

## Research Report

### Language ability and adult homelessness

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#### Abstract

**Background:** People experiencing homelessness are at increased risk of neurological disorder due to multiple factors such as substance abuse, infection, and higher rates of serious mental illness and traumatic brain injury. This could affect cognitive and language skills. Indeed, past research has suggested that certain language-related skills tend to be lower in people experiencing homelessness. However, that research has compared homeless samples with age-matched normative samples and not with samples of people from similar socio-economic backgrounds. Therefore, it is unclear whether homelessness is even a relevant factor, or if adults who are homeless tend to have appropriate linguistic skills relative to their social and educational background.

**Aims:** To compare the language skills of a group of adults with histories of homelessness with an education-matched control group. It was hypothesized that participants with histories of homelessness would have worse language performance than their matched controls.

**Methods & Procedures:** A quasi-experimental design was employed involving 17 adults with histories of homelessness, mainly rough sleeping, in the city of Quito in Ecuador, and a sample of 16 adults who had never been homeless. All were assessed with measures of head injury, substance dependence, affective disorder and language skills. A paired-sample analysis was performed on homeless and control participants matched for educational background, used as an index of socio-economic background.

**Outcomes & Results:** The mean years of formal education was low in both the homeless sample (mean = 5.82 years) and the control sample (mean = 6.75 years). There were no differences between the groups for any demographic or clinical factors, nor for a measure of expected or 'premorbid' ability based on single-word reading, nor for current non-verbal cognitive functioning. In contrast, the homeless group scored significantly worse than the control group on measures of auditory comprehension and oral expression.

**Conclusions & Implications:** Adults with histories of homelessness may have worse language skills than would be expected based on their educational backgrounds and non-verbal cognitive abilities. It is possible that some of this lower language ability is pathological, in the form of either a developmental language disorder or an acquired impairment. As such, some adults who are homeless may benefit from therapy directed at clinical language disorders.

**Keywords:** homelessness, socio-economic status, poverty, aphasia, language, cognitive impairment.

#### What this paper adds

##### *What is already known on this subject*

Previous research has shown that adults with histories of homelessness often score below 'average' on tests of language ability. However, it has not been shown that they score below what would be expected for their socio-economic background.

##### *What this paper adds to existing knowledge*

A sample of adults experiencing homelessness scored poorly on measures of auditory comprehension and oral expression. The fact that they scored below the levels of education-matched control participants suggests that their lower ability may be partly pathological, in the form of developmental language disorder or an acquired impairment.

*What are the potential or actual clinical implications of this work?*

Clients with histories of homelessness may present with relatively poor language skills. However, one should not automatically assume that this simply reflects the abilities of clients of low socio-economic position. Some of the poor performance may reflect developmental or acquired pathology and could be treated as such.

## Introduction

Homelessness is a common socio-economic phenomenon in most, if not all, countries, regardless of overall level of wealth or development. It is widely recognized that people who are homeless, along with other marginalized and overlapping groups such as drug-abusers, are at much greater risk for a wide range of negative health outcomes, including physical and psychological illnesses (Aldridge *et al.* 2018, Fazel *et al.* 2008). The reasons for this are complex and include interactions between economic and disease-related risk factors for homelessness, as well as the effects of lived homelessness on health, such as exposure to contagious illness and pollution, stress, malnutrition, vulnerability to abuse and violence, etc.

It has also been observed that people who are homeless tend to perform below the level of normative samples on tests of current cognitive and language function (Davidson *et al.* 2014, O'Neil-Pirozzi 2003, Pluck *et al.* 2012, Solliday-McRoy *et al.* 2004). Some of this lower functioning is likely just normal variation in ability, which is associated with socio-economic status (SES) (Noble *et al.* 2007, Turrell *et al.* 2002). In addition, it is likely that pathological language development trajectories are overrepresented in adults who become homeless. Developmental language disorder (DLD), which involves multiple difficulties with language development, including development of phonological processing, vocabulary and grammar, is more commonly seen in boys and in those from lower SES family backgrounds (Snowling *et al.* 2019). Homeless adults are disproportionately male, and disproportionately with childhood histories of living in poverty (Koegel *et al.* 1995), which may be associated with a raised prevalence of DLD. Furthermore, poor early language development is predictive of later emotional and behavioural problems (Clegg *et al.* 2015), perhaps contributing to circumstances that put individuals at risk of homelessness. Some support for this comes from a study of runaway and homeless street youth that found that a majority had reading disability associated with severe deficits of phonological processing (Barwick and Siegel 1996).

However, there is also evidence that some of the lower cognitive functioning observed in samples of homeless adults is a consequence of acquired cognitive impairments (Pluck *et al.* 2012). Furthermore, downward social mobility, which is a characteristic of

homelessness, is itself associated with relatively poor cognitive functioning (Turrell *et al.* 2002).

Nevertheless, there have been very few studies of the specific language skills of people who are homeless. Research that has reported reading ability of homelessness-experiencing participants has generally reported that they perform below the level of normative samples or control groups. For example, a study of 90 men residing in a homeless shelter in the United States reported poor reading ability, amongst many other cognitive problems. In that research, the performance of the shelter residents was compared with the normative sample (Solliday-McRoy *et al.* 2004). As described previously, a study in Canada of runaway and homeless youth found that a majority (52%) performed abnormally for reading ability, and many (29%) also demonstrated impaired arithmetic and writing ability, compared with normative data (Barwick and Siegel 1996). A US-based study reported lower letter fluency in a sample of 30 adults accessing homeless services when compared with an age-matched control group (Davidson *et al.* 2014). The only study that provided a comprehensive assessment of language ability measured the two primary language modalities (auditory comprehension and oral expression), and also the equivalent literacy modalities (reading and writing). The performance of a group of 25 female homeless shelter residents (again US based) tended to be below that of the test norms. In fact, 15 of the 25 women (60%) performed within the delayed or impaired range, defined as more than 1.5 SD (standard deviation) below the normative scores for at least one of the four modalities measured (O'Neil-Pirozzi 2003). All four modalities appeared to be affected, but the lowest frequency of delayed/impaired performance was for auditory comprehension (4/25 women, 16%).

The existing research, therefore, appears to confirm that adults with histories of homelessness tend to show some delay or impairment of language. However, in all cases, participants in the homeless study groups were compared with normative samples or with age-matched controls. There is a problem with this interpretation. Homelessness is a socio-economic state, and it is known that cognitive ability in general varies along a socio-economic gradient (Noble *et al.* 2007, Turrell *et al.* 2002). Furthermore, adults who become homeless tend to come from very low SES family backgrounds (Koegel *et al.* 1995). It is, therefore, quite possible that the participants in previous homelessness research were only

scoring below the normative samples, but not necessarily pathologically below the level that would be expected for their particular SES background. Simply put, it has not been shown that homelessness is a relevant factor. If people who are homeless are compared with some form of SES-matched control group, it is perfectly reasonable that they may perform within the normal, non-pathological, range.

