with a wide range of abilities in their languages. In the full group, younger respondents were more satisfied with their social life, and respondents with many languages were more satisfied with their social life than respondents with few languages. In the multilingual group, younger respondents were more satisfied with their social life, and the more skilled in their third language the more satisfied with their social life. This is the first study describing the language history and social experiences of a large group of bilingual and multilingual autistic adults. It highlights how autistic people can encounter a new language, learn it and use it in their daily life, and how their bilingualism experiences shape their social life.

Keywords

autism spectrum disorders, bilingualism, communication and language, language learning, quality of life, social life quality

Introduction

The social processes differences characteristic of autism can impact the quality of daily life and social life of autistic people, regardless of the cultural environment. Studies conducted in Europe and Asia showed that when rating their quality of life across multiple domains, autistic adults

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give the social life domain the lowest score (Kamp-Becker et al., 2010; Lin, 2014; Lin & Huang, 2017) – unlike neurotypical adults, who rate all domains as equally satisfying (Lin, 2014). Consistently, autistic adults rate their social life quality significantly lower than do neurotypical adults (Jennes-Coussens et al., 2006; Kamio et al., 2013; Kamp-Becker et al., 2010; Lin, 2014; Lin & Huang, 2017; Schmidt et al., 2015; van Heijst & Geurts, 2015; Vincent et al., 2019). Since social life activities are a positive predictor of general quality of life for autistic adults (Mason et al., 2018; Schmidt et al., 2015), it is essential to understand the factors contributing to a more satisfying social life for autistic people. Bilingualism and multilingualism are among the relatively unexplored factors.

Bilingualism is a skill shared by half the world's population (Grosjean, 2010) with an inherent social and interactive dimension (Bialystok, 2007). There is a wide range of bilingual profiles described in the neurotypical population, and the term can be applied to all people who know two or more signed or spoken languages, learned simultaneously or sequentially, with varying proficiency levels. Defining a threshold above which one can be considered as bilingual is a sensitive matter, requiring agreement on both the relevant metric (e.g. proficiency in second language, age of acquisition of second language) and threshold. Definitions vary between authors and fields, which may explain some of the conflicting results found in bilingualism research (Luk & Bialystok, 2013). Different bilingualism parameters seem to influence different neurocognitive processes, and relevant contributing elements of bilingualism include the number of languages known (Schroeder & Marian, 2017), age of acquisition of each language (Johnson & Newport, 1989), proficiency in each language (Perani, 1998) or language-switching habits (Verreyt et al., 2016).

The linguistic and cognitive effects of bilingualism in autism are still poorly understood, compared to what is known in the neurotypical population. With rising autism prevalence and increases in the global bilingual population (de Oliveira, 2015), it is timely to chart the effect of bilingualism on the social life of autistic people. Anecdotal self-reports of bilingualism and multilingualism among autistic adults suggest that learning and using multiple languages may have a positive role in creating and sustaining good quality of life (Tammet, 2017). However, there is a lack of systematic research on bilingualism in autistic adults. Data from autistic children, while also limited, indicates that simultaneous bilinguals perform as well as age-matched monolinguals on linguistic measures and show no delay in language (Drysdale et al., 2015; Hambly & Fombonne, 2012; Kay-Raining Bird et al., 2016; Reetzke et al., 2015). Bilingualism may not only be harmless for cognitive processes in autism, but has even been suggested to have a positive influence, especially regarding social and communication skills (Iarocci et al., 2017; Uljarević et al., 2016). Despite the positive account presented by these – albeit preliminary – findings, parents still report a lack of support from practitioners and services when it comes to raising autistic children speaking more than one language (Hampton et al., 2017; Kay-Raining Bird et al., 2012). This may be because bilingualism is still often perceived as entailing a heavy cognitive load (Park, 2014).

Indeed, autism is associated with a wide range of language abilities. While some autistic people are minimal or non-verbal, others have typical (Brignell et al., 2018) or enhanced (Hyltenstam, 2016) language skills, with or without peculiar speech patterns (Gernsbacher et al., 2016). The presence of these linguistic capacities in many autistic people suggests that learning and achieving fluency in more than one language is also possible for autistic people, as it is for their non-autistic peers. Nonetheless, to date research on bilingualism in autism reports in majority only, two profiles of autistic bilinguals. Most studies focus on autistic children raised in bilingual environments (Hampton et al., 2017) and describe the language (Drysdale et al., 2015; Hambly & Fombonne, 2012, 2014; Ohashi et al., 2012; Petersen et al., 2012; Reetzke et al., 2015; Valicenti-McDermott et al., 2013; Zhou et al., 2019) or cognitive (Iarocci et al., 2017) development of the autistic child. At the other extreme of the bilingual experience, a handful of case studies focus on autistic polyglots and describe their linguistic (Bates, 1997; Hyltenstam, 2016; Smith & Tsimpli, 1991; Tsimpli & Smith, 1991; Vulchanova, Talcott, Vulchanov, & Stankova, 2012; Vulchanova, Talcott, Vulchanov, Stankova, & Eshuis, 2012) or cognitive (Hyltenstam, 2018; Tsimpli & Smith, 1998) abilities. As such, the current literature on autistic bilinguals does not reflect the diversity of language history profiles extensively described in the non-autistic population (Grosjean, 2010).

This study explores language profile diversity in the autistic bilingual population, and assesses the potential influence of bilingualism on the self-reported social habits and quality of life of autistic adults. The first aim is to richly characterise a substantial sample of autistic bilingual adults, describing their language learning history, current use and proficiency. We predict that the language history profiles existing in the bilingual autistic population will be more diverse than those currently described in the literature, with various levels of learning experiences and uses. The second aim is to examine the relationship between aspects of bilingualism (e.g. age of acquisition, proficiency) and self-perceived social life quality.

Methods

Participants

The final sample includes 297 participants (Table 1, and see Survey Data Management for data exclusion criteria),

Table 1. Respondents' demographic characteristics.

