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Growing Up in Australia:
The Longitudinal Study of Australian Children (LSAC)

LSAC Technical Paper No. 18

A Longitudinal Measure of Socioeconomic Position in LSAC

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Executive Summary

A Socio-economic position (SEP) variable was created in Wave 1 and was replicated in Waves 2–4.

The SEP is calculated taking into account occupational prestige (Australian Standard Classification of Occupation (ASCO)), income and education.

Wave 1 was of LSAC was conducted in 2004. The Australian, New Zealand Standard Classification of Occupation (ANZSCO) commenced in 2006. Hence, ANZSCO is unavailable for Wave 1.

ANZSCO superseded ANSCO in 2006. The LSAC has ASCO coding from Wave 1 to Wave 4 and ANZSCO coding from Wave 2 and beyond.

ANZSCO and ASCO differ and in this paper we explore how that affects the SEP measure.

Occupational coding is a key component of the SEP and—due to differences between ANZSCO and ASCO—two separate measures were created: SEP1 (ASCO) (Wave 1 to Wave 4) and SEP2 (ANZSCO) (Wave 2 and beyond). Both measures will be available to researchers.

The SEP measures do differ and it is up to the researcher to determine which one they use.

A combination of both could be used, but it is important to read and understand this paper before doing so.

This paper provides a rationale for the developing a new SEP measure (Section 2), comparison between SEP measures (Section 3) and recommendations on why and how a specific SEP measure should be used (Section 4).

1 Introduction

1.1 *Growing Up in Australia*: The Longitudinal Study of Australian Children (LSAC)

Growing Up in Australia, the Longitudinal Study of Australian Children (LSAC) is Australia's first nationally representative longitudinal study of child development. The study provides policymakers and researchers with access to quality data about children's development within the current economic, social and cultural environment. The study commenced in 2004 with two age cohorts—approximately 5,000 children who were 4 to 5 years old and approximately 5,000 children who were 0 to 1 year old. LSAC is a stratified random sample of children from all Australian states and territories, excluding the most remote areas. Children and their families have been visited every two years since 2004, and data is collected by face-to-face interview, paper questionnaire, computer-assisted self-interview and direct assessments of the children. For more information about the study, see Edwards (2014). The study is conducted in partnership between the Department of Social Services (DSS), the Australian Institute of Family Studies (AIFS) and the Australian Bureau of Statistics (ABS).

1.2 Socioeconomic position

A robust longitudinal measure of socioeconomic status is vital in order to be able to track developmental outcomes of LSAC children. One of LSAC's key research questions is 'What is the influence of parents' labour force participation, education and economic status on individual outcomes and how does this change over time?' (FaHCSIA, 2013, p2) and a measure of socioeconomic status can be important to identify where intervention and prevention may be necessary and to inform policy to support families in disadvantaged circumstances.

For example, the current LSAC socioeconomic position (SEP) variable has been used to investigate whether socioeconomic status is associated with children's opportunities and outcomes (AIFS, 2012). In particular, children classified as being in the 25 per cent most disadvantaged families according to their socioeconomic position were found to be less likely to attend preschool (Maguire & Hayes, 2012). Further, children classified in this most disadvantaged group were also more likely to be overweight or obese and to continue to be overweight or obese over time (Wake & Maguire, 2012). These findings are consistent with other analyses of LSAC data that found socioeconomic disadvantage was associated with poorer outcomes for several physical and developmental health outcomes across the birth to 7-year-old cohorts (Nicholson, Lucas, Berthelsen & Wake, 2012).

1.3 Why is a new measure of SEP needed for LSAC?

In LSAC, the original SEP variable (SEP1) was developed as an indicator of socioeconomic status. SEP was derived by combining variables that measured the education level, income and occupational status of the parents in each family (Parent 1 and, where appropriate, Parent 2). This resulted in a score that ranked each family in terms of their socioeconomic position relative to all other families in the sample.

Figure 1 is a path diagram of the original SEP coding process, showing how the component LSAC variables were used to derive the SEP variable.

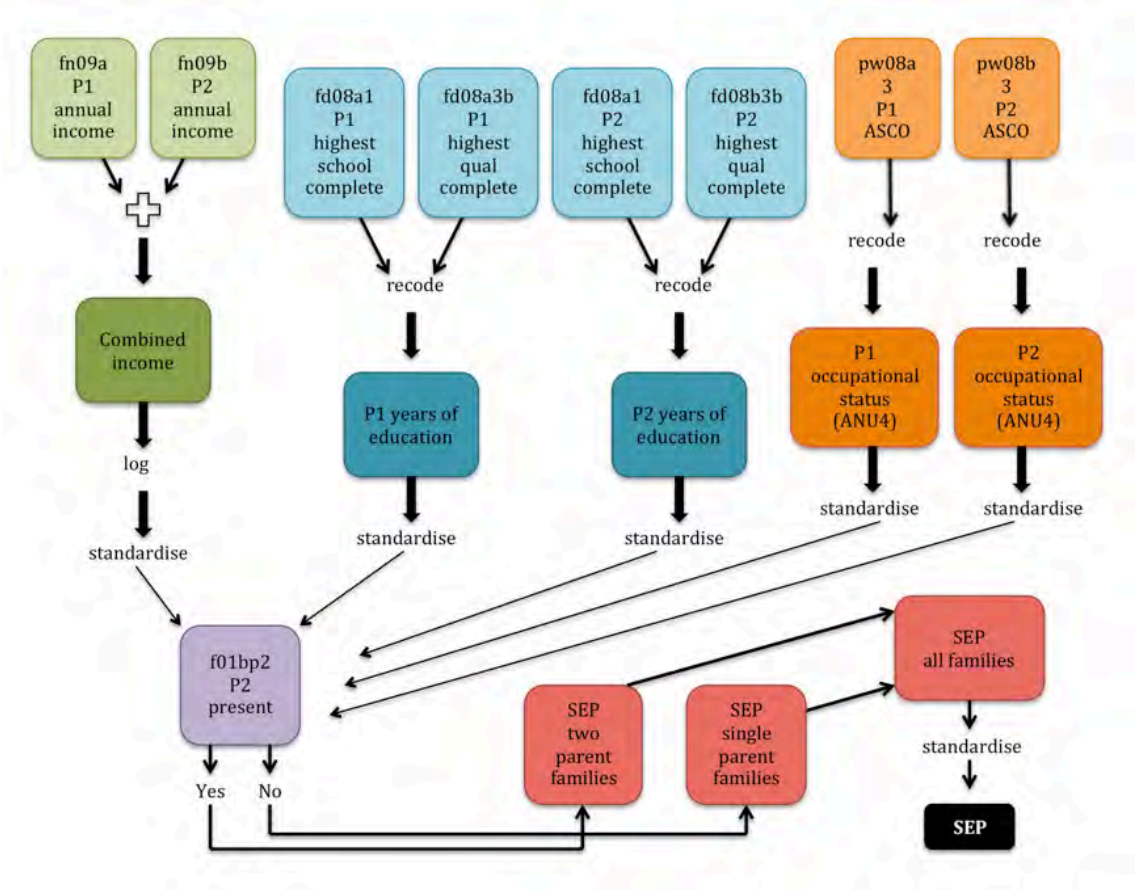

Figure 1: SEP1 coding process

From Waves 1 to 4 the indicator of occupational status was a measure created by the Australian Bureau of Statistics (ABS) and the Department of Employment, Education, Training and Youth Affairs (DEETYA), called the Australian Standard Classification of Occupations (ASCO) code. During the progression of the LSAC project, the ASCO was replaced with the Australian and New Zealand Standard Classification of Occupations (ANZSCO) code. There are some differences between the measures (see http://www.immi.gov.au/employers/_pdf/ansco-anzsco-differences.pdf and see section 2.3 of this paper for more information).