The aim of the current research is, therefore, to compare the language skills of a group of adults with histories of homeless to a group of controls of similar SES background, but without histories of homelessness. Matching for current SES between homeless and non-homeless groups is not possible, simply because the state of homelessness is itself a specific SES factor. What is needed, therefore, is to match on a factor that is not in itself influenced by homelessness. The simplest way to achieve this is to match members of the homeless and non-homeless (control) groups based on education.

Educational history, often simply measured as years of completed education, captures many long-term aspects of early-life socio-economic position, is usually set by early adulthood, and is relevant to individuals irrespective of age and occupational factors (Galobardes *et al.* 2006). As an indicator of socio-economic background, it is therefore more appropriate for matching homeless and non-homeless participants than other commonly used indicators such as occupation or earnings, which are confounded by current status.

However, matching for educational history needs to be used cautiously in groups of research participants who may have histories of psychiatric illness, such as those with histories of homelessness. This is because of the counterintuitive effect that psychiatric patients sometimes show better cognitive abilities than education-matched controls, an effect called the 'matching fallacy' (Glahn *et al.* 2006, Kremen *et al.* 1996). This has been revealed with single-word pronunciation tests that require orthographic (i.e., lexical reading). The reason that such pronunciation tests are used is that reading aloud words via an orthographic route is thought to be special amongst cognitive functions in that it is generally unaffected by psychiatric illness and even neurological illness (Crawford *et al.* 1987, Del Ser *et al.* 1997, Pluck *et al.* 2017), nevertheless performance correlates highly with other cognitive functions, particularly psychometrically measured intelligence (Schrelen *et al.* 2005). Such pronunciation tests can, therefore, be used to estimate *expected cognitive ability* (in the case of non-clinical samples) or *premorbid cognitive ability* (in clinical samples).

In contrast to preserved single-word pronunciation ability, educational attainment is often curtailed by psychiatric illness. The result is that psychiatric patients show better pronunciation ability (taken to index cogni-

tive potential in general) than their education-matched controls (hence the matching fallacy). Consequently, real differences in cognitive performance are attenuated, possibly resulting in incorrect acceptance of the null hypothesis. To assess this possibility in the current research, we included a Spanish-language equivalent of one of the pronunciation tests that has been used to show this phenomenon in psychiatric patients. As single-word pronunciation is closely linked to education in terms of both years of exposure and achievement (Crawford *et al.* 1988, Pluck 2018); it also acts as a proxy measure for quality of formal educational experience.

It is hypothesized that on measures of language skills, adults with histories of homelessness will score below the level of a control group of adults matched for educational level. This would allow us to disambiguate the existing corpus of literature on language and homelessness, in which it is not clear whether participants experiencing homelessness actually score below the level that would be expected based on their socio-economic backgrounds. The results will have implications for how speech and language therapists interpret ostensibly impaired language ability in clients who are homeless.

## Method

### *Participants*

A total of 17 participants with histories of homelessness were recruited to the current research. The definition of homelessness used for recruitment was a standard one used in research, that is, lacking a secure tenancy, accessing homeless services and self-describing as homeless (Pluck *et al.* 2012, 2015). The majority of those who participated (16/17) fulfilled that definition at the point of recruitment, which was at a religion-based charitable service providing emergency accommodation, meals and outreach for poor people in Quito, Ecuador. However, one participant was initially recruited as a control but reallocated to the homeless group based on his description of a past history of homelessness revealed during the interview. Six of the participants in the homeless group reported sleeping in a shelter during the previous evening, one stayed at a friend's home, one (initially recruited as a control) in their own home, and the remainder reported rough sleeping (i.e., sleeping overnight in public places). One participant was homeless with their family, but the remainder would be considered 'single homeless'. As a group, the mean time spent homeless (i.e., rough sleeping or in insecure accommodation) was 14.04 years (SD = 13.33 years), most of this time was spent rough sleeping (mean = 13.00 years, SD = 12.94 years). Therefore, the homeless sample is comprised of adults with histories of homelessness, and in fact the majority, 16/17, were currently homeless.

**Table 1. Demographic and poverty-related details of the homeless and control groups**

Factor	Homeless	Control	Significance
Participants	17	16	n.a.
Age (years) <sup>a</sup>	46.06 (12.47)	41.56 (16.00)	$t(31) = 0.904, p = 0.373$
Education (years) <sup>a</sup>	5.82 (4.72)	6.75 (3.70)	Mann–Witney $U$ -test, $p = 0.363$
Male <sup>b</sup>	16 (94.12%)	14 (87.50%)	Fisher's exact test, $p = 0.601$
White/ <i>mestizo</i> <sup>b</sup>	13 (76.47%)	14 (87.50%)	$\chi^2(1) = 0.170, p = 0.680$
Paid employment <sup>b</sup>	7 (41.18%)	12 (75.00%)*	$\chi^2(1) = 3.860, p = 0.049$
Meals/day <sup>a</sup>	2.25 (1.29)	2.94 (0.57)**	Mann–Witney $U$ -test = 60.000, $p = 0.010$

Notes: <sup>a</sup>Mean (SD).<sup>b</sup>Count (%).\* $p < 0.05$ , \*\* $p < 0.01$ .

As a comparison group, 16 controls were recruited who did not have histories of homelessness. As in the homeless group, all were Spanish speakers. We deliberately sought participants with relatively low education levels to match those of the homeless sample. This was achieved through recruiting friends of the authors who matched the profile, and then asking them to recommend their family members or friends. This snowball-sampling approach was generally successful in matching the homeless and control groups. Demographic and poverty related variables are summarized in table 1. In terms of self-identified ethnicity, the homeless sample comprised 13 people from the Ecuadorian majority population, that is, white or *mestizo* (combined European and indigenous American ancestry), two black and two indigenous Americans. In the control sample, 14 identified as white or *mestizo* and two as indigenous American. There were no significant between-group differences for any demographic variables (age, education, sex, ethnicity). However, the homeless-group participants scored significantly below the control-group participants on the poverty related measures (past month paid employment and number of meals eaten per day).