Demographics	
Age in years, *M* (*SD*, range)	32.4 (12.0, 16–80)
Gender, *N* (%)	
Female	173 (58.2)
Male	67 (22.6)
Other gender identity	50 (16.8)
Not disclosed	7 (2.4)
Diagnosis, *N* (%)	
Diagnosed	237 (79.8)
Self-identified	60 (20.2)
Age of diagnosis, *M* (*SD*, range)	26.4 (14.5, 2–78)
Highest Education, *N* (%)	
Less than an undergraduate degree	138 (46.5)
Undergraduate degree or higher	159 (53.5)
Country of birth, *N* (%)	
United Kingdom	122 (41.1)
Non-UK, English-speaking[a]	108 (36.4)
Europe, non-English-speaking[b]	45 (15.2)
Outside Europe, non-English-speaking[c]	21 (7.1)
Country of residence, *N* (%)	
United Kingdom	145 (48.8)
Non-UK, English-speaking[d]	105 (35.4)
Europe, non-English-speaking[e]	37 (12.5)
Outside Europe, non-English-speaking[f]	10 (3.4)
Non-UK-born UK residents, *N* (%)	22 (7.4)
Age of arrival in the UK, *M* (*SD*, range)	17.8 (10.5, 0.7–36)

SD: standard deviation.
Sociodemographic characteristics of the respondents ($n = 297$).
[a]Australia (6), Canada (14), Ireland (4), United States (84).
[b]Belgium (4), Czech Republic (1), Estonia (1), France (6), Germany (14), Italy (2), The Netherlands (4), Norway (3), Poland (1), Spain (4), Sweden (5).
[c]Algeria (1), Argentina (1), Bahrain (1), Brazil (1), Curacao (1), Hong Kong (1), Indonesia (1), Israel (1), Mexico (2), Paraguay (1), Puerto Rico (1), Singapore (3), Taiwan (1), Trinidad & Tobago (1), Turkey (2).
[d]Australia (5), Canada (13), Ireland (6), United States (81).
[e]Belgium (2), Estonia (2), France (6), Germany (12), Italy (1), The Netherlands (4), Norway (2), Spain (3), Sweden (4), Switzerland (1).
[f]Curacao (1), Israel (1), Mexico (1), New Zealand (1), Paraguay (1), Singapore (2), Thailand (1), Trinidad & Tobago (1), Turkey (1).

clinically diagnosed with autism ($n = 237$) or self-identified as autistic ($n = 60$). The mean age was 32.4 years (range: 16–80 years), with a mean age at diagnosis of 26.4 years (range: 2–78 years). The gender distribution is 58.2% female, 22.6% male, and 19.2% not listed or not disclosed. The study was conducted in the United Kingdom, and the recruitment strategy targeted residents of the United Kingdom, resulting in 48.8% of respondents being UK residents. The recruitment flyer was clearly advertising this study as focusing on bilingualism, but was also encouraging the participation of monolingual and multilingual autistic adults. It was circulated around universities and autism networks in the United Kingdom (see below in Procedure). However, the recruitment flyer was also circulated online through social media, which led to the participation of non-UK residents as well (51.2% of the respondents). Notably, 27% of the respondents were residents of the United States, 4% residents of Canada, and 4% residents of Germany. All other countries represented no more than 2% of the sample (see Table 1 for further details about the countries of origin and residence of the respondents). The survey was circulated in English, and so required reading and writing proficiency in that language, and participants had to be 16 years or above to participate. Participants were not compensated for their participation in the study.

Design

This study was a cross-sectional survey design using self-report measures to explore correlations between bilingualism and social life quality.

Measures

The Autism & Bilingualism Census (ABC, Digard & Fletcher-Watson, 2019) is an online survey, created in SurveyMonkey, and it is available to view at https://osf.io/xsqy7/. The ABC was created for this research and designed to capture data from monolingual, bilingual and multilingual autistic adults. It consists of four sections:

- Section A: General demographic information;
- Section B: General life satisfaction and social life quality;
- Section C: Language history;
- Section D: Open-ended questions.

Section A collected demographic information about the respondents such as age, countries of birth and residence, highest education level, and autism diagnosis.

Section B focused on social experiences including social life habits (such as the making and maintaining of friendships, or online and in-person engagement in social activities) and quality of life. It was composed of four blocks of statements addressing *general life satisfaction* (5 statements), *current mood* (11 statements), *social life quality* (12 statements) and *personality* (6 statements). This section was inspired by pre-existing validated quality of life and quality of social life questionnaires: the WHOQOL (The WHOQOL Group, 1995) – versions of which have been previously used with autistic populations (Jennes-Coussens et al., 2006; Kamio et al., 2013; Kamp-Becker et al., 2010; Lin, 2014; Lin & Huang, 2017; Mason et al., 2018; Vincent et al., 2019), the WHODAS 2.0 (Üstün et al., 2010), the Goldberg Depression Scale (Goldberg et al., 1988), the European Social Survey (ESS Round 8: European Social Survey Round 8 Data, 2016) and the Satisfaction with Life Scale (Diener et al., 1985). Items were composed, drawing on these scales (see Table S1 in

Supplementary Material), but tailoring the wording and content to the population being recruited. Participants rated their agreement with each statement on a seven-point Likert-type scale (from 'strongly disagree' to 'strongly agree'). Participants' ratings were converted to a seven-point scale for subsequent analysis (range: 1–7). All blocks but the current mood block only contained positive statements ('I can easily make new friends'), and for these blocks, the conversion scores matched the original Likert-type scale. The current mood block only contained negative statements ('I feel anxious'), and these were reverse-scored, so that a high score indicates high satisfaction in all measured domains.

Section C focused on the respondents' language history and use. This section drew on pre-existing validated language history and language use questionnaires: the Bilingualism and Emotions Questionnaire (Dewaele & Pavlenko, 2001), the Language History Questionnaire (Li et al., 2006), the Language Experience and Proficiency Questionnaire (LEAP-Q, Marian et al., 2007) and the Bilingual Language Experience Calculator (BiLEC, Unsworth, 2013). For each language known, respondents were asked how old they were when they first encountered the language and in what context they encountered it. Participants self-rated their current proficiency on a nine-point Likert-type scale (from 'Not at all'=0 to 'Excellent'=8) in four standard language skills: oral expression, oral comprehension, written expression and written comprehension. Respondents also indicated on a seven-point Likert-type scale (from 'Never'=1 to 'Always'=7) the frequency with which they used each language with their friends, family and other people in their environments, both currently and while learning the language, and the current frequency of use of each language for a selection of mental and communication tasks (e.g. 'Do maths', 'Swear') and daily activities ('Watching TV'). Participants could provide information for up to seven languages, each language being covered in a separate page of the survey. If they knew more than seven languages, they were offered the possibility to list any other languages they knew, without providing further details.

Section D involved open-ended questions asking about the respondents' language learning experience, their perception of the importance of language learning and how these were influenced by autism. Open-ended comment boxes were also available for each language for the participants to provide, if needed, more details about their past and current use of the language. The qualitative data from these items are not covered in this report.

Procedure

The study was approved by the PPLS Research Ethics Committee of the University of Edinburgh. The consent form was built into the online survey and participants provided consent by completing the first page of the survey, which was a pre-requisite for progression to further questions. Respondents were recruited between February and March 2017, with a recruitment flyer circulated via autism charities and networks across the United Kingdom, disability services of UK universities and social media. Participants completed the questionnaire online by themselves, on their own devices, in their own time.