As the ASCO code has been superseded, it is not available for Wave 5 data. Therefore the SEP1 was not created for Wave 5. The result of the changes in coding of occupations during LSAC means that there is currently no suitable variable to measure socioeconomic position longitudinally. In order to have a longitudinally consistent measure we need to first establish whether creating SEP using ANZSCO is equivalent to creating SEP using ASCO.

As ANZSCO was not developed until 2006, it was unavailable for Wave 1 (2004). We do however have both ASCO and ANZSCO for Waves 2 to 4. This allows us to derive alternative versions of SEP for these waves and compare their properties. The purpose of this paper is to investigate the potential impact of using ANZSCO instead of ASCO to compute SEP.

In order to test this we will carry out and document the following steps:

1. Derive a new version of the SEP variable (SEP2), using ANZSCO rather than ASCO to derive SEP values.
2. Analyse the differences between the SEP1 and SEP2 variables to ascertain whether the two derived measures are comparable (for Waves 2, 3 and 4 only).

On the basis of these findings we will detail which of the following is our recommended approach to longitudinal SEP. There are two options:

1. If the difference between SEP1 and SEP2 for Waves 2 to 4 is found to be not statistically significant, the SEP2 measure will be treated the same as SEP1 and the variable name structure will remain the same (e.g., esep for B cohort & gsep for K cohort). As a result, the SEP measure for Waves 1 to 4 will be calculated using ASCO code and from Wave 5 onwards using ANZSCO code. This SEP measure then can be used longitudinally across all waves. (Note that no changes will be made to SEP measure derived in waves 1 to 4 in previous data releases.)
2. Alternatively, if SEP1 and SEP2 are found to be different measures, we will derive SEP2 for Waves 2 onwards. In this case, a different variable name will be used. Researchers then will have an option to choose which version to use for Waves 2 to 4. For Wave 1, we would recommend that SEP1 not be compared longitudinally with SEP2 from other waves, due to the considerable differences.

1.4 Structure of this report

Section 2 provides a brief explanation of the rationale for the original LSAC SEP variable and describes the indicator variables and method of composition of both versions of SEP, highlighting the differences in how they derived. Section 3 provides statistical descriptions and analysis comparing the SEP measures. Section 4 provides a summary of the findings, a recommendation of how SEP should be coded longitudinally and information on how the variables will be provided to data users.

2 Descriptions and coding of the SEP variables

Section 2 will provide a brief explanation of the establishment of the original LSAC SEP variable and will describe the indicator variables and method of composition of both versions of SEP, highlighting the differences.

2.1 Socioeconomic measures

There are several benefits of having a single socioeconomic measure that encompasses several social and economic variables over analysing the component variables separately (Willms & Shields, 1996; Blakemore, Gibbings & Strazdins, 2006 & 2009). Socioeconomic status has been measured since the 19th century and has been calculated in many different ways (for a historical overview see Jones & McMillain, 2001). However a common method is to combine income, occupational status and education in some manner. In the context of children's socioeconomic position, this information pertains to the child's parent/s.

Blakemore et al. (2009) reviewed several international methods of creating indicators of socioeconomic position when developing an appropriate measure for the LSAC study. One such international measure, the socioeconomic status (SES) measure developed for National Longitudinal Study of Children, Canada (Willms & Shields, 1996), was particularly relevant in the context of LSAC. This measure ranks each family's status in comparison to the other families in the study based on the education, income and occupational status of the primary caregiver (the person most knowledgeable about the children in the family) and the partner (where applicable).

In the Willms and Shields (1996) method, years of education was derived from the highest level of schooling attained in primary, secondary and post-secondary qualifications, ranging from 0 (= no schooling) to 20 (= postgraduate). Annual income of parents (combined) was obtained as a value where possible, or taken as the midpoint of a range. Some values were top coded and a logarithmic transformation was applied. Occupation was scored according to the 1980 Standard Occupational Classification into 16 ranked categories, based on a detailed description of the job. The scale was reversed and a 17th category ('unemployed') was included for those not in the labour force. The average of the sum of the standardised component variables was taken (and then re-standardised) and added together for a SES score. Single-parent families received a score if they had data available for two out of the three components, whereas two-parent families received a score if they had data for three out of the five components. The final scale was also standardised. The method chosen by Blakemore et al. (2009) for LSAC was modelled on the Willms and Shields (1996) method and is described below.

2.2 The original LSAC SEP variable

Measuring the socioeconomic position of families in HILDA & LSAC

The original SEP scale was created and tested with data from both the LSAC and the Household Income and Labour Dynamics in Australia Survey (HILDA). As part of the analysis SEP was separated into low, medium and high groups and the socioeconomic characteristics of the different groups were described for single and two-parent families. For example, a typical parent of a low SEP B cohort single-parent family might have Year 12 education, be in the Elementary Clerical, Sales and Service Workers industry and have an annual income of $20,400. Using the continuous version of the scale, correlational analysis demonstrated how each of the individual components of the measure (education, income, occupational status) contributed to the total score. All variables were highly correlated with the total score as expected, and the components had correlations of relatively equal strength for both LSAC cohorts (between 0.7 to 0.8). Also as expected, correlations between SEP and known indicators of socioeconomic disadvantage (for example, low SEIFA, hardship, income support, jobless parents) were significant, in a negative direction, and of medium to high strength. SEP was also found to be significantly, negatively correlated with some adverse outcomes (for example poor health, low birthweight, smoking), although not strongly. Finally, the ability of measures to explain variance in adverse outcomes was compared and the authors concluded that the combined SEP measure performed better than the component variables on their own (for more detail see Blakemore et al., 2009).

2.3 Variables used to derive SEP

Table 1 describes the LSAC Parent 1 and Parent 2 education, income, occupational status and family type variables that were used to derive the original SEP measure.

Table 1 SEP variables

Variable Name	Variable Label	Values
fn09a	P1 Usual weekly income	Scale
fn09b	P2 Usual weekly income	Scale
fd08a1	P1 School completion	Year 12 or equivalent, Year 11 or equivalent, Year 10 or equivalent, Year 9 or equivalent, Year 8 or below, Never attended school, Still at school
fd08b1	P2 School completion	Year 12 or equivalent, Year 11 or equivalent, Year 10 or equivalent, Year 9 or equivalent, Year 8 or below, Never attended school, Still at school
fd08a3b*	P1 Highest qualification	Postgraduate degree, Graduate diploma/Graduate certificate, Bachelor degree with without honours, Advanced diploma/ diploma, Certificate III/IV including trade certificate, Certificate not otherwise defined, Certificate I/II, Other non-school qualification
fd08b3b*	P2 Highest qualification	Postgraduate degree, Graduate diploma/Graduate certificate, Bachelor degree with without honours, Advanced diploma/ diploma, Certificate III/IV including trade certificate, Certificate not otherwise defined, Certificate I/II, Other non-school qualification
pw08a3#	P1 Current or most recent occupation	ASCO occupation codes
pw08b3#	P2 Current or most recent occupation	ASCO occupation codes
pw08a5*	P1 ANZSCO code for occupation	ANZSCO occupation codes
pw08b5*	P2 ANZSCO code for occupation	ANZSCO occupation codes
f01bp2*	P2 Present for wave	Yes

* These variables were different in Wave 1. 'fd08a3b' and 'fd08b3b' were measured by 'afd08a3a' and 'afd08b3a' and included less specific response options: Postgraduate degree, Graduate diploma/Certificate, Bachelor degree, Advanced diploma/diploma, Certificate, Other. Also, in Wave 1, 'f01bp2' was measured by 'af01m3' and the response options were 'yes' and 'no'. ANZSCO codes were not available in Wave 1 so the variables 'apw08a5' and 'apw08b5' are not available.