### Assessment

To describe the background of the homeless-group participants, in comparison with the control-group participants, several assessments of health factors associated with homelessness were included. History of traumatic brain injury is common among adults with histories of homelessness (McMillan *et al.* 2015), as is substance abuse (Pluck *et al.* 2007) and affective disorder (Fazel *et al.* 2008). Here we used a clinical screen for identifying probable past traumatic brain injury that was validated on a homeless sample, the HELPS (Hux *et al.* 2009). To measure substance abuse we used the Leeds Dependence Questionnaire which gives a continuous scale of dependence on either alcohol or illicit drug use (Raistrick *et al.* 1994), with a cut score of 10 points usually taken to indicate substance dependence. We used a validated Spanish-language version (González-Sáiz and

Salvador-Carulla 1999). To measure affective disorder we used the Hospital Anxiety and Dependence Scale, a validated self-report measure that gives scores for both depression and anxiety (Zigmond and Snaith 1983). We used a validated Spanish-language version (Herrero *et al.* 2003).

To estimate expected or premorbid cognitive ability we used the Word Accentuation Test (Del Ser *et al.* 1997). This is a Spanish-language equivalent of English-language tests such as the National Adult Reading Test (O'Carroll *et al.* 1987), which are designed to estimate expected or premorbid ability. Multiple studies have shown that such tests are resistant to psychiatric and neurological illness (Crawford *et al.* 1987, Del Ser *et al.* 1997, Pluck *et al.* 2017) and they provide an estimate of what the participants' cognitive level would be if they were neurologically healthy. The Word Accentuation Test used here has acceptable reliability and validity for use in Ecuador (Pluck 2018, Pluck *et al.* 2017).

However, the primary aim was to assess for language impairments. To this end we used the abbreviated form of the Boston Diagnostic Aphasia Examination (BDAE)—Spanish version (Goodglass *et al.* 2001). The BDAE is one of the most widely used assessments of acquired language impairment, including in the Andean region (Rosselli *et al.* 1990). It contains multiple items testing receptive and expressive language ability. Language skill is measured on five basic domains: conversational and expository speech, auditory comprehension, oral expression, reading and writing.

### Procedure

All participants provided written informed consent in accordance with the research ethics committee approved protocol. All but one of the homeless-group participants were recruited at a charitable service for the poor in central Quito. Workers at the service approached participants who they knew to be experiencing homelessness and suggested participation in the research. We had hoped to recruit a convenience sample not selected for any special language factor. However, on one day

of data collection, one worker commented that he had recommended homeless participants who he considered to have poor language skills; this potentially affected the recruitment of four participants. These four were maintained in the analyses because either including or excluding them at this stage introduces a potential bias in the sample. However, we have presented both analyses, including those four, as well as when they are excluded from the sample.

The interviews of most of the homeless-group participants were made in a private, quiet room at the charitable service. They were conducted by a psychologist under the supervision of a doctoral-level neuropsychologist. All sessions with homeless-group participants were conducted in the mornings, when the individuals were less likely to be intoxicated. An exclusion criterion was intoxication; however, this was never an issue. For all the control participants and one of the homeless-group participants, the interviews were conducted by the same psychologists in an interview room at a university. The procedure for all participants, homeless or control, was the same. Basic demographic information was collected on each participant, including items related to poverty and homelessness. For the formal assessment, all participants were assessed with the Mini-Mental State Examination (MMSE), the Word Accentuation Test, the HELPS screening tool, the Hospital Anxiety and Depression Scale, and the Leeds Dependence Scale in that order. Then the final assessment was the BDAE. The entire session took between 45 min and 2 h for each participant. Following data collection, all participants were debriefed: the research was explained to them and they were able to ask questions. Finally, each participant was compensated for their time. For the participants recruited as controls this was a US\$20 gift card for a local supermarket. For those recruited to the homeless group, they were given food, a non-alcoholic drink and clothes that had a total retail value of US\$20.

### Statistical analysis

All assessments were scored in the standard format. Data analysis was conducted with SPSS version 23. Nominal data analyses were with  $\chi^2$  or Fisher's Exact test when expected cell counts were low. For continuous data, normality of distributions were first assessed with Shapiro–Wilk tests. For normally distributed data parametric tests were employed (e.g., *t*-tests). When data distributions in either group differed significantly from normal, non-parametric tests were used (e.g., Wilcoxon-Signed Rank tests). For all tests, the significance threshold was 0.05. For between-group comparisons on the demographic and clinical measures (e.g., age, depression scores), independent-groups tests were employed (two tailed). However, to maximize statistical power in

this small-sample research, for the main hypotheses regarding language ability two special methods were employed. First, between-group analyses were performed one tailed. This is because our hypotheses are clearly directional, and, therefore, to truly use the 0.05 threshold, analyses should be one tailed. The other step taken was to use paired-sample analyses, as opposed to the more commonly used independent-groups analysis. A paired-sample analysis is more sensitive to hypothesized differences if the participants are paired on a variable that correlates with the dependent variable (i.e., language ability). In this case, scores on the BDAE are well known to be associated with educational experience (Rosselli *et al.* 1990). Therefore, we used education as a pairing criterion to allow us to use a paired-sample analysis. Effect sizes are given as Cohen's *d* (Cohen 1992).

### Results

In the first stage of analysis we compared the 17 homeless-group participants with the 16 control-group participants on the clinical measures. On the measure of probable past traumatic brain injury (the HELPS screen), seven of the 17 homeless-group participants scored positive (41.2%). However, the control-group participants scored even higher with 11 out of 16 (68.8%) meeting criteria. Nevertheless, this difference was not significant,  $\chi^2$ (d.f. = 1) = 2.528,  $p = 0.112$ . Next, we examined substance dependence, as measured with the Leeds scale. One of the 16 controls (6.3%) and five of the 17 homeless-group participants (29.4%) scored positive for at least moderate dependence (scores > 10), although this difference was not significant, Fischer's Exact test,  $p = 0.175$ .

The next analyses examined affective disorder as measured by the Hospital Anxiety and Depression Scale. For depression scores, the homeless group scored 7.47 (SD = 3.79), which is somewhat higher than the control group mean score of 5.38 (SD = 2.87); however, the difference was not significant,  $t(31) = 1.780$ ,  $p = 0.085$ ,  $d = 0.599$ . Similarly, the homeless group scored slightly higher on anxiety (mean = 7.12, SD = 3.59) than the control group (mean = 6.44, SD = 3.39), but the difference was again not significant,  $t(31) = -0.559$ ,  $p = 0.580$ ,  $d = 0.199$ . Finally, we examined general cognitive performance with the MMSE, an assessment frequently used to identify cognitive impairments. The homeless group scored a mean of 21.47 (SD = 6.59), which was lower than the control mean of 24.19 (SD = 3.25), although the difference was not significant,  $t(23.659) = 1.516$ ,  $p = 0.143$ ,  $d = 0.509$ . In summary, although the samples are small and only relatively large differences could be detected, there were no significant health differences between the two sample with regard to

traumatic brain injury, substance dependence, affective disorder and general cognitive impairment.