Survey data management

A total of 491 responses were recorded by SurveyMonkey. No catch item or repeated item was used, but the requirement to type the name of each language known and the multiple open-ended questions allowed us to ensure no bot-like response was present in the final sample. In addition, responses were excluded if they:

- Did not provide full information for at least their first language (179 responses), as this could indicate the respondent had not actually completed the questionnaire and had dropped out after completing the consent form, but before providing all the necessary information to be included in the analysis. This high dropout rate was in all likelihood due to the length of the questionnaire;
- Listed information about several languages on one page (two responses), as it was unclear which language was associated with the proficiency and use reported;
- Failed to provide adequate information about diagnosis or self-identification of autism (seven responses);
- Did not list English as any of their languages, or indicated a general English proficiency strictly less than three ('Slightly less than adequate') (five responses), as this suggests that the respondent might not fully understand the questions of the survey;
- Were duplicate responses from the same participant (one response): in this case, the second and more complete response was retained for analysis

Several variables were created based on the participants' responses:

Language proficiency: for each language, proficiency was calculated as the average of four self-rated standard language skills (oral expression, oral comprehension, written expression and written comprehension).

Number of languages reported (N language R): each respondent provided data on a number of languages ranging from 1 to 7. This was further converted into a categorical variable (N language R-group) for analysis: monolingual (one language reported), bilingual (two languages reported) and multilingual (three languages or more reported).

Number of languages known with medium to high proficiency (N language P): for each participant, this was the number of languages reported with a proficiency equal to or over three ('Slightly less than adequate'). This threshold was defined as indicating that the respondents had a more than basic grasp of the language. This discrete variable ranged from 1 to 7. This was further converted into a categorical variable (N language P-group) for analysis: monolingual (proficient in one language), bilingual (proficient in two languages) and multilingual (proficient in three or more languages).

Age of acquisition: participants were asked 'how old were you when you first encountered L2' and the answer to this question was defined as age of acquisition.

Language order: participants reported their languages in varying orders (e.g. by increasing age of acquisition, or by decreasing proficiency). Languages were reordered by age of acquisition, with the second language being the first language learned after the native language. Thirteen participants did not report a specific age of acquisition in years for some of their languages. In this case, answers were re-coded as missing data, but in most cases, reordering of the languages by age of acquisition was still possible (e.g. where the respondent replied 'infancy' for age of acquisition).

Balance: relative proficiency between the first (L1) and second (L2) languages was calculated as the absolute difference between the first and second language proficiency. A score of 0 indicated a balanced proficiency, and a score of 7 indicated a complete dominance in one of the languages. The same balance was calculated between the first and third (L3) languages.

Acquisition context: for each language, respondents indicated frequency of use with different interlocutors and in different contexts. The home environment included five item scores (parent 1, parent 2, siblings, other people in the household and other members of the family), the school environment included one item (school), and the community environment included two item scores (friends, community). Not all respondents assigned a score to all items (e.g. respondents without siblings did not report a score for this item). The maximum score reported in an environment was the score assigned to that environment. The main context of acquisition was identified as the environment with the highest score. When the main (highest-scoring) context had a score strictly under three ('Occasionally'), the main context was re-coded as 'independent', highlighting the fact that the respondent mostly learned the language independently and didn't use it in the home, the school or the community.

Current context: the main context of current use was identified in the same manner as the main context of acquisition. For this variable, the home environment included seven item scores (parent 1, parent 2, siblings, partner, children, other members of the family and flatmates), the school/work environment included one item (school/work) and the community environment included two item scores (friends and community). For the respondents' first language (L1) only, the community environment featured only one item (community) due to an error when building the online survey. When the main context had a score strictly under 3 ('Occasionally'), the main context was re-coded as 'independent', as above.

Social life quality (SLQ) scores: for each block of statements in section B, internal consistency was measured using Cronbach's Alpha. Each block showed high internal consistency (general life satisfaction: $\alpha = 0.88$, current mood: $\alpha = 0.86$, social life: $\alpha = 0.83$, personality: $\alpha = 0.7$). For each participant, the scores in each block were therefore averaged to provide a single sub-scale score for that block. The SLQ score is derived from the social life quality subsection and is the outcome variable used in the analysis described below.

The anonymised data set and analysis script will be made available at https://osf.io/vd53u/ (Digard & Fletcher-Watson, 2019).

Community involvement

Community involvement in the study was modest. We consulted informally with Autistic advisors affiliated with the authors' lab group, including one trilingual autistic advisor, when formulating the original questions and design for the project. However, most autistic people only engaged with the study as participants.

Analysis methods

Sociodemographic characteristics and social life quality predictors were determined by descriptive analyses. Then, linear regression models computed using R (version 3.5.3) and R studio (version 1.2.1335) were used to determine how language profiles predict social life quality. The available predictors varied with language group: for example, monolingual people do not have data on age of acquisition of additional languages, and do not have data on balance between L2 and L1. Therefore, the analysis deployed three different linear regression models, applied to specific samples of respondents. For each model, all the applicable predictors were first entered, and a stepwise regression with both forward and backward selection was then used to obtain the optimal model. The three optimal models were validated using 10-fold cross-validation.

Model 1 was applied to all 297 respondents to investigate how bilingualism and multilingualism predicted the self-rated social life quality of autistic adults, relative to monolingual peers. Relevant predictors available for these