\# ASCO codes have been replaced with ANZSCO codes in Wave 5 so these variables are not available.

Note: In Wave 1 the additional variables 'afd08a2b' and 'afd08b2b' were used for the parental education coding: Have you (partner) completed a trade certificate or other educational qualification? (1 No; 2 No, still studying for first qualification; 3 Yes, trade certificate/apprenticeship; 4 Yes, other qualification).

Income

Parent 1 report their income and (where applicable) the income for Parent 2. Parent 1 is described as the primary caregiver or the parent who knows the child best/spends the most time with the child. In the majority of instances this is the child's biological mother, but is sometimes the father or another guardian, and Parent 2 is usually the partner of Parent 1 (AIFS, 2014). Across all cohorts and waves, with slight variations, Parent 1 was asked what they (and their partner) usually received from all sources before income tax is taken out. A list of sources was provided and P1 was asked what period this covered. The income variable was derived from the provided amount as well as the period, converted into a weekly amount for each parent to get the total weekly gross income variables listed in Table 1 (see Mullan & Redmond, 2011 and Mullan, Daraganova & Baker, 2014 for more information on the income variables). The incomes of both parents were then combined and converted to an annual income value. A log transformation ($\ln(x)$) was performed on the annual income variable, and the variable was standardised to have a mean of 0 and a standard deviation of 1.

Education

Parent 1 also reported their education level and (where appropriate) the education level of Parent 2. Across all cohorts and waves (see above for difference in Wave 1), Parent 1 was asked what was their (and their partner's) highest completed year of primary or secondary school, and what was the highest qualification they ever completed. These values were then recoded in years of education for Parent 1 and for Parent 2, as shown in Table 2. The years of education variables for Parent 1 and Parent 2 were also standardised.

Table 2 Years of education

Variable Label	Values
Never attended school	0
Year 8 or below	9
Year 9 or equivalent	10
Year 10 or equivalent	11
Year 11 or equivalent	12
Year 12 or equivalent	13
Still at school	13
Other non school qualifications	14
Certificates	14
Diplomas	16
Graduate diploma or graduate certificate or Bachelor with or without honours	17
Postgraduate degree	20

Occupational status

Parent 1 provides occupation information for Parent 1 and Parent 2. Across all cohorts and waves, Parent 1 was asked what their (and their partner's) occupation was in their main job held last week. This included asking the full title and main tasks they usually preform. For those not currently in the workforce, the previously provided and coded occupation is used. Participant responses were recorded as text and ABS later coded these occupation descriptions into a standard occupation classification called the Australian Standard Classification of Occupations (ABS, 1997).

ASCO

The second edition of ASCO was developed by the ABS and the DEETYA to replace the first edition from1986. It was designed to be a skilled-based classification for use in all ABS census and surveys that collected occupation information. The code assigning system allows consistent and accurate coding system based on coding rules. There are nine major groups (one-digit codes), 35 sub-major groups (two-digit codes), 81 minor groups (three-digit codes), 340 unit groups (four-digit codes) and 986 occupations (six-digit codes) (ABS, 1997). LSAC provides the four-digit codes in the unconfidentialised data files, and the two-digit codes in the general release version of the data. The four-digit level was used in the derivation of SEP.

The ANU4

The ANU4 is a coding system that converts the ASCO classification codes to occupation status codes. It was developed by the Australian National University, as an improvement over earlier versions of the ANU status coding dating back to 1965. It was created using census data from the ABS. The scoring system applies algorithms from the International Socioeconomic Index (SEI) (Ganzeboom, De Graaf & Treiman, 1992). The coding takes ASCO codes and converts them into 118 scores, including one for those who are unemployed. It has been age corrected and thoroughly tested (see Jones & McMillan, 2001 for more information). Coding published online (Australian National University, 2009) was utilised to convert the occupation codes into Parent 1 occupation status codes and Parent 2 occupation status codes for use in the SEP. These variables were also standardised.

ANZSCO

The Australian and New Zealand Standard Classification of Occupations (ABS, 2006) has superseded ASCO. It was modified to include skill level criteria for occupations, to include new occupations, to incorporate New Zealand occupations and to better align with international coding. It has been coded in LSAC since Wave 2 using the same process as described for ASCO and was released to data-users for the first time in Wave 5. It has eight major groups, 43 sub major groups, 97 minor groups, 358 unit groups and 998 occupations. There is no concordance between ASCO and ANZSCO and there are substantial differences (see ABS, 2006 for more information about the differences). The four-digit (ANZSCO) level was used in the derivation of SEP (SEP2).

2.3.1 The AUSEI06

The Australian Socioeconomic Index 2006 (AUSEI06) is an updated version of the ANU4, which uses ANZSCO to generate status values rather than ASCO. McMillan, Beavis and Jones (2009) explain the process used to create AUSEI06, which is exactly the same method as used for ANU4 with the exception that 2006 census data was used. They compared the AUSEI06 with the ANU4 and found the scales were highly correlated (0.98). The authors conclude the scales are 'virtually indistinguishable', that data using ANU4 can be directly compared longitudinally with AUSEI06 and do not need to be converted to ANUEI06 (McMillan et al., 2009, page 130). Coding published online (Australian Council for Educational Research, 2014) was utilised to convert the occupation codes into Parent 1 occupation status codes and Parent 2 occupation status codes for use in the SEP2. These variables were also standardised.

The ANU4 and AUSEI06 values have also been made available to data-users. Variables named 'pw08a4' and 'pw08b4', which represent the ANU4 score for Parent 1 and Parent 2 have been added to the Waves 1 to 4 files (for Wave 5 release). Variables named 'pw08a7' and 'pw08b7', which represent the AUSEI06 score for Parent 1 and Parent 2 have also been added to the Waves 2 to 5 files (for Wave 5 release). Note for Wave 1 these variables exist but contain no observations.

2.4 SEP1 coding using ASCO

The original SEP coding process is provided in a step-by-step diagram in Figure 1 (refer section 1.3). It outlines how the original LSAC variables are aggregated into income, education and occupation measures and then aggregated to form the SEP variable.

2.5 SEP2 coding using ANZSCO

This method differs slightly from that described in Figure 1 in that the AUSE106 classification (using ANZSCO codes) is used for occupational status rather than the ANU4 (using ASCO coding). Additionally, because there is no Wave 1 ANZSCO, there are no values to roll over for Wave 2. Therefore, Wave 2 occupational codes are only available for those currently employed. Given the only change to SEP coding is the change from ANU4 to AUSEI06 and that these have been previously established as highly correlated, we expect SEP1 and SEP2 to be very similar. We will test this assumption by correlating ANU4 and AUSEI06 using LSAC data, and correlating SEP1 and SEP2.