In the second stage of analysis, focused on language skills, we used a paired-sample analysis (one tailed). Of the 17 participants in the homeless group, the BDAE was not administered to one due to an error. It was administered to all the 16 control participants. To ensure similar backgrounds and maximize statistical power, we matched pairs of homeless and control participants based on their reported years of formal education. The criterion was to match a homeless-group participant to a control-group participant who had the same years of education ( $\pm 2$  years). We were able to produce successfully 14 pairs in this way. The mean educational years of the homeless group was 6.71 (SD = 4.62) and of the control group it was 6.79 (SD = 3.97), and the success of the matching process confirmed by the lack of significant difference and tiny effect size of the differences, Wilcoxon Signed Rank test:  $Z = 12.00$ ,  $p = 0.748$ ,  $d = 0.066$ .

As a check of the 'matching fallacy' that sometimes produces differences in cognitive ability between education-matched groups, particularly if one group is composed of people with histories of psychiatric illnesses, we examined the scores on the Word Accentuation Test. The homeless group scored a mean of 12.21 (SD = 7.30), which is slightly lower than the control group score of 14.00 (SD = 5.20), but this difference was not significant (two-tailed analysis) and the effect size was small to negligible,  $t(13) = -0.765$ ,  $p = 0.458$ ,  $d = 0.204$ . This suggests that the groups are matched not only for years of education but also expected cognitive function.

Before examining any differences between homeless and control participants on the BDAE, we examined the psychometric properties of the various items and scales that comprise the BDAE. This was done for two main reasons. First, it is considered good psychometric practice not to rely on previously published reliability estimates, but to calculate them for each study (Tavakol and Dennick 2011). Second, this is particularly important in the current study, because although the BDAE contains items testing a range of linguistic skills, its primary use is differential diagnosis of aphasia types. In the current research we wished to produce continuous scales from the items in the five different sections: conversational and expository speech, auditory comprehension, oral expression, reading, and writing. To do this we examined the internal consistency, as measured by Cronbach's alpha based on standardized items for all items within a section. We also examined the mean inter-item correlations as this additionally informs on unidimensionality of scales, a psychometric feature that cannot be inferred from Cronbach's alpha (Clark and Watson 1995).

For the section on conversational and expository speech, there are five items (overall severity, phrase length, melodic line, grammatical form and simple social responses). The Cronbach's alpha for these items was  $\alpha = 0.826$ , and the mean inter-item correlation was mean  $r = 0.487$  (range of  $r$ -values =  $-0.041$  to  $0.917$ ). Generally, the target range of correlations for a psychometrically sound test is  $r$ -values between 0.15 and 0.50 (Clark and Watson 1995). Examination of the inter-item correlations revealed that the measure of simple social responses had negative correlations with two of the other items, suggesting it should not be included in the scale. When it is removed, the  $\alpha$  or the remaining four items = 0.927, with a mean inter-item correlation of  $r = 0.761$  (range of  $r$ -values =  $0.684$ – $0.917$ ). Although the observed range here implies very high internal consistency and unidimensionality, it also suggests that the items are all measuring more or less the same thing. In psychometrics this is called the 'attenuation paradox' and implies that although reliability is very high, the validity of the measurement is doubtful (Boyle 1991, Briggs and Cheek 1986, Clark and Watson 1995). The doubt about the validity is because the concept of 'conversational and expository speech' would be considered a rather broad concept, and given the excessively high inter-item correlations, the individual items are unlikely to be capturing the breadth of the concept. Therefore, the data from conversational and expository speech group of items are not included in the later paired-sample analyses.

There are three scales within the group measuring auditory comprehension (table 2). The Cronbach's alpha of these three items is  $\alpha = 0.550$ , which is rather low but likely a consequence of the small number of items. Indeed, the mean inter-item correlation was  $r = 0.290$  (range of  $r$ -values =  $0.212$ – $0.424$ ), which is within the acceptable range for unidimensionality and homogeneity (Clark and Watson 1995). The Oral expression group of items includes 12 separate items; however, we had incomplete data on four of these (phonemic, verbal, neologistic and multi-word paraphasias) and so they were not analysed. The Cronbach's alpha of the remaining eight items (table 2) was  $\alpha = 0.892$  and the mean inter-item correlation was  $r = 0.508$  (range of  $r$ -values =  $0.117$ – $0.905$ ). That mean score is close to the recommended range. The Reading group contains seven items. The Cronbach's alpha for these was acceptable,  $\alpha = 0.756$ , as was the mean inter-item correlation,  $r = 0.317$ . However, the range of  $r$ -values ( $-0.148$  to  $0.790$ ) suggests some extreme correlations, which were associated with the second and seventh items (number matching and sentence and paragraph comprehension, respectively). With these two items removed the  $\alpha = 0.778$  and the mean inter-item correlation is  $r = 0.411$  (range of  $r$ -values =  $0.240$ – $0.743$ ), which is an acceptable mean

Table 2. Group means (SD) and raw scores of individuals for the Mini-Mental State Examination (MMSE) and composite z-scores for the Boston Diagnostic Aphasia Examination (BDAE) in the 11 pairs matched for educational level

	Mean (SD)	Pair 1		Pair 2		Pair 3		Pair 4		Pair 5		Pair 6		Pair 7		Pair 8		Pair 9		Pair 10		Pair 11				
		H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C			
Education		7.1 (4.7)	7.2 (4.2)	6	6	2	3	4	4	6	6	3	3	12	12	6	6	4	6	18	17	11	10	6	6	
MMSE		23.8 (4.5)	24.9 (3.2)	23	24	19	27	23	22	29	24	16	19	25	30	21	23	26	29	26	29	30	27	21	23	
Language-items only		7.1 (1.3)	8.0 (0.0)	7	8	6	8	8	8	8	8	4	8	8	8	6	8	7	8	8	8	8	8	8	8	
				repetition, multi-step spoken command, single-step written command, writing a sentence																						
Non-language items only		16.7 (3.6)	16.9 (3.2)	16	16	13	19	15	14	21	16	12	11	17	22	15	15	19	21	21	18	22	19	13	15	
				Orientation, calculation, memory, copying																						
BDAE		-0.06 (0.66)	0.38 (0.40)	-0.4	-0.2	0.3	0.8	-0.4	0.7	0.4	-0.3	-0.3	0.6	0.3	0.7	-10.5	-0.1	0.2	0.6	10.2	0.2	-0.4	0.6	-0.2	0.7	
				Basic word discrimination, commands, complex ideational material																						
Auditory comprehension		-0.09 (0.72)	0.34 (0.17)	-0.4	0.4	0.1	0.5	0.4	0.3	-0.3	0.6	-2	0.1	0.4	0.3	0	0	0	0.4	0.7	0.3	0.5	-0.4	0.5	0.5	
				Articulatory agility, automatized sequences, word repetition, sentence repetition, responsive naming, Boston naming test, naming special categories, paraphasia rating from speech profile																						

Continued



inter-item correlation for an internally consistent and unidimensional scale. Therefore, this reduced set five-item version of the reading assessment was used for later analysis. Finally, the Writing group contains eight items. The Cronbach's alpha for these was  $\alpha = 0.921$ , with a mean inter-item correlation of  $r = 0.593$  (range of  $r$ -values = 0.286–0.886). This is rather high and suggests there is limited variation in what the different items measure; however, as writing would be considered a fairly narrow ability, we took this to be acceptable. The items used from the reading and writing scales are also shown in table 2.