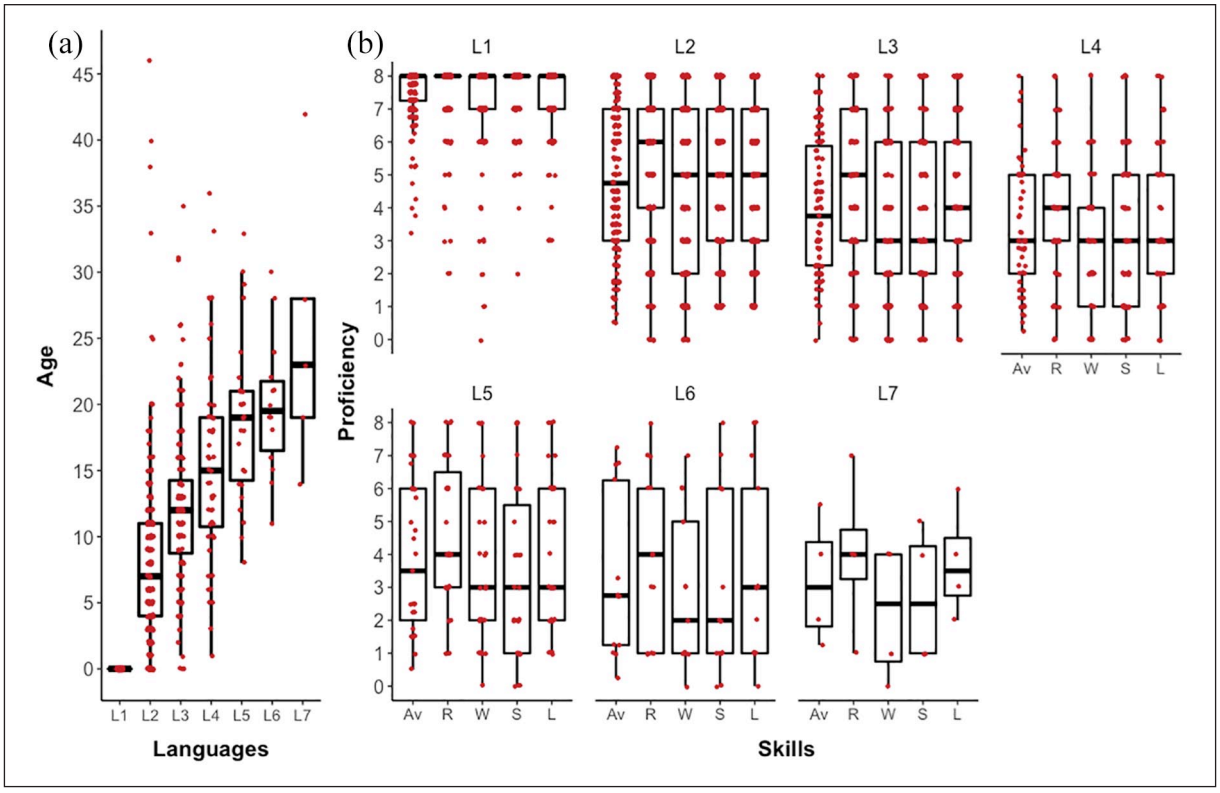

Figure 1. Age of acquisition and proficiency of the languages reported. (a) Age of acquisition: boxplot and scatterplot of the distribution of the reported ages of acquisition for the languages (L) 1 to 7, ranked by age of acquisition for each respondent. (b) Language proficiency: boxplot and scatterplot of the self-rated average (Av) and detailed (reading = R, writing = W, speaking = S, listening = L) proficiency for the languages 1 to 7, ranked by age of acquisition for each respondent (Digard et al., 2019).

respondents were entered: respondent age; N language R; N language R-group; N language P; and N language P-group.

Model 2 was applied to the bi- and multilingual respondents ($n = 196$, participants who reported two languages or more), to investigate how specific features of the bilingual experience predicted the self-rated social life quality of autistic bilingual adults. Relevant predictors available for these respondents were entered: respondent age; N language R; N language R-group; N language P; N language P-group; L2 age of acquisition; L2 proficiency; and L2/L1 balance.

Model 3 was applied to the multilingual respondents ($n = 108$, participants who reported three languages or more), to investigate how specific features of the multilingual experience predicted the self-rated social life quality of autistic multilingual adults. All the predictors available for these respondents were entered: respondent age; N language R; N language P; L2 age of acquisition; L2 proficiency; L2/L1 balance; L3 age of acquisition; L3 proficiency; and L3/L1 balance.

Results

Language profiles

The language characteristics of the sample are reported in Figure 1 and Table 2. The acquisition context and the current context for the respondents who reported more than one language are presented in Supplementary Material (Table S2).

In our sample of 297 autistic adults, 98 reported knowing two languages, 56 reported three languages and 54 reported four or more languages (Table 2, A). Proficiency in the second language ranged from 0.5 to 8, with a mean of 4.9 ($SD = 2.2$), and proficiency in the third language ranged from 0 to 8, with a mean of 4.1 ($SD = 2.0$) (see Table 2, B). When considering only the languages known at a 'slightly less than adequate' level of proficiency or higher, 104 respondents knew two languages, 43 knew three languages and 29 knew four languages or more.

Ages of acquisition for the second language ranged from 0 to 46 years ($M = 8.0$ years, $SD = 6.9$) (see Table 2, C). Twenty-three respondents (11.7% of the respondents who reported an age of acquisition for L2) reported learning L2 from birth, and 61 (31.1%) between ages 1 and 5 years, which indicates that 42.9% of the respondents who reported an age of acquisition for L2 fit the profile of simultaneous or early bilingualism generally reported in the field of bilingualism in autism research. Nonetheless, 46 (23.5%) reported acquiring their L2 during adolescence (between ages 11 and 17 years) and 12 (6.1%) after age of 18 years. Ages of acquisition for the third language ranged

Table 2. Respondents' language characteristics ($n = 297$).

A. Number of languages

	R, *n* (%)	P, *n* (%)
1 language	89 (30.0)	121 (40.7)
2 languages	98 (33.0)	104 (35.0)
3 languages	56 (18.9)	43 (14.5)
4 languages	26 (8.8)	20 (6.7)
5 languages	14 (4.7)	6 (2.0)
6 languages	9 (3.0)	1 (0.3)
7+ languages	5 (1.7)	2 (0.7)

B. Age of acquisition and proficiency

	Languages (*N*)	Age in years, *M* (*SD*, range)	Proficiency, *M* (*SD*, range)
Monolinguals	L1 (89)	0 (0, 0–0)	7.3 (1.1, 3–8)
Bilinguals and multilinguals	L1 (208)	0 (0, 0–0)	7.6 (0.8, 3.3–8)
	L2 (208)	8.0 (6.9, 0–46)	4.9 (2.2, 0.5–8)
	L3 (110)	12.3 (6.5, 0–35)	4.1 (2.0, 0–8)
	L4 (54)	15.6 (7.5, 1–36)	3.5 (1.9, 0.3–8)
	L5 (28)	18.9 (6.3, 8–33)	3.9 (2.3, 0.5–8)
	L6 (14)	19.9 (5.2, 11–30)	3.2 (2.5, 0.3–7.3)
	L7 (5)	25.2 (10.7, 14–42)	3.1 (1.7, 1.3–5.5)

C. Age of acquisition – Age groups distribution, *n* (%)

Language (*N*)[a]	Birth (age = 0)	Early childhood (age = 1–5 years)	Late childhood (age = 6–10 years)	Adolescence (age = 11–17 years)	Early adulthood (age = 18–30 years)	Adulthood (age > 30 years)
L1 (297)	297 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
L2 (196)	23 (11.7)	61 (31.1)	54 (27.6)	46 (23.5)	8 (4.1)	4 (2.0)
L3 (108)	4 (3.7)	10 (9.3)	25 (23.2)	52 (48.2)	14 (13.0)	3 (2.8)
L4 (52)	0 (0.0)	4 (7.7)	9 (17.3)	18 (34.6)	19 (36.5)	2 (3.9)
L5 (26)	0 (0.0)	0 (0.0)	2 (7.7)	8 (30.8)	15 (57.7)	1 (3.9)
L6 (14)	0 (0.0)	0 (0.0)	0 (0.0)	4 (28.6)	10 (71.4)	0 (0.0)
L7 (5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (20.0)	1 (20.0)	3 (60.0)

SD: standard deviation.