3 Statistical comparisons of the two SEP measures

Section 3 provides statistical descriptions and analysis comparing the SEP measures. As SEP 2 is not available for Wave 1 and SEP 1 is not available for Wave 5, descriptions are provided for all waves, but comparisons only for Waves 2 to 4.

3.1 SEP descriptive statistics

Table 3 provides the median, minimum, maximum and number of participants for each of the SEP measures. Only one version of SEP is calculated for Waves 1 and 5, so no comparisons can be made for these. For the remaining waves it can be seen that the median values are similar for SEP1 and SEP2, but tend to be slightly higher for SEP1. The minimum tends to be slightly lower for SEP2, except for Wave 4, in which they are the same. The maximums also tend to be slightly lower for SEP2 compared with SEP1 for all waves. The number of cases for the SEP2 is lower than for SEP1 because fewer cases have ANZSCO coding compared to ASCO.

Table 3 SEP descriptive statistics comparison of SEP1 and SEP2, Waves 1 to 5, B and K cohort

Wave	Cohort	Variable	Median	Min	Max	N
1	B	SEP1	-.14	-4.28	3.08	5092
1	K	SEP1	-.15	-3.73	3.00	4965
2	B	SEP1	-.12	-4.90	3.03	4602
		SEP2	-.10	-5.93	3.05	4585
2	K	SEP1	-.11	-5.46	3.20	4458
		SEP2	-.10	-7.10	3.20	4438
3	B	SEP1	-.12	-6.69	2.99	4382
		SEP2	-.09	-7.54	2.84	4367
3	K	SEP1	-.12	-5.05	3.10	4327
		SEP2	-.09	-7.17	2.93	4312
4	B	SEP1	-.11	-6.95	2.86	4215
		SEP2	-.09	-6.95	2.77	4218
4	K	SEP1	-.11	-5.43	3.00	4124
		SEP2	-.09	-5.43	2.92	4134
5	B	SEP2	-.06	-6.42	2.92	4036
5	K	SEP2	-.07	-5.34	2.83	3907

Note. All these variables are standardised and therefore have a Mean of 0 and an SD of 1.

3.1.1 SEP1 and SEP2 distributions (density plots)

Figure 2 provides a visual representation of the distributions of the SEP variables for all waves of the B cohort in the form of a density plot. For Waves 2 to 4 both SEP1 and SEP2 are displayed. For Wave 1, only SEP1 is displayed, and for Wave 5 only SEP2 is shown.

As illustrated, for all waves the distribution of the SEP variables is steeper and less varied before the mean than after the mean. Most importantly, the distribution of SEP1 and SEP2 are virtually identical across all waves where both measures are available.

Figure 3 displays the distributions of the SEP variables for all waves of the K cohort. Similar to Figure 2, the distribution of both versions of SEP remain consistent over time. In general, the distributions of SEP are more symmetrical for the K cohort than the B cohort. Again, the distributions of SEP1 and SEP2 are virtually the same.