We next examined performance of the two groups on the four sections of the BDAE that had acceptable psychometric properties (auditory comprehension, oral expression, reading and writing). We calculated  $z$ -scores (i.e., standard scores) for all 28 participants (14 pairs) for all items (i.e., converted score distributions had means of 0 and SDs of 1). This ensures that when items are summed to produce total scores, all contributing items have equal weights despite being scored on varying scale lengths. We then calculated the mean  $z$ -score for each participant for each of the four BDAE sections studied. A simple way to understand this is that if participants in the homeless and control groups had equivalent linguistic abilities, their group scores in each section of the BDAE would be around 0. However, if the homeless group tended to have linguistic difficulties compared with their controls, as we have hypothesized, then their mean  $z$ -scores would be  $< 0$ , and the control scores would be correspondingly  $> 0$ . Indeed, for all measures of language ability the homeless-group participants scored below the level of their education-matched controls. For auditory comprehension, the mean  $z$ -score of the homeless-group participants was  $-1.90$  ( $SD = 0.790$ ) compared with  $1.90$  ( $SD = 0.626$ ) for the controls. This difference was significant, Wilcoxon-Signed Rank test:  $Z = 82.00$ ,  $p = 0.032$ ,  $d = 0.559$  (note the upper-case  $Z$  here denotes the test statistic of the Wilcoxon-Signed Rank test, and is different to the lower-case  $z$  used to denote standard scores). Similarly, the homeless-group mean  $z$ -score for the section on oral expression was  $-2.56$  ( $SD = 0.989$ ) and the control sample  $z$ -score for that section was  $2.56$  ( $SD = 0.250$ ), also a significant difference, Wilcoxon-Signed Rank test:  $Z = 72.00$ ,  $p = 0.038$ ,  $d = 0.552$ . In contrast, for reading ability, although the homeless participants scored a mean  $z$ -score of  $-1.04$  ( $SD = 0.888$ ), which was lower than their matched controls with a mean  $z$ -score of  $1.04$  ( $SD = 0.536$ ), the difference was not significant, Wilcoxon-Signed Rank test:  $Z = 39.00$ ,  $p = 0.199$ ,  $d = 0.303$ . Finally, the homeless-group participants scored a mean  $z$ -score of  $-2.50$  ( $SD = 1.01$ ) for the writing section, compared with a mean  $z$ -score of  $2.50$  ( $SD = 0.428$ ) for the controls on that section, a

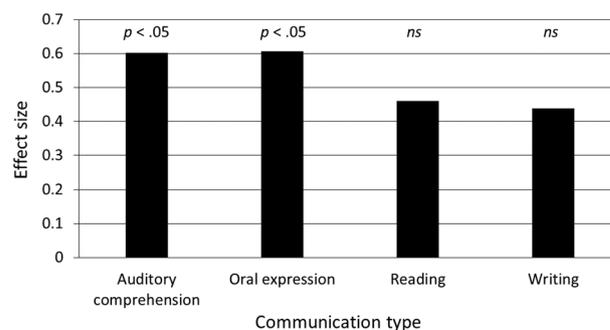


Figure 1. Effect sizes (Cohen's  $d$ ) for the lower performance by the 11 homeless-group participants compared with their 11 education-matched controls.

significant difference,  $t(13) = -1.968$ ,  $p = 0.036$ ,  $d = 0.529$ . Overall, these analyses suggest that the homeless-group participants scored significantly below the level of controls for three of the four different BDAE measures: auditory comprehension, oral expression and writing.

As mentioned above, four participants in the homeless group may have been inadvertently selected for participation based on language difficulties. Of those four, three were included in the matched-pairs design examining BDAE scores described above (one was not included because they could not be education matched to an equivalent control participant). When we excluded those three cases and repeated the analyses on the remaining 11 pairs, similar results were found. The mean scores for the homeless and control groups are shown in table 2; also included are the individual scores for each participant within the 11 homeless–control pairs. The homeless-group participants scored significantly below the levels of their matched controls for auditory comprehension, Wilcoxon-Signed Rank test:  $Z = 52.00$ ,  $p = 0.045$ , and also for oral expression, Wilcoxon-Signed Rank test:  $Z = 44.00$ ,  $p = 0.047$ . And as previously with 14 pairs, when limited to the 11 pairs, reading scores were higher in the control participants, but not significantly so,  $t(10) = -1.526$ ,  $p = 0.079$ . When we examine the writing scale scores, the significantly better performance by control participants, when analysed with all 14 pairs, is no longer significant when limited to the 11 pairs,  $t(10) = -1.453$ ,  $p = 0.089$ .

Thus, in this more stringent analysis, the homeless-group participants scored below the levels of their education-matched control participants on the two linguistic measures from the BDAE: auditory comprehension and oral expression, but not on the two literacy measures: reading and writing. To represent these between-group differences, we calculated standardized effect sizes with Cohen's  $d$ . A summary of these effect sizes is shown in figure 1. Higher  $d$ -values indicate greater impairment by the homeless sample compared with the matched controls. From figure 1, it can be

seen that the two significant differences between the homeless and control groups, auditory comprehension and oral expression, both had qualitatively 'medium' effect sizes, that is,  $d > 0.5$  (Cohen 1992).