Some percentages do not sum up to 100% due to cumulative rounding effects. A. Number of languages: number and proportion of respondents who reported (R) or were proficient (P) in 1, 2, 3, 4, 5, 6 or 7 or more languages (lang.); B. Age of acquisition and proficiency: age of acquisition (Age) and proficiency reported by the respondents in languages (L) 1 to 7; C. Age of acquisition – Age groups distribution: number and proportion of respondents who acquired their languages (L) 1 to 7 at birth, during early childhood, late childhood, adolescence, early adulthood and late adulthood.

[a]Reported sample sizes (*N*) reflect the number of respondents who provided useable age of acquisition data (in years).

from 0 to 35 years, with a mean of 12.3 years ($SD = 6.5$). While, based on the ages of acquisition of L3 reported, adolescence is the largest age group for the learning of L3 (48.2%), 14 respondents (13.0%) reported learning L3 before age of 5 years and 17 (15.7%) reported learning L3 after age of 18 years.

Social life quality

The SLQ results are displayed in Table 3. After stepwise regression, model 1 included the following predictors: respondent age and N language P-group. Model 1 was applied to the full sample of respondents ($n = 297$) to investigate the relationship between the predictors (respondent age, N language P-group) and SLQ scores. The data met the assumptions of homogeneity and linearity and the residuals were appropriately distributed. The post hoc power was high, at 92.7%, and the model was a significant predictor of SLQ scores ($F_{2,294} = 8.016$, $p = 0.0004$). There was a significant relationship between age and SLQ score ($\beta = -0.01$, $p = 0.003$), and between N language P-group and SLQ score ($\beta = 0.19$, $p = 0.0067$), together accounting for 4.53% of SLQ score variance, with a small effect size ($f^2 = 0.047$). There was a decrease of 0.014 points in the SLQ score per extra year of participant age, indicating lower social life quality for older respondents. There was an average increase of 0.19 points in the SLQ score from monolingual to bilingual groups, and from bilingual to multilingual groups, indicating higher social life quality with increasing number of proficiently known languages, at a group level.

After stepwise regression, model 2 included the following predictors: respondent age; N language P-group; and L2/L1 balance. Model 2 was applied to the sample of respondents who reported two languages or more ($n = 196$) to investigate the relationship between specific bilingualism parameters (N language P-group, L2/L1 proficiency balance) and age, and the SLQ scores, in the autistic bi- and multilingual population. The data met the assumptions of homogeneity and linearity, and the residuals were appropriately distributed. The post hoc power was low, at 54.9%, and the model was a significant predictor of SLQ scores ($F_{3,192} = 3.158$, $p = 0.026$). There was a significant relationship between N language P-group and SLQ score ($\beta = 0.33$, $p = 0.0063$), as seen in model 1 with the full sample of respondents: there was an increase of 0.329 points in

Table 3. Prediction of SLQ scores using multiple linear regression.

SLQ, *M* (*SD*, range)	Model 1					Model 2					Model 3				
	3.59 (0.98, 1.17–6.33)					3.65 (1.00, 1.17–6.33)					3.75 (1.00, 1.41–5.92)				
Coef.	β	SE	CI (95%)	Stat.	*p*	β	SE	CI (95%)	Stat.	*p*	β	SE	CI (95%)	Stat.	*p*
Intercept	3.68	0.21	3.27–4.08	17.93	<0.001***	3.04	0.38	2.30–3.78	8.03	<0.001***	4.02	0.35	3.33–4.71	11.41	<0.001***
Age	–0.01	0.00	–0.02 to –0.00	–2.95	0.003**	–0.01	0.01	–0.02 to 0.00	–1.44	0.151	–0.02	0.01	–0.04 to –0.00	–2.33	0.022*
N language P-group	0.19	0.07	0.05–0.33	2.73	0.007***	0.33	0.12	0.10–0.56	2.76	0.006**					
L2/L1 pro. balance						0.06	0.04	–0.02 to 0.14	1.53	0.128					
L3 av. pro.											0.10	0.05	0.01–0.19	2.07	0.041*
Obs.	297					196					103				
R^2/adj. R^2	0.052/0.045					0.047/0.032					0.085/0.066				
F-statistic	8.016					3.158					4.618				
p	0.0004***					0.026*					0.012*				

Coef.: coefficients; β: estimates of regression β coefficients; SLQ: social life quality; SD: standard deviation; SE: standard errors; CI: confidence interval; Stats.: *t*-statistics; *p*: *p*-value; pro: proficiency; av.: average; Obs.: observations; adj.: adjusted.

SLQ score from the bilingual to the multilingual groups, indicating higher social life quality with increasing number of proficiently known languages, at a group level. In this case, there was no significant relationship between age and SLQ score ($\beta = -0.01$, $p = 0.15$), and between the L2/L1 proficiency balance and the SLQ score ($\beta = 0.06$, $p = 0.13$), even though both these predictors were selected during the stepwise regression as improving the accuracy of the model. This model accounted for 3.21% of the SLQ score variance, with a small effect size ($f^2 = 0.033$).

After stepwise regression, model 3 included the following predictors: age of respondent and L3 proficiency. Model 3 was applied to the sample of respondents who reported three languages or more ($n = 103$, as five participants had missing values in one or several of the predictors selected) to investigate the relationship between specific bilingualism parameters (L3 proficiency) and age, and SLQ scores, in the autistic multilingual population. The data met the assumptions of homogeneity and linearity and the residuals were appropriately distributed. The post hoc power was low, at 66.2%, and the model was a significant predictor of SLQ scores ($F_{2,100} = 4.618$, $p = 0.012$). There was a significant relationship between age and SLQ score ($\beta = -0.02$, $p = 0.022$), and between L3 proficiency and SLQ score ($\beta = 0.10$, $p = 0.041$), together accounting for 6.63% of SLQ score variance, with a small effect size ($f^2 = 0.071$). For L3 proficiency, there was an increase of 0.098 point in SLQ score per extra proficiency point, indicating that higher proficiency in a third language is associated with higher social life quality. There was a decrease of 0.021 points in the SLQ score per extra year of participant age, indicating lower social life quality for older respondents.

Discussion

This study reveals a great diversity in the language history profiles of autistic bilingual people and demonstrates that bilingualism has a modest but significant positive association with the self-rated social life quality of autistic people.