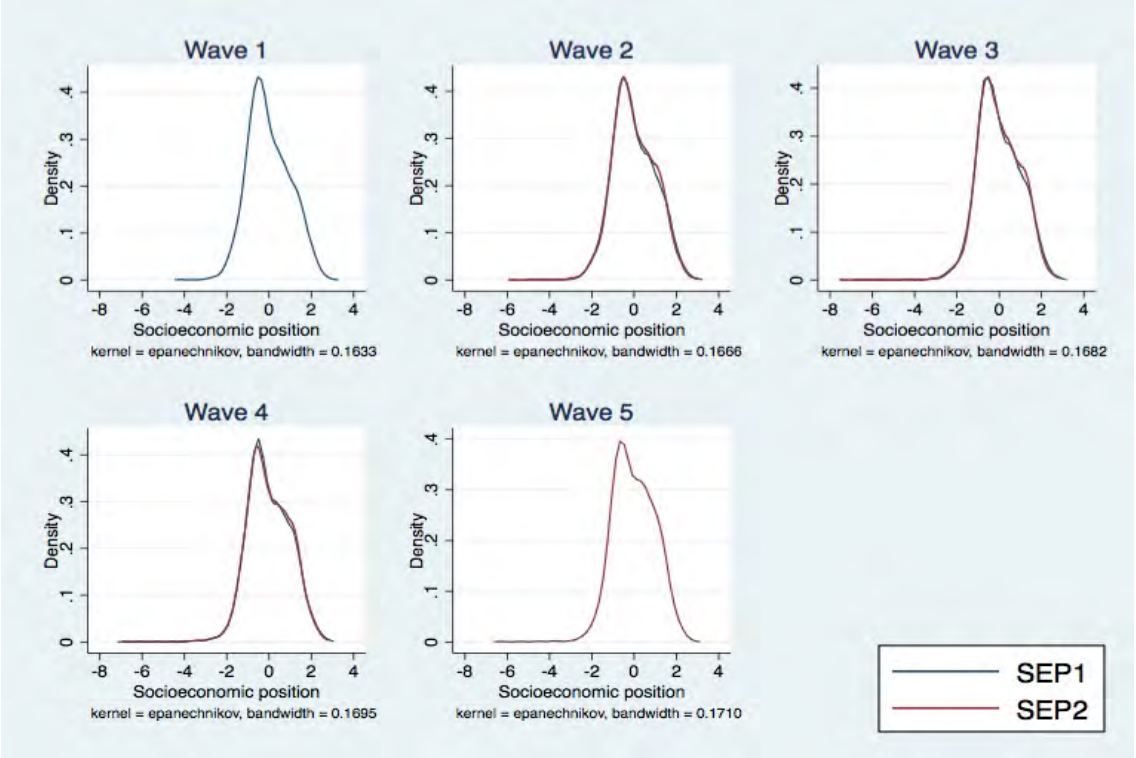

Figure 2: SEP density plots, Waves 1 to 5, B cohort

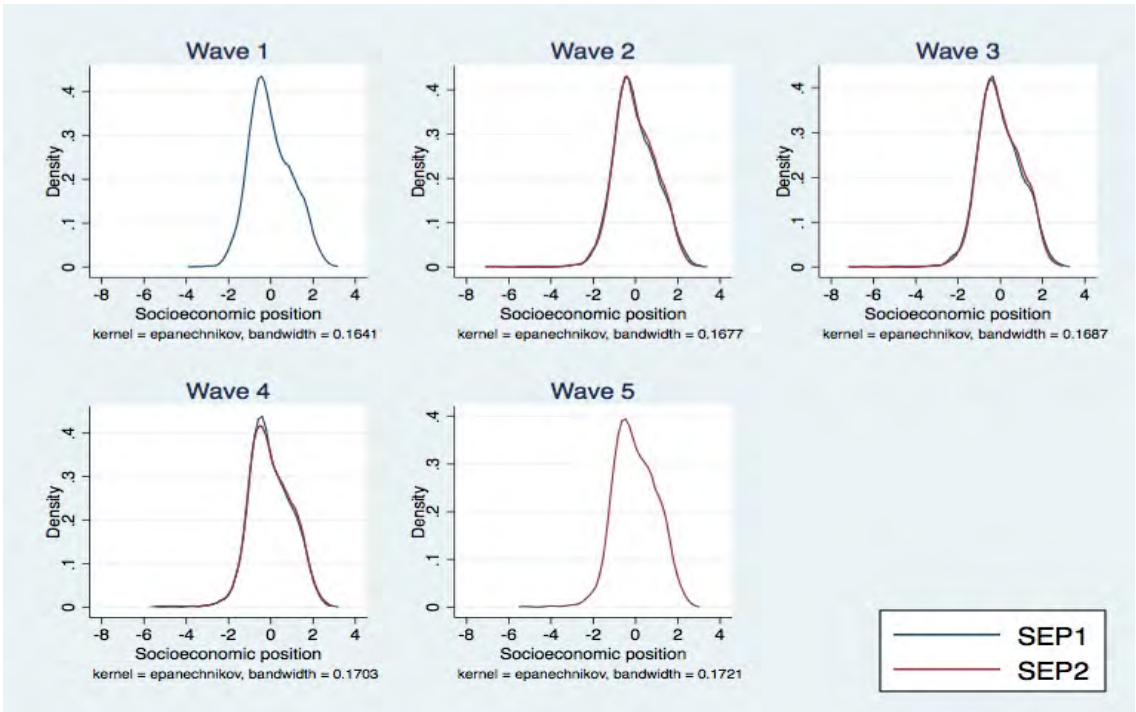

Figure 3: SEP density plots, Waves 1 to 5, K cohort

3.2 Consistency between the two SEP measures

Correlations between ANU4 and AUSEI06

There are a number of ways that we assess concordance in this technical report. We use Lin's (2000) concordance correlation coefficient to assess the agreement between two continuous measures, as it has advantages over a Pearson correlation coefficient because it measures accuracy and precision in the one metric. The concordance correlation coefficient increases in value when it gets closer to the line of 45 degrees (perfect concordance or accuracy) and when the tightness of the data around the major axis increases (precision). The following two tables show the correlations between the ANU4 and the AUSEI06 for the LSAC data, for those waves in which we have both measures. Table 4 shows the correlations for Parent 1 occupations and for Parent 2 occupations.

Table 4 Concordance correlations between ANU4 and AUSEI06 for Parent 1, for Waves 2 to 4, and for B and K cohorts

	Cohort	Wave	Correlation between ANU4 and AUSEI06	N
Parent 1		2	0.960*	2,717
	B	3	0.961*	3,204
		4	0.964*	2,875
		2	0.963*	3,016
	K	3	0.962*	3,486
		4	0.964*	3,120
Parent 2		2	0.967*	3,879
	B	3	0.965*	3,769
		4	0.967*	3,387
		2	0.968*	3,585
	K	3	0.963*	3,581
		4	0.966*	3,169

Note: $p < 0.001$, two tailed.

As can be seen from Table 4, coding occupations according to the ANU4 and the AUSEI06 results in scores that are so similar that they can be considered the same measure. The high correlation values (0.96 for P1, and 0.96 to 0.97 for P2) are as expected, and align with the results of previous comparisons of the measures of 0.98 (McMillan et al., 2009). These results indicate that ANU4 and AUSEI06 are essentially the same.

Having established that the occupational coding component of the SEP scales are similar, we now investigate whether the SEP scores themselves significantly differ. Table 5 shows the concordance correlations between SEP1 and SEP2 for Waves 2 to 4. As expected, the concordance correlations between SEP1 and SEP2 are also so highly correlated (over 0.98) they can be considered the same measure.

3.2.1 Correlations between SEP1 and SEP2

Table 5 Concordance correlations between SEP1 and SEP2, for Waves 2 to 4, and for B and K cohorts

	Cohort	Wave	SEP2	N
SEP1		2	0.981*	4,585
	B	3	0.987*	4,369
		4	0.989*	4,215
		2	0.982*	4,438
	K	3	0.988*	4,318
		4	0.989*	4,124

Note: $p < 0.001$, two tailed.

To further highlight the similarities between the two measures, we provide a visual display of the relationship between SEP1 and SEP2. Figure 4 displays scatterplots of SEP1 and SEP2 for Waves 2 to 4 for both cohorts. The strong positive linear relationship between the two measures is evident from the closely grouped circles in the diagonal line across all waves and both cohorts. Both SEP measures display a slight spread of results at the minimum scores, becoming more homogenous at the mean and maximum values. In both cohorts, the two SEP measures are more strongly aligned in Wave 3 than for the other waves. There are values still spread out in the tail, but these appear less varied than for other waves. The circles shown in blue represent cases where the SEP1 or SEP2 score has been derived from parents who have a current occupation code. The red circles represent cases where the SEP1 or SEP2 score has been derived from parents previous occupation code (rolled over from the previous wave) because they do not have a current occupation. The pattern of these different coloured circles demonstrates SEP1 and SEP2 are more closely aligned when current data are available than when data from previous waves are used. Most of the values that are spread out in the tails of the plots are also cases that have been rolled over[1].

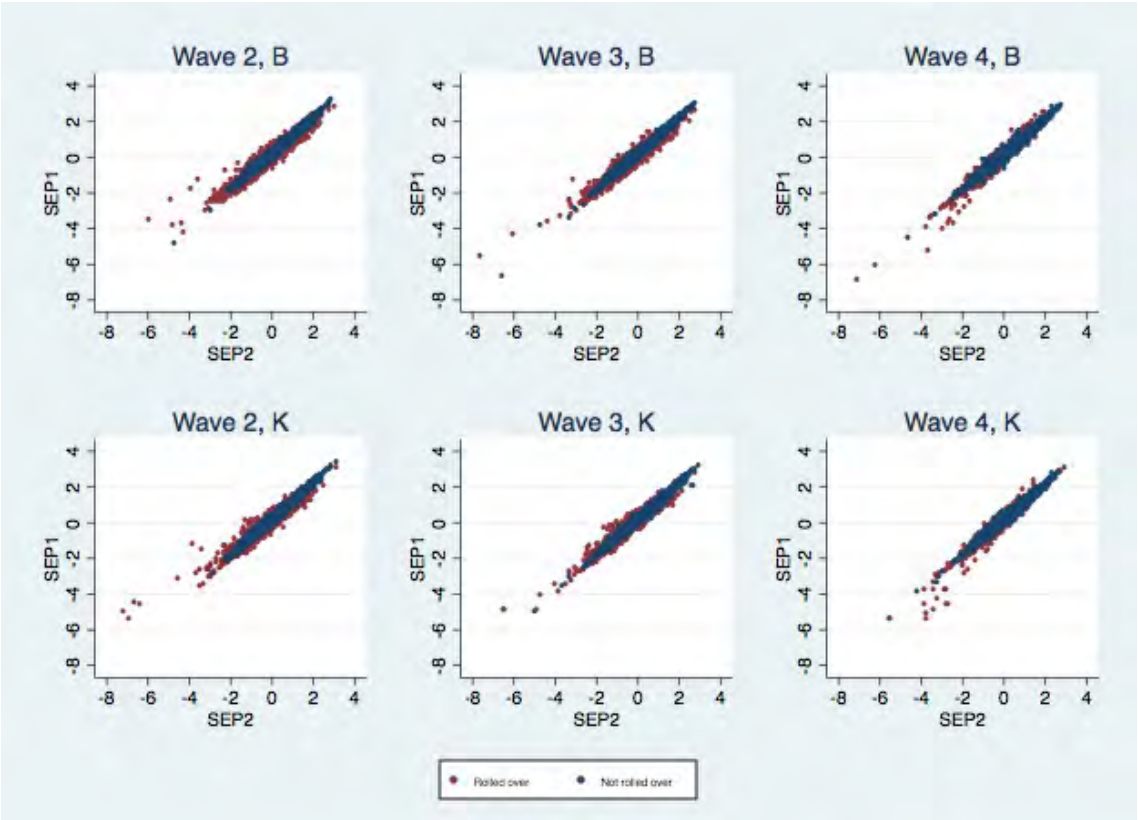

Figure 4: SEP scatterplots for Waves 2 to 5, B & K cohorts

[1] Another way to assess the variation between measures is to look at the plots of difference versus average value, i.e. "Bland-Altman plots". These plots can be found in Appendix A and B.