Finally, we used the same paired analysis to examine scores on the MMSE, which is considered to be a good measure of general cognitive impairment. For this analysis we continued to use the more stringent analysis in which only 11 pairs were included. The mean scores for the groups as well as the individual scores for the 11 pairs are also shown in table 2. In this paired analysis with participants matched for education, the homeless group on average scored one point below the control group for total MMSE scores. That difference was not significant,  $t(10) = -0.944$ ,  $p = 0.367$ ,  $d = 0.285$ . However, the MMSE contains 11 items, totalling 30 points. Five of those items are language based, and together total to 8 points (table 2). We calculated a total language score for each participant on those items. The paired-sample analysis revealed that the homeless-group participants performed particularly poorly on that total language score from the MMSE, again scoring on average about 1 point below the control-group participants. That difference was significant and had a qualitatively 'medium' effect size, Wilcoxon-Signed Rank test:  $Z = 15.00$ ,  $p = 0.041$ ,  $d = 0.699$ . This suggests that any cognitive impairment in the homeless sample mainly involves language skills. Indeed, when we calculated the MMSE total excluding the language items, the homeless and control participants had near identical scores, differing by only 0.2 points, a small difference which was not significant  $t(10) = -0.179$ ,  $p = 0.862$ ,  $d = 0.054$ . The same pattern of results with the MMSE was found when we repeated the paired-sample analyses using all 14 pairs.

## Discussion

We found that a sample of adults with experiences of homelessness performed below a control sample of participants on two measures of language ability: auditory comprehension and oral expression, and perhaps on one literacy measure, that is, writing ability. Furthermore, the differences found cannot be explained by lower education levels of the homeless-group participants compared with the control group, nor to lower expected cognitive ability, as measured by a word pronunciation task. This suggests that the homeless- and control-group participants were well matched for socio-economic background and educational exposure. Although previous studies have also reported language-related difficulties in adults or adolescents with histories of homelessness (Barwick and Siegel 1996, Davidson *et al.* 2014, O'Neil-Pirozzi 2003, Solliday-McRoy *et al.* 2004), those studies only showed that performance was below 'normal'

for people from the country where the homeless samples were recruited. In the current research we show that performance of a homeless adult sample falls below what would be expected based on the participants' socio-economic and educational background.

A major issue when considering cognitive and language ability in homeless adults is that most of the research, including this study, is cross-sectional. This is because longitudinal studies of homelessness, particularly transition to homelessness, are largely impractical. The cross-sectional nature of the evidence base, therefore, makes it difficult to distinguish whether the language issues identified represent naturally lower performance, or perhaps delayed development, as opposed to acquired language problems.

On the first possible explanation, naturally lower performance, it seems likely that this is an issue. Language ability, like other cognitive abilities, varies widely within the normal population, it is hence 'normal' for some people to perform considerably lower than the average for the overall population. In addition, this variation covaries to a large extent with SES (Turrell *et al.* 2002). In support of this interpretation, childhood poverty is a risk for adult homelessness (Koegel *et al.* 1995). And the largest impact of childhood poverty on cognitive development is on language development (Noble *et al.* 2007).

Furthermore, this natural variation interpretation is consistent with what is known as the 'p > v sign' in neuropsychology. This is the observation that in many socially excluded groups, particularly those with antisocial behaviour, intelligence tests tend to reveal scores on 'Performance' tests (i.e., non-verbal) that are greater than on 'Verbal' tests (hence p > v). This is a robust phenomenon and is thought to be caused by lower absolute verbal ability rather than by enhanced (non-verbal) performance ability (Isen 2010). Homeless adults, as members of a low-SES and socially excluded group, often from poor backgrounds, are likely, therefore, to achieve at the lower end of the normal variation in language ability. It is notable that our sample of homeless adults scored significantly below the level of controls on the language-based items of the MMSE. In contrast, the homeless participants scored at equivalent levels on the non-verbal items in the same test. This suggests that the homeless participants had a fairly selective problem with language, a form of the p > v sign. It is also remarkable that the equivalent performance of the homeless and control participants on the non-verbal items supports our matching procedure. The homeless-group participants appear to have equivalent non-verbal cognitive abilities, compared with the control-group participants, but suppressed verbal ability.

However, such a pattern of performance, that is, impaired language use in the context of relatively preserved

non-linguistic skills, is also consistent with pathological language development such as DLD (Conti-Ramsden and Durkin 2017). As each trajectory to homelessness is different, it seems likely that DLD would be an important factor for increasing risk for adult homelessness in some cases. Indeed, evidence suggests that DLD in young adults, when compared with typically developing peers, is associated with worse educational outcomes, lower income and increased unemployment (Conti-Ramsden *et al.* 2018). These are all factors that increase risk of becoming homeless (Bramley and Fitzpatrick 2018).

Nevertheless, the current findings also suggest that acquired impairment may be relevant. On two measures on language ability our homeless group scored below the levels that would be expected, considering the socio-economic and educational background of the participants. Furthermore, they scored at equivalent levels on the test that is used to predict expected or premorbid ability, due to its resilience to neurological and psychiatric illness, the Word Accentuation Test. When expected or premorbid ability is equivalent to a comparison sample, but current ability (here measured with the BDAE) is reduced, this is often taken to suggest acquired cognitive impairment (O'Carroll *et al.* 1987). However, such a dissociation could also result from pathological language development such as DLD. The test that we used to estimate premorbid or expected ability relies on orthographic reading, as lexical entries need to be accessed for accurate word pronunciation (Pluck 2018). Evidence suggests that many children with DLD do not show reading impairments, at least in terms of being dyslexic (Snowling *et al.* 2019). Furthermore, children with DLD tend to favour orthographic over more impaired phonological reading, and in fact have better performance on orthographic reading compared with children without DLD matched for overall reading level (Macchi *et al.* 2019). Therefore, our orthographic reading test, used as the estimated or premorbid function measure, may be insensitive to DLD. For this reason, the current results are consistent with interpretations that suggest either acquired language impairment, or DLD. At the group level, it is likely that both aetiologies are associated with impaired language function of homeless adults.

The cause of DLD is not clear but it is likely multifactorial as there is evidence for both genetic transmission as well social factors, as reflected in the disproportionate number of children with DLD being from low SES backgrounds (Conti-Ramsden and Durkin 2017). The exact mechanism of acquired impairment of language is unknown and is almost certainly also multifactorial. To appreciate this, consider the range of issues that are associated with homelessness that have the potential to impair neurological func-

tioning. These include increased rates of head trauma (McMillan *et al.* 2015), childhood psychological trauma (Pluck *et al.* 2011), mental illness (Fazel *et al.* 2008) and substance abuse (Pluck *et al.* 2007). However, it should be noted that in the current research we observed no significant differences between homeless and control groups for prevalence of head trauma, substance abuse, affective disorder or general cognitive function. Clients with histories of homelessness may nevertheless present with transient or enduring neurological symptoms, including language difficulties. However, these could be amenable to therapy.