Our descriptive data confirm our prediction that the language history profiles of the bilingual autistic population are more diverse than those currently described in the literature. Most studies on autistic bilinguals focus on one of the two extremes of the bilingualism experience: simultaneous or early bilingual autistic children raised in a bilingual family (Drysdale et al., 2015; Hampton et al., 2017), or on autistic self-taught polyglots (Hyltenstam, 2016, 2018), and seem to imply that the bilingualism diversity of the autistic population does not reflect the bilingualism diversity described in the non-autistic population. Our results add to the current picture of autistic bilingualism, showing a rich diversity of language profiles. Even the sample size is striking, given that these data were collected

over just 2 months in an English language survey, and circulated mainly in a country with a very dominant monolingual profile. This suggests a high level of interest in this research area from the autistic population. Responses reveal a broad range of numbers of languages known, with variable proficiencies in those languages. Similar to their non-autistic peers, autistic people can know several languages without necessarily becoming highly proficient polyglots. While some participants were raised in bilingual or multilingual households, we also revealed that successful acquisition of a second language can also occur later in life, and even in adulthood. Likewise, childhood trilingualism is also possible in autism, as well as the late acquisition of a third language during adolescence or adulthood, which could be linked to the study of foreign languages at school. To the best of our knowledge these language experiences have not yet been presented in autism research. Taken together, while this study, especially targeting bilingual and multilingual autistic adults, does not claim that this sample is representative of the whole autistic population in term of proportion of language profiles (for example in term of number of languages known), our results show that a wide diversity of language profiles does exist.

Overall, our research suggests that there are areas of language research in autism that require greater investigation. For example, there is a need for better comprehension of the cognitive impact of early multilingualism – not only bilingualism – in autism, as well as more research into the potentially specific support needs of families with autistic children growing up in a multilingual setting. With language acquisition also occurring after childhood, it is interesting to consider the cognitive skills required for late language acquisition in autism, as well as best practices to support language learning for autistic people outside of the family environment.

In models investigating monolingual, bilingual and multilingual respondents, respondents with proficiency in two or more languages rated their social life as more satisfactory than their monolingual peers, though this effect is modest. Reinforcing this link, we also found that social quality of life was higher for the multilingual group compared with bilingual people. In addition, balanced proficiency between languages also contributed to the fit of our model of social quality of life. Taken together, these results indicate a possible dose-dependent relation between language proficiency and quality of life, such that increasing language knowledge is associated with increasing social life quality. However, there are apparent limits to this effect. There was no evidence that knowing four, five or more languages is associated with even higher satisfaction with social life – though reducing power in this necessarily smaller group would also influence that result. In addition, older respondents were less satisfied with the quality of their social life. This aligns with previous findings on social and psychological quality of life in autism (Mason et al., 2018), though a recent meta-analysis reported no association between age and general quality of life in autism, indicating that other factors may be more influential predictors (Kim & Bottema-Beutel, 2019). This argument is also relevant when taking into account the small proportion of the social life quality ratings explained by the models (3.2%–6.6%). While our results show that bilingualism does have a small but significant influence on the social life quality of autistic adults, other factors, such as coexisting conditions or current family support (Kamio et al., 2013; Lin & Huang, 2017; Vincent et al., 2019), may have a greater impact.

What is the mechanism of these effects of bilingualism? One possibility is that acquiring proficiency in multiple languages requires cognitive and social resources that also confer quality of life benefits in the social domain. However, we found no predictive value of age of acquisition in our models, partly puncturing this notion. If cognitive skills were the underlying cause of both language proficiency and better social life quality, we might expect these effects to be especially pronounced in people who had mastered a second language late in life, rather than those who were raised in bilingual households. Put another way, if there is a positive influence of bilingualism on social life during childhood, acquiring a second or third language later in life seems to carry the same benefits in terms of social life habits. This suggests that an alternative mechanism, such as the social interactive benefits accrued from knowing multiple languages, and opening up new communication and communities, is also worth probing in future research.

Limitations

The results of this study are necessarily restricted by the limitations of the cross-sectional, self-report methods used, making it impossible to draw causal inferences, and the circulation of the survey in English. For example, recent male-to-female ratio estimates in autism approach 3:1 (Loomes et al., 2017) and thus are at odds with the gender distribution in our sample, hindering its representativity. However, this overrepresentation of females reflects a regularly reported bias in online studies (Sax et al., 2003; Smith, 2008), including online studies with autistic respondents (Deserno et al., 2017). In addition, for proficiency ratings, it is possible that respondents had a variable and heterogeneous understanding of what is an average or a good language proficiency. Although studies have shown that self-rated proficiency is generally accurate compared to standardised language testing (Brantmeier et al., 2012; Edele et al., 2015), this has not been verified in autism. Furthermore, our recruitment strategy focused on the United Kingdom, though some respondents living in other countries were included. The United Kingdom is de facto a monolingual country with high immigration, meaning

that our data may reflect the experience of a specific population defined not just by language knowledge and autism but also by high rates of immigration. The country of residence was not included in the analysis because of the distribution of the data. Indeed, 48.8% of the respondents were UK residents, and most other countries contributed 1–6 data points (2% or less of the respondents). The only exceptions were the United States, with 27% of the responses, and Canada and Germany, each with 4% of the responses (see Table 1 for a detailed account of the countries of origin and residence of the participants). Future research could explore the cultural differences in social life quality in relation to language knowledge, particularly contrasting monolingual and bilingual environments. Indeed, while the diversity of our sample is a strength, more focused examinations of the specific impact of bilingualism in specific demographic or linguistic sub-samples would be of interest. Finally, as discussed above, several potential confounds linked to social life quality have not been accounted for in the present model, such as gender, level of education, relationship status, maternal support, aggressive behaviours, comorbid psychiatric conditions and mental health conditions (Kamio et al., 2013; Lin & Huang, 2017; Mason et al., 2018).

Conclusion

This study reveals for the first time the range and complexity of language learning profiles among autistic people. We observe an impressive diversity of experiences of language learning across the lifespan, and variability in both proficiency and context of use. Autistic bilinguals and multilinguals are not all linguistic savants, nor all raised in multilingual households. Many have learnt one or more second languages at school or independently, and use them with moderate proficiency, as non-autistic people do. In addition, through statistically robust analyses, we find evidence that proficiency in two or more languages is associated with better self-rated social quality of life for autistic people. The consequences of these results for family decision-making, language education and lifelong learning should be explored in future studies.

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Supplemental material

Supplemental material for this article is available online.

References

Bates, E. (1997). On language savants and the structure of the mind. *International Journal of Bilingualism*, *1*, 163–179.

Bialystok, E. (2007). Language acquisition and bilingualism: Consequences for a multilingual society. Applied Psycholinguistics, 28(3), 393.

Brantmeier, C., Vanderplank, R., & Strube, M. (2012). What about me?: Individual self-assessment by skill and level of language instruction. *System*, *40*(1), 144–160. https://doi.org/10.1016/j.system.2012.01.003

Brignell, A., Morgan, A. T., Woolfenden, S., Klopper, F., May, T., Sarkozy, V., & Williams, K. (2018). A systematic review and meta-analysis of the prognosis of language outcomes for individuals with autism spectrum disorder. *Autism & Developmental Language Impairments*, *3*, 2396941518767610. https://doi.org/10.1177/2396941518767610

de Oliveira, E. (2015). A literature review on bilingualism among children diagnosed with autism spectrum disorders. *Revista Chilena de Fonoaudiología*, *14*, 33–44.