In order to investigate whether the change from SEP1 to SEP2 would impact single-parent families differently to two-parent families, we correlated SEP1 and SEP2 for these types of families separately. The correlations between SEP1 and SEP2 for both single and two-parent households were over 0.96 for Waves 2 to 4, for both cohorts. The high correlations demonstrate again that there is very little difference between the two SEP measures, whether the occupational data is sourced from one parent's occupation or from two.

3.2.2 Difference scores

In addition to the overall pattern of difference between the measures, we wanted to investigate whether there had been large changes for individual cases. For each wave and cohort, we therefore created an 'absolute difference' variable. This variable was calculated as absolute value of (SEP2–SEP1). To make the comparison possible across waves and cohort we re-calculated the "absolute difference" variable as a proportion of the corresponding standard deviation. Table 6 presents the distribution of re-calculated "absolute differences".

As can be seen in Table 6 the majority of cases (between 86–93%) have "absolute difference" scores between 0 and 0.2 standard deviations. These changes are relatively minimal. The remaining cases have greater differences, with fewer cases (around 3.5%) having large differences (≥ 0.5 standard deviation). For over 98% of the cases, the change is less than one standard deviation.

These results indicate that while the overall distribution of SEP1 and SEP2 remains consistent, there are important changes occurring for individual families' rankings that need to be considered. Contrary to previous correlation findings, these results indicate that deriving SEP using ANZSCO results in a change in individual scores that might have consequences for analysis and may make longitudinal comparisons between SEP1 and SEP2 unadvisable in many circumstances.

3.2.3 Changes due to prestige ranking change between ANZSCO and ASCO

Some change in the prestige ranking of jobs between ASCO and ANZSCO is expected to be influencing the difference scores, given the differences in the coding of these occupational scales. However, because SEP is derived from income and education alone in circumstances where occupation is not available, it was important to also determine the extent to which missing occupational codes were contributing to the SEP difference scores.

Further investigation of the larger differences (> 0.2 standard deviations) was undertaken on a case-by-case basis. This revealed that, as expected, there were changes in the occupational coding that created some positive change in SEP2, as some occupations are considered more prestigious in ANZSCO than ASCO. Some negative changes also occurred due to the lowering of prestige scores for some occupations in ANZSCO compared with ASCO.

3.2.4 Changes due to a lack of concordance between ANZSCO and ASCO

However, the changes due to coding differences alone were far outweighed by changes that occurred due to missing cases. The majority of changes between SEP2 and SEP1 for Waves 2 and 3 (both cohorts) were driven by ANZSCO codes being unavailable where ASCO codes were available. This resulted in difference scores in both positive and negative directions, depending on the prestige level of the occupational code that is missing, how many occupational codes were missing (two parents or one) and the family type (single or two-parent).

For example for a single-parent family, if the parent's socioeconomic position was high in SEP1 and that data is missing in SEP2, the SEP2 score will be lower than the SEP1 score. Whereas if the occupational code was low in SEP1 and then missing in SEP2, the SEP2 score will be higher.

The possible scenarios are more complicated for two-parent households, where the various combinations of high and low prestige occupations, and whether one or both data points are missing determine whether the change in SEP2 is positive or negative. For example, if both parents occupational ratings are similar (for example, both high or both low) and both are missing in SEP2, the same outcome occurs as described for the single-parent family above. However, if only one of the two parents' occupational codes

was missing the impact would depend on the remaining parent's occupational prestige status in relation to the other parent. For families where one parent had a prestigious occupation and the other had a low ranking occupation, the SEP1 score would be somewhat balanced out by these opposing occupations. SEP2 would be higher if the remaining parent's data was the high ranking occupation, and lower if the remaining parent's data was low ranking occupation. For Waves 2 and 3, there were a greater number of positive changes than negative changes, creating an overall upward trend in SEP2 scores.

The results were somewhat different for Wave 4 (both cohorts). The majority of changes were still due to missing data points, however the missing data results from a lack of ASCO codes rather than ANZSCO codes. This created the same sort of complexities in scoring as described above. However, there were also a greater number of negative changes than positive changes, creating an overall shift downward in SEP2 scores for this wave alone.

In summary, most of the large difference scores between SEP2 and SEP1 resulted from a lack of correspondence between ANZSCO and ASCO coding which created missing cases, as well as some prestige ranking changes in the coding between ANZSCO and ASCO. These differences between the SEP measures demonstrate that it is not advisable to regard SEP1 and SEP2 as interchangeable. Instead, the recommendation is to treat SEP1 and SEP2 as variables that produce similar aggregate results, with data users being aware that they differ in the socioeconomic ranking for some families.

Table 6 Absolute difference between SEP2 and SEP1 measures expressed in terms of standard deviations, Waves 2 to 4, B & K cohorts

Absolute difference between SEP2 and SEP1 expressed in terms of SD	W2 B, %	W2 K, %	W3 B, %	W3 K, %	W4 B, %	W4 K, %
0	32.2	33.4	38.4	39.4	44.3	41.9
0.1	38.7	39.7	40.0	41.8	39.3	41.4
0.2	14.8	14.2	11.7	10.9	9.0	9.2
0.3	7.1	6.3	5.0	3.6	3.8	4.0
0.4	3.9	3.4	2.6	2.2	1.6	2.0
≥ 0.5	3.3	2.9	2.3	2.1	2.1	1.4
Total	100	100	100	100	100	100
Total, N	4,585	4,438	4,369	4,318	4,215	4,124

Note: Percentages do not total 100% due to rounding.

We also investigated whether there had been large changes for individual cases between waves for SEP1 scores compared with SEP2 scores. We created 'difference' variables (calculated as SEP1 Wave 4–SEP1 Wave 3, SEP1 Wave 3–SEP1 Wave 2, SEP2 Wave 4–SEP2 Wave 3, and SEP2 Wave 3–SEP2 Wave 2). Figure 5 presents the density plots for the change scores for SEP1 and SEP2 across Waves 2 to 4 for the B cohort. As can be seen in Figure 5, the changes over the waves is of a similar rate and pattern over the years for SEP1 and SEP2, particularly for the Wave 2 to Wave 3 change. For Wave 3 to Wave 4, SEP2 seems to have slightly less change over time (greater per cent of cases with zero change) than SEP1, as indicated by the higher peak at zero for SEP2. This suggests that SEP2 values are more stable over time than SEP1 values.