As already alluded to, our argument that language ability of some people with histories of homelessness may show pathological etiology, in the form of either acquired language difficulties or DLD, needs to be considered cautiously, considering the cross-sectional nature of the research. However, the acquired deficit interpretation is consistent with earlier neuropsychological studies that have suggested that adult homelessness is associated with acquired impairments in intelligence, and particularly, memory ability (Pluck *et al.* 2012). Furthermore, in our most stringent analyses, limited to 11 homeless-control pairs, the two language skills (auditory comprehension and oral expression) were significantly lower in the homeless compared with the control participants, but the two literacy measures (reading and writing) were not. This is consistent with at least some of the difference in language ability between groups being either acquired, as opposed to normal developmental (e.g., linked to school failure), which would be expected to particularly impair literacy measures, or related to DLD without dyslexia (Snowling *et al.* 2019), which could produce a similar dissociation.

There are some limitations to the current research. The sample size is small. We attempted to counteract this by maximizing statistical power with a matched-pairs design. Nevertheless, the results should be considered cautiously. In particular, we matched control-group participants to homeless-group participants to be within 2 years for level of education. In some of the pairs this could have been an important difference contributing to the language performance observed. Furthermore, the homeless participants were mainly all rough sleeping, which is the most severe form of homelessness, and rather infrequent compared with the more common insecurely housed form of homelessness seen in more developed countries (e.g., shelter living). On the other hand, published studies of rough-sleeping participants are rare, and in this sense, we have been able partly to redress that neglect in the extant literature. A further issue is that the current research was conducted in a South American city, which may limit its generalizability to other countries with different socio-economic contexts. On the other hand, there is a dearth

of cognitive and language-based research on homelessness in low and middle-income countries, with virtually all existing research on homelessness emanating from the United States, Canada, the UK and Australia. There is a need for research such as ours to redress the ongoing imbalance of research that is hugely biased to Western industrialized countries.

### Conclusions

Despite some limitations, our results tentatively suggest that adults with histories of homelessness may present with language levels, particularly auditory comprehension and oral expression, that are lower than might be expected based on their educational background, and even compared with their non-verbal cognitive ability. We tentatively suggest that this lower language ability is pathological, with likely aetiologies being DLD or acquired neurological impairments. If so, clients who are homeless may benefit from speech and language therapy developed for clinical language problems, such as Schuell's stimulation approach (Katz 2001) and picture-naming therapy (Conroy *et al.* 2009). In addition, if there is language pathology associated with homelessness, the involvement of speech therapists in homeless contexts, and across the life span, is warranted. However, larger studies using our methodology of matching for educational background could confirm or refute the pathological impairment hypothesis raised here, as well as the potential of treatment of auditory comprehension and oral expression difficulties in homeless contexts by speech and language therapists.

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### References

- ALDRIDGE, R. W., STORY, A., HWANG, S. W., NORDENTOFT, M., LUCHENSKI, S. A., HARTWELL, G., TWEED, E. J., LEWER, D., VITAL KATIKIREDDI, S. and HAYWARD, A. C., 2018, Morbidity and mortality in homeless individuals, prisoners, sex workers, and individuals with substance use disorders in high-income countries: a systematic review and meta-analysis. *Lancet*, **391**, 241–250.
- BARWICK, M. A. and SIEGEL, L. S., 1996, Learning difficulties in adolescent clients of a shelter for runaway and homeless street youths. *Journal of Research on Adolescence*, **6**, 649–670.
- BOYLE, G. J., 1991, Does item homogeneity indicate internal consistency or item redundancy in psychometric scales? *Personality and Individual Differences*, **12**, 291–294.
- BRAMLEY, G. and FITZPATRICK, S., 2018, Homelessness in the UK: who is most at risk? *Housing Studies*, **33**, 96–116.
- BRIGGS, S. R. and CHEEK, J. M., 1986, The role of factor analysis in the development and evaluation of personality scales. *Journal of Personality*, **54**, 106–148.
- CLARK, L. A. and WATSON, D., 1995, Constructing validity: Basic issues in objective scale development. *Psychological Assessment*, **7**, 309–319.
- CLEGG, J., LAW, J., RUSH, R., PETERS, T. J. and ROULSTONE, S., 2015, The contribution of early language development to children's emotional and behavioural functioning at 6 years: an analysis of data from the Children in Focus sample from the ALSPAC birth cohort. *Journal of Child Psychology and Psychiatry*, **56**, 67–75.
- COHEN, J., 1992, A power primer. *Psychological Bulletin*, **112**, 155–159.
- CONROY, P., SAGE, K. and RALPH, M. L., 2009, Improved vocabulary production after naming therapy in aphasia: can gains in picture naming generalize to connected speech? *International Journal of Language & Communication Disorders*, **44**, 1036–1062.
- CONTI-RAMSDEN, G., DURKIN, K., TOSEEB, U., BOTTING, N. and PICKLES, A., 2018, Education and employment outcomes of young adults with a history of developmental language disorder. *International Journal of Language & Communication Disorders*, **53**, 237–255.
- CONTI-RAMSDEN, G. and DURKIN, K., 2017, Developmental language disorder. In: Skuse, D., Bruce, H. & Dowdney, L. (eds.) *Child Psychology and Psychiatry: Frameworks for Clinical Training and Practice*. 3rd ed. Hoboken, NJ: John Wiley & Sons, Ltd.
- CRAWFORD, J. R., BESSON, J. A., PARKER, D. M., SUTHERLAND, K. M. and KEEN, P. L., 1987, Estimation of premorbid intellectual status in depression. *British Journal of Clinical Psychology*, **26** (Pt 4), 313–314.
- CRAWFORD, J. R., STEWART, L. E., GARTHWAITE, P. H., PARKER, D. M. and BESSON, J. A., 1988, The relationship between demographic variables and NART performance in normal subjects. *British Journal of Clinical Psychology*, **27**, 181–182.
- DAVIDSON, D., CHROSNIAK, L. D., WANSCHURA, P. and FLINN, J. M., 2014, Indications of reduced prefrontal cortical function in chronically homeless adults. *Community Mental Health Journal*, **50**, 548–552.
- DEL SER, T., GONZALEZ-MONTALVO, J. I., MARTINEZ-ESPINOSA, S., DELGADO-VILLALPOS, C. & BERMEJO, F., 1997, Estimation of premorbid intelligence in Spanish people with the Word Accentuation Test and its application to the diagnosis of dementia. *Brain & Cognition*, **33**, 343–356.
- FAZEL, S., KHOSLA, V., DOLL, H. and GEDDES, J., 2008, The prevalence of mental disorders among the homeless in western countries: systematic review and meta-regression analysis. *PLoS Medicine*, **5**, e225.
- GALOBARDES, B., SHAW, M., LAWLOR, D. A., LYNCH, J. W. and DAVEY SMITH, G., 2006, Indicators of socioeconomic position (part 1). *Journal of Epidemiology and Community Health*, **60**, 7–12.
- GLAHN, D. C., BEARDEN, C. E., BOWDEN, C. L. and SOARES, J. C., 2006, Reduced educational attainment in bipolar disorder. *Journal of Affective Disorders*, **92**, 309–312.
- GONZÁLEZ-SÁIZ, F. and SALVADOR-CARULLA, L., 1999, Análisis de la fiabilidad y validez de la versión española de la escala Leeds Dependence Questionnaire (LDQ) en una muestra de pacientes con dependencia de opiáceos. *Revista Española de Drogodependencias*, **24**, 46–60.