Deserno, M. K., Borsboom, D., Begeer, S., & Geurts, H. M. (2017). Multicausal systems ask for multicausal approaches: A network perspective on subjective well-being in individuals with autism spectrum disorder. *Autism*, *21*(8), 960–971. https://doi.org/10.1177/1362361316660309

Dewaele, J.-M., & Pavlenko, A. (2001). *Web questionnaire on bilingualism and emotion* [Unpublished manuscript, University of London].

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of Personality Assessment*, *49*(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13

Digard, B. G., & Fletcher-Watson, S. (2019). *Autism & bilingualism census*. https://doi.org/10.17605/OSF.IO/X8NDW

Digard, B. G., Sorace, A., Stanfield, A., & Fletcher-Watson, S. (2019). *Bilingualism in autism: Language learning profiles and social experiences*. https://doi.org/10.17605/OSF.IO/VD53U

Drysdale, H., van der Meer, L., & Kagohara, D. (2015). Children with autism spectrum disorder from bilingual families: A systematic review. *Review Journal of Autism and Developmental Disorders*, *2*(1), 26–38. https://doi.org/10.1007/s40489-014-0032-7

Edele, A., Seuring, J., Kristen, C., & Stanat, P. (2015). Why bother with testing? The validity of immigrants' self-assessed language proficiency. *Social Science Research*, *52*, 99–123. https://doi.org/10.1016/j.ssresearch.2014.12.017

ESS Round 8: European Social Survey Round 8 Data. (2016). *Data file edition 2.1. NSD – Norwegian Centre for Research Data, Norway: Data Archive and distributor of ESS data for ESS ERIC*. https://doi.org/10.21338/NSD-ESS8-2016

Gernsbacher, M. A., Morson, E. M., & Grace, E. J. (2016). Language and speech in autism. *Annual Review of Linguistics*, *2*(1), 413–425. https://doi.org/10.1146/annurev-linguist-030514-124824

Goldberg, D., Bridges, K., Duncan-Jones, P., & Grayson, D. (1988). Detecting anxiety and depression in general medical settings. *British Medical Journal*, *297*(6653), 897–899. https://doi.org/10.1136/bmj.297.6653.897

Grosjean, F. (2010). *Bilingual*. Harvard University Press.

Hambly, C., & Fombonne, E. (2012). The impact of bilingual environments on language development in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *42*(7), 1342–1352. https://doi.org/10.1007/s10803-011-1365-z

Hambly, C., & Fombonne, E. (2014). Factors influencing bilingual expressive vocabulary size in children with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *8*(9), 1079–1089. https://doi.org/10.1016/j.rasd.2014.05.013

Hampton, S., Rabagliati, H., Sorace, A., & Fletcher-Watson, S. (2017). Autism and bilingualism: A qualitative interview study of parents' perspectives and experiences. *Journal of Speech, Language, and Hearing Research*, *60*(2), 435–446. https://doi.org/10.1044/2016

Hyltenstam, K. (2016). The exceptional ability of polyglots to achieve high-level proficiency in numerous languages. In K. Hyltenstam (Ed.), *Advanced proficiency and exceptional ability in second languages* (pp. 241–272). De Gruyter.

Hyltenstam, K. (2018). Polyglotism: A synergy of abilities and predispositions. In K. Hyltenstam, I. Bartning, & L. Fant (Eds.), *High-level language proficiency in second language and multilingual contexts* (1st ed., pp. 170–195). Cambridge University Press.

Iarocci, G., Hutchison, S. M., & Toole, G. O. (2017). Second language exposure, functional communication, and executive function in children with and without autism spectrum disorder (ASD). *Journal of Autism and Developmental Disorders*, *47*, 1818–1829. https://doi.org/10.1007/s10803-017-3103-7

Jennes-Coussens, M., Magill-Evans, J., & Koning, C. (2006). The quality of life of young men with Asperger syndrome: A brief report. *Autism*, *10*(4), 403–414. https://doi.org/10.1177/1362361306064432

Johnson, J. S., & Newport, E. L. (1989). Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology*, *21*(1), 60–99. https://doi.org/10.1016/0010-0285(89)90003-0

Kamio, Y., Inada, N., & Koyama, T. (2013). A nationwide survey on quality of life and associated factors of adults with high-functioning autism spectrum disorders. *Autism*, *17*(1), 15–26. https://doi.org/10.1177/1362361312436848

Kamp-Becker, I., Schröder, J., Remschmidt, H., & Bachmann, C. J. (2010). Health-related quality of life in adolescents and young adults with high functioning autism-spectrum disorder. *GMS Psycho-Social-Medicine*, *7*, Article Doc03. https://doi.org/10.3205/psm000065

Kay-Raining Bird, E., Genesee, F., & Verhoeven, L. (2016). Bilingualism in children with developmental disorders: A narrative review. *Journal of Communication Disorders*, *63*, 1–14. https://doi.org/10.1016/j.jcomdis.2016.07.003

Kay-Raining Bird, E., Lamond, E., & Holden, J. (2012). Survey of bilingualism in autism spectrum disorders. *International Journal of Language and Communication Disorders*, *47*(1), 52–64. https://doi.org/10.1111/j.1460-6984.2011.00071.x

Kim, S. Y., & Bottema-Beutel, K. (2019). A meta regression analysis of quality of life correlates in adults with ASD. *Research in Autism Spectrum Disorders*, *63*, 23–33. https://doi.org/10.1016/j.rasd.2018.11.004

Li, P., Sepanski, S., & Zhao, X. (2006). Language history questionnaire: A Web-based interface for bilingual research. *Behavior Research Methods*, *38*(2), 202–210. https://doi.org/10.3758/BF03192770

Lin, L.-Y. (2014). Quality of life of Taiwanese adults with autism spectrum disorder. *PLOS ONE*, *9*(10), Article e109567. https://doi.org/10.1371/journal.pone.0109567

Lin, L.-Y., & Huang, P.-C. (2017). Quality of life and its related factors for adults with autism spectrum disorder. *Disability and Rehabilitation*, *41*(8), 896–903. https://doi.org/10.1080/09638288.2017.1414887

Loomes, R., Hull, L., & Mandy, W. P. L. (2017). What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, *56*(6), 466–474. https://doi.org/10.1016/j.jaac.2017.03.013