Figure 6 presents density plots of the change in SEP1 scores across Waves 2 to 4, and change in SEP2 scores across Waves 2 to 4 for the K cohort.

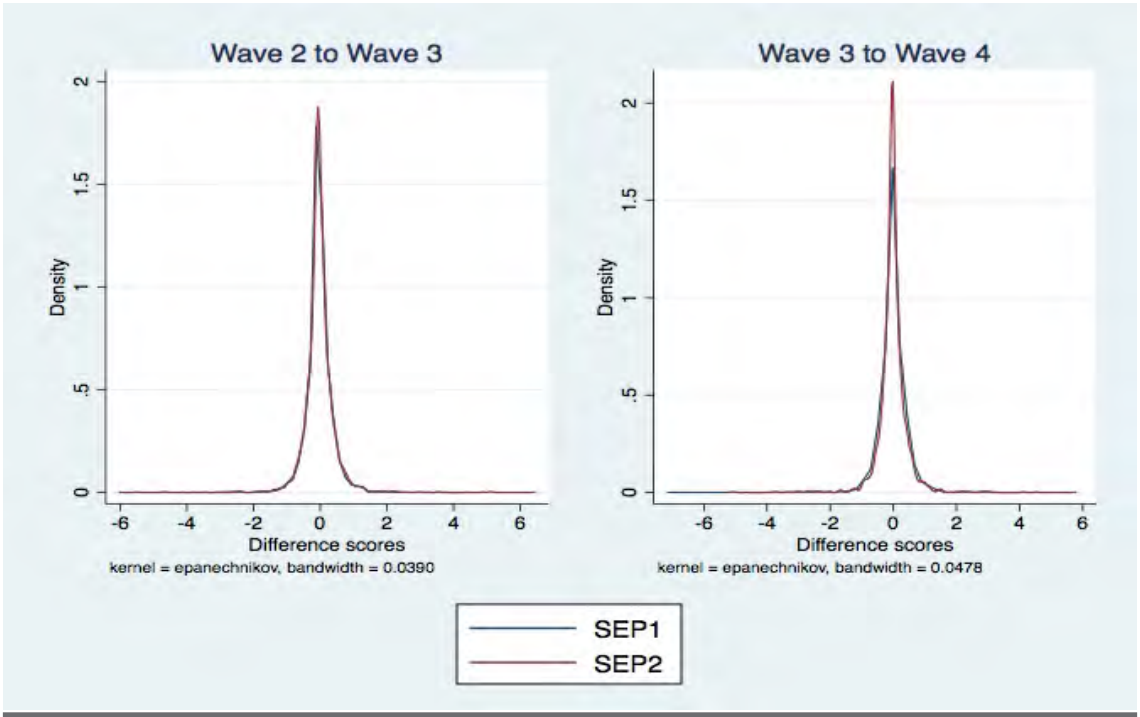

Figure 5: SEP1 and SEP2 density plots, Waves 2 to 4, B cohort

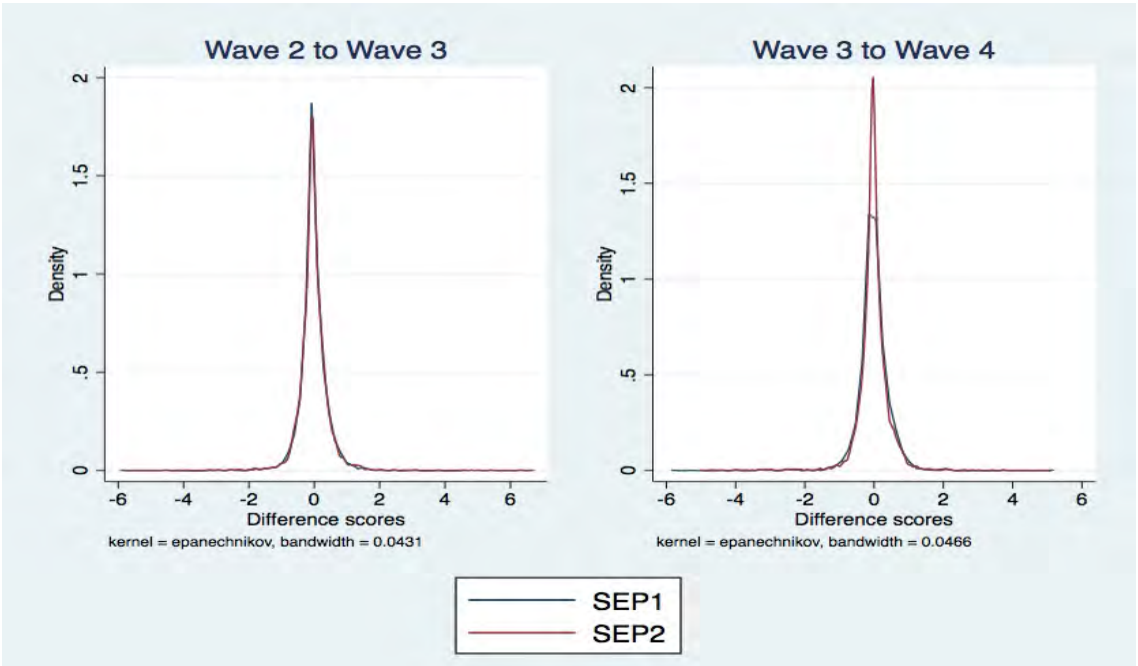

Figure 6: SEP1 and SEP2 density plots, Waves 2 to 4, K cohort

Similar to the B cohort, the SEP1 and SEP2 changes for the K cohort are very similar to the change between Wave 2 to Wave 3. Again for the Wave 3 to Wave 4 change, SEP2 displays much less change over time than SEP1. This peak at zero for SEP2 is even more pronounced for the K cohort than for the B cohort.

Although the distributions and correlations indicate the scales are very similar, we wanted to also investigate whether the relationship between the global SEP scale and the individual variables that make up the scale had changed. Therefore, correlations were run between SEP1, SEP2 and the component measures P1 and P2 education, P1 and P2 occupation and combined income. The results were similar across waves, cohorts and both SEP measure. For illustrative purposes we display only the initial correlations between SEP1 and components from Wave 1 (B and K) and then compare this with the correlations between SEP2 and components using the most recent data (Wave 5 (B and K)). The results are displayed in Table 7.

3.2.5 Correlations between SEP and component variables

Table 7 Correlations between SEP1 and SEP2, and their component variables for Waves 1 and 5, and for B and K cohorts

	Cohort	Wave	Years of school P1	Years of school P2	Occupational Prestige P1 (ANU4 W1, AUSEI06 W5)	Occupational Prestige P2 (ANU4 W1, AUSEI06 W5)	Combined Income (Log)
SEP1	B	1	0.78*	0.75*	0.76*	0.77*	0.67*
	K	1	0.77*	0.75*	0.75*	0.76*	0.68*
SEP2	B	5	0.74*	0.75*	0.73*	0.74*	0.66*
	K	5	0.74*	0.74*	0.75*	0.74*	0.67*

Note: $p < 0.001$, two tailed.

The Wave 1 results from Table 7 have been reported previously in the initial LSAC SEP paper (Blakemore et al., 2006). Parents' years of schooling and occupations both correlate highly with the overall SEP measure, whereas income correlates slightly less than the other components.