- GOODGLASS, H., KAPLAN, E. and BARRESSI, B., 2001, *El test de Boston para el diagnóstico de la afasia, Tercera Edición* Bogota, Colombia: Editorial Medical Panamericana.
- HERRERO, M. J., BLANCH, J., PERI, J. M., DE PABLO, J., PINTOR, L. and BULBENA, A., 2003, A validation study of the hospital anxiety and depression scale (HADS) in a Spanish population. *General Hospital Psychiatry*, **25**, 277–283.
- HUX, K., SCHNEIDER, T. and BENNETT, K., 2009, Screening for traumatic brain injury. *Brain Injury*, **23**, 8–14.
- ISEN, J., 2010, A meta-analytic assessment of Wechsler's P>V sign in antisocial populations. *Clinical Psychology Review*, **30**, 423–435.
- KATZ, R. C., 2001, Computer applications in aphasia treatment. In: CHAPEY, R. (ed.) *Language Intervention Strategies in Aphasia and Related Neurogenic Communication Disorders*. 4th ed. Baltimore: Lippincott Williams and Wilkins.
- KOEGEL, P., MELAMID, E. and BURNAM, M. A., 1995, Childhood risk factors for homelessness among homeless adults. *American Journal of Public Health*, **85**, 1642–1649.
- KREMEN, W. S., SEIDMAN, L. J., FARAONE, S. V., PEPPLE, J. R., LYONS, M. J. and TSUANG, M. T., 1996, The “3 Rs” and neuropsychological function in schizophrenia: An empirical test of the matching fallacy. *Neuropsychology*, **10**, 22–31.
- MACCHI, L., CASALIS, S. and SCHELSTRAETE, M. A., 2019, Phonological and orthographic reading routes in French-speaking children with severe developmental language disorder. *Journal of Communication Disorders*, **81**, 105909.
- MCMILLAN, T. M., LAURIE, M., ODDY, M., MENZIES, M., STEWART, E. and WAINMAN-LEFLEY, J., 2015, Head injury and mortality in the homeless. *Journal of Neurotrauma*, **32**, 116–119.
- NOBLE, K. G., MCCANDLISS, B. D. and FARAH, M. J., 2007, Socioeconomic gradients predict individual differences in neurocognitive abilities. *Developmental Science*, **10**, 464–480.
- O'CARROLL, R. E., BAIKIE, E. M. and WHITTICK, J. E., 1987, Does the National Adult Reading Test hold in dementia? *British Journal of Clinical Psychology*, **26**, 315–316.
- O'NEIL-PIROZZI, T. M., 2003, Language functioning of residents in family homeless shelters. *American Journal of Speech-Language Pathology*, **12**, 229–242.
- PLUCK, G., 2018, Lexical reading ability predicts academic achievement at university level. *Cognition, Brain, Behavior*, **22**, 175–196.
- PLUCK, G., ALMEIDA-MEZA, P., GONZALEZ-LORZA, A., MUÑOZ-YCAZA, R. A. and TRUEBA, A. F., 2017, Estimation of pre-morbid cognitive function with the Word Accentuation Test. *Revista Ecuatoriana de Neurología*, **26**, 226–234.
- PLUCK, G., LEE, K. H., DAVID, R., MACLEOD, D. C., SPENCE, S. A. and PARKS, R. W., 2011, Neurobehavioural and cognitive function is linked to childhood trauma in homeless adults. *British Journal of Clinical Psychology*, **50**, 33–45.
- PLUCK, G., LEE, K. H., DAVID, R., SPENCE, S. A. and PARKS, R. W., 2012, Neuropsychological and cognitive performance of homeless adults. *Canadian Journal of Behavioural Science*, **44**, 9–15.
- PLUCK, G., LEE, K. H. and PARKS, R., 2007, Homeless shelters and substance misuse. *Canadian Medical Association Journal*, **176**, 489.
- PLUCK, G., NAKAKARUMAI, M. and SATO, Y., 2015, *Homelessness and cognitive impairment: an exploratory study in Tokyo* Japan: East Asian Archives of Psychiatry, 25, 122–1227.
- RAISTRICK, D., BRADSHAW, J., TOBER, G., WEINER, J., ALLISON, J. and HEALEY, C., 1994, Development of the Leeds Dependence Questionnaire (LDQ): a questionnaire to measure alcohol and opiate dependence in the context of a treatment evaluation package. *Addiction*, **89**, 563–572.
- ROSSELLI, M., ARDILA, A., FLOREZ, A. and CASTRO, C., 1990, Normative data on the Boston Diagnostic Aphasia Examination in a Spanish-speaking population. *Journal of Clinical and Experimental Neuropsychology*, **12**, 313–322.
- SCHRETLEN, D. J., BUFFINGTON, A. L., MEYER, S. M. and PEARLSON, G. D., 2005, The use of word-reading to estimate “pre-morbid” ability in cognitive domains other than intelligence. *Journal of the International Neuropsychological Society*, **11**, 784–787.
- SNOWLING, M. J., NASH, H. M., GOOCH, D. C., HAYIOU-THOMAS, M. E., HULME, C. and WELLCOME LANGUAGE READING PROJECT TEAM, 2019, Developmental outcomes for children at high risk of dyslexia and children with developmental language disorder. *Child Development*, **90**, e548–e564.
- SOLLIDAY-MCROY, C., CAMPBELL, T. C., MELCHERT, T. P., YOUNG, T. J. and CISLER, R. A., 2004, Neuropsychological functioning of homeless men. *Journal of Nervous and Mental Disease*, **192**, 471–478.
- TAVAKOL, M. and DENNICK, R., 2011, Making sense of Cronbach's alpha. *International Journal of Medical Education*, **2**, 53–55.
- TURRELL, G., LYNCH, J. W., KAPLAN, G. A., EVERSON, S. A., HELKALA, E. L., KAUMANEN, J. and SALONEN, J. T., 2002, Socioeconomic position across the lifecourse and cognitive function in late middle age. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, **57**, S43–S51.
- ZIGMOND, A. S. and SNAITH, R. P., 1983, The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, **67**, 361–370.