Luk, G., & Bialystok, E. (2013). Bilingualism is not a categorical variable: Interaction between language proficiency and usage. *Journal of Cognitive Psychology*, *25*(5), 605–621. https://doi.org/10.1080/20445911.2013.795574. Bilingualism

Marian, V., Blumenfeld, H. K., & Kaushanskaya, M. (2007). The language experience and proficiency questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language, and Hearing Research*, *50*, 940–967. https://pubs.asha.org/doi/abs/10.1044/1092-4388%282007/067%29

Mason, D., McConachie, H., Garland, D., Petrou, A., Rodgers, J., & Parr, J. R. (2018). Predictors of quality of life for autistic adults: Quality of life of autistic adults. *Autism Research*, *11*(8), 1138–1147. https://doi.org/10.1002/aur.1965

Ohashi, J. K., Mirenda, P., Marinova-Todd, S., Hambly, C., Fombonne, E., Szatmari, P., Bryson, S., Roberts, W., Smith, I., Vaillancourt, T., Volden, J., Waddell, C., Zwaigenbaum, L., Georgiades, S., Duku, E., & Thompson, A. (2012). Comparing early language development in monolingual- and bilingual- exposed young children with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *6*(2), 890–897. https://doi.org/10.1016/j.rasd.2011.12.002

Park, S. (2014). Bilingualism and children with autism spectrum disorders: Issues, research, and implications. *NYS TESOL Journal*, *1*(2), 122–129.

Perani, D. (1998). The bilingual brain. Proficiency and age of acquisition of the second language. *Brain*, *121*(10), 1841–1852. https://doi.org/10.1093/brain/121.10.1841

Petersen, J. M., Marinova-Todd, S. H., & Mirenda, P. (2012). Brief report: An exploratory study of lexical skills in bilingual children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *42*(7), 1499–1503. https://doi.org/10.1007/s10803-011-1366-y

Reetzke, R., Zou, X., Sheng, L., & Katsos, N. (2015). Communicative development in bilingually exposed Chinese children with autism spectrum disorders. *Journal of*

Speech, Language, and Hearing Research, *58*(3), 813–825. https://doi.org/10.1044/2015_JSLHR-L-13-0258

Sax, L. J., Gilmartin, S. K., & Bryant, A. N. (2003). Assessing response rates and nonresponse bias in web and paper surveys. *Research in Higher Education*, *44*(4), 409–432. https://doi.org/10.1023/A:1024232915870

Schmidt, L., Kirchner, J., Strunz, S., Bro, J., Ritter, K., Roepke, S., & Dziobek, I. (2015). Psychosocial functioning and life satisfaction in adults with autism spectrum disorder without intellectual impairment. *Journal of Clinical Psychology*, *71*(12), 1259–1268. https://doi.org/10.1002/jclp.22225

Schroeder, S. R., & Marian, V. (2017). Cognitive consequences of trilingualism. *International Journal of Bilingualism*, *21*(6), 754–773. https://doi.org/10.1177/1367006916637288

Smith, N., & Tsimpli, I.-M. (1991). Linguistic modularity? A case study of a 'savant' linguist. *Lingua*, *84*(4), 315–351.

Smith, W. G. (2008). *Does gender influence online survey participation? A record-linkage analysis of university faculty online survey response behavior*. San José State University. https://eric.ed.gov/?id=ED501717

Tammet, D. (2017). *Every word is a bird we teach to sing: Encounters with the mysteries & meanings of language*. Hachette UK.

Tsimpli, I.-M., & Smith, N. (1991). Second-language learning: Evidence from a polyglot savant. *Working Papers in Linguistics*, *3*, 171–185.

Tsimpli, I.-M., & Smith, N. (1998). Modules and quasi-modules: Language and theory of mind in a polyglot savant. *Learning and Individual Differences*, *10*(3), 193–2015.

Uljarević, M., Katsos, N., Hudry, K., & Gibson, J. L. (2016). Practitioner review: Multilingualism and neurodevelopmental disorders – An overview of recent research and discussion of clinical implications. *Journal of Child Psychology and Psychiatry*, *57*(11), 1205–1217. https://doi.org/10.1111/jcpp.12596

Unsworth, S. (2013). Assessing the role of current and cumulative exposure in simultaneous bilingual acquisition: The case of Dutch gender. *Bilingualism: Language and Cognition*, *16*(1), 86–110. https://doi.org/10.1017/S1366728912000284

Üstün, T. B., Kostanjsek, N., Chatterji, S., & Rehm, J. (Eds.) (2010). *Measuring health and disability: Manual for WHO Disability Assessment Schedule WHODAS 2.0*. World Health Organization.

Valicenti-McDermott, M., Tarshis, N., Schouls, M., Galdston, M., Hottinger, K., Seijo, R., Shulman, L., & Shinnar, S. (2013). Language differences between monolingual English and bilingual English-Spanish young children with autism spectrum disorders. *Journal of Child Neurology*, *28*(7), 945–948. https://doi.org/10.1177/0883073812453204

van Heijst, B. F., & Geurts, H. M. (2015). Quality of life in autism across the lifespan: A meta-analysis. *Autism*, *19*(2), 158–167. https://doi.org/10.1177/1362361313517053

Verreyt, N., Woumans, E., Vandelanotte, D., Szmalec, A., & Duyck, W. (2016). The influence of language-switching experience on the bilingual executive control advantage. *Bilingualism: Language and Cognition*, *19*(1), 181–190.

Vincent, A., Fonseca, D. D., Baumstarck, K., Charvin, I., Alcaraz-Mor, R., & Lehucher-Michel, M.-P. (2019). The quality of life and the future of young adults with Asperger syndrome. *Disability and Rehabilitation*, *0*(0), 1–8. https://doi.org/10.1080/09638288.2018.1544297

Vulchanova, M., Talcott, J. B., Vulchanov, V., & Stankova, M. (2012). Language against the odds, or rather not: The weak central coherence hypothesis and language. *Journal of Neurolinguistics*, *25*(1), 13–30. https://doi.org/10.1016/j.jneuroling.2011.07.004

Vulchanova, M., Talcott, J. B., Vulchanov, V., Stankova, M., & Eshuis, H. (2012). Morphology in autism spectrum disorders: Local processing bias and language. *Cognitive Neuropsychology*, *29*(7–8), 584–600. https://doi.org/10.1080/02643294.2012.762350

The WHOQOL Group. (1995). The World Health Organization quality of life assessment (WHOQOL): Position paper from the World Health Organization. *Social Science & Medicine*, *41*(10), 1403–1409. https://doi.org/10.1016/0277-9536(95)00112-K

Zhou, V., Munson, J. A., Greenson, J., Hou, Y., Rogers, S., & Estes, A. M. (2019). An exploratory longitudinal study of social and language outcomes in children with autism in bilingual home environments. *Autism*, *23*(2), 394–404. https://doi.org/10.1177/1362361317743251