As can be seen in Table 7, there is virtually no change in the relationship between the SEP1 measure and component measures (education, occupation and income) for Wave 1 when compared with the relationship between SEP2 and component measure in Wave 5. Parents' years of schooling and occupations still correlated more highly with SEP than income.

These results indicate that, not only has the make up of SEP remained stable in the transition from SEP1 to SEP2, but also that the relationship between SEP and its components has remained stable over time (throughout the 10 years of LSAC). This provides further evidence that SEP is a consistent measure.

Correlations between SEP and other disadvantage variables

Table 8 shows the correlations between SEP1 and SEP2 with other indicators of disadvantage for Waves 2 to 4 and both cohorts. The disadvantage variables are: the economic hardship scale ('hshipb') calculated as a count of 'yes' responses to six hardship questions(for example, could not pay rent); whether either P1 or P2 are recipients of income support (based on 'fn03a1' and 'fn03b1'); whether either P1 or P2 are jobless (based on 'aempt' and 'bempt'); and the SEIFA measures of disadvantage ('cnfsad', 'cnfsda', 'cnfser' and 'cfnseo') for the area within which the family resides.

As expected, there was no difference in the way SEP2 correlated with other disadvantage indicators when compared with SEP1. Both SEP1 and SEP2 were weakly to moderately correlated with all other disadvantage variables across all waves and cohorts. Unsurprisingly, the highest correlation was with SEIFA education and occupation.

Table 8 Correlations between SEP1 and SEP2 and disadvantage variables for Waves 2 and 4, and for B and K cohorts

Wave	Cohort	SEP	Economic hardship scale	Parent/s receiver of income support	Jobless parent/s	SEIFA advantage/ disadvantage	SEIFA disadvantage	SEIFA Economic resources	SEIFA Education and occupation
2	B	SEP 1	0.27*	0.41*	0.27*	0.43*	0.38*	0.30*	0.46*
		SEP 2	0.28*	0.38*	0.23*	0.43*	0.38*	0.31*	0.46*
	K	SEP 1	0.29*	0.43*	0.26*	0.43*	0.38*	0.32*	0.46*
		SEP 2	0.29*	0.41*	0.22*	0.41*	0.38*	0.32*	0.45*
3	B	SEP 1	0.27*	0.40*	0.24*	0.43*	0.38*	0.30*	0.46*
		SEP 2	0.27*	0.39*	0.21*	0.43*	0.38*	0.31*	0.46*
	K	SEP 1	0.29*	0.42*	0.26*	0.43*	0.38*	0.32*	0.46*
		SEP 2	0.29*	0.41*	0.24*	0.43*	0.38*	0.32*	0.45*
4	B	SEP 1	0.26*	0.41*	0.24*	0.40*	0.35*	0.21*	0.45*
		SEP 2	0.27*	0.42*	0.25*	0.42*	0.36*	0.22*	0.46*
	K	SEP 1	0.28*	0.39*	0.22*	0.43*	0.37*	0.24*	0.46*
		SEP 2	0.28*	0.40*	0.24*	0.43*	0.39*	0.25*	0.46*

Note: $p < 0.001$, two tailed. Dissimilarities between results presented here and those in Blakemore et al (2006) arise from different coding and analyses techniques.

4 Conclusions and recommendations

Section 4 will provide a review of the paper, a conclusion based on the results and a recommendation of how SEP will be coded longitudinally and how the variables will be provided to data users.

4.1 Overview

As ASCO occupation coding is no longer available for Wave 5 LSAC data, and because ANZSCO occupation coding was not yet available for Wave 1 data, a new socioeconomic position variable needed to be created. Both SEP measures use parental education, parental occupation status, and combined parental income to derive SEP rankings for families. The new version of SEP was coded differently to the original SEP by using AUSEI06 for occupational status rather than the ANU4.

In order to test the comparability of the variables that contribute to SEP, we ran correlations between ANU4 and AUSEI06 for each wave and cohort where data were available. In order to test whether the new SEP was similar to the original SEP, we then ran correlations between the two SEP measures for each wave and cohort where data were available. We then conducted this analysis separately for single-parent families and twoparent families. We also investigated difference scores (SEP2 minus SEP1) to see whether significant departures occurred for individual cases and we ran correlations between the global SEP measures and their individual components (education, occupation and income) to see whether there had been major changes to the way these variables were relating to overall SEP. Other measures of economic disadvantage (economic hardship, joblessness, income support and area disadvantage) were also correlated with the SEP measures to see if there had been changes to the way these variables related to SEP. We also provided descriptive information and graphs to demonstrate the relationship between the two SEP measures.

4.2 Findings

For all waves and cohorts, the ANU4 and the AUSEI06 were highly correlated, in line with previous findings (all correlations > 0.9 and all *ps* < 0.001). The new version of SEP that was coded using the AUSEI06 (which utilises ANZSCO occupations) was found to be statistically similar to the original SEP variable which was coded using the ANU4 (which utilises ASCO occupations) (all correlations > 0.9 and all *ps* < 0.001). In all correlations across waves and cohorts, the two versions of SEP were found to be so highly correlated that they are considered to be virtually the same measure. Importantly, this high correlation was found for both single-parent families and for two-parent families (all correlations > 0.9 and all *ps* < 0.001).

Further, when investigating difference scores between SEP1 and SEP2, for 98% of cases the change value was between zero and 0.5 across all waves and both cohorts. However a considerable amount of cases had changes of over 0.2 (up to 15%). Despite the high degree of correlation, these findings indicate that SEP2 and SEP1 are not directly interchangeable.

The changes were largely accounted for by cases where the ANZSCO code was not available for one or both parents to calculate SEP2, while it was available for SEP1 when using ASCO. Some changes were also due to the change in prestige rankings of some occupations when using the ANZSCO as opposed to ASCO. Both of these factors could create negative or positive change scores, however for Waves 2 and 3 (both cohorts), there were more positive changes than negative changes, suggesting an inflation of SEP2 scores.

For Wave 4 (both cohorts), most changes were still due to missing occupational codes, however for this wave it was the ASCO codes that were missing when calculating SEP1, while there were ANSCO codes available to calculate SEP2. There were also some changes due to occupational prestige changes between ANZSCO and ASCO. This again resulted in both positive and negative change scores, however for Wave 4 there were more negative changes, suggesting a deflation of SEP2 scores for this wave alone. This highlights that although SEP2 and SEP1 behave in a similar manner, they are different measures.

There did not appear to be a change in the way the component variables were relating to the global SEP measures between Wave 1 (SEP1) and Wave 5 (SEP2), with education, occupation and income all correlating highly and significantly with the overall SEP measures. There also did not appear to be a

change in the way SEP related to disadvantage indicators, with economic hardship, joblessness, income support and area disadvantage. Visual inspection of the distributions and scatterplots of SEP1 and SEP2 across waves and cohorts further confirmed that there were no obvious differences between the original and new versions of SEP.

Taking all of these results into consideration, we conclude that while SEP2 and SEP1 are comparable measures, they are best presented as separate measures with separate variable names. There may be some impact on analysis from using the new SEP coding method. We suggest providing both versions of SEP to users (with the exception of Wave 1 for which SEP2 is unavailable) and allowing users to decide which of the two measures best suits their analysis needs.

4.3 Providing SEP to users

We will therefore be providing a new version of SEP (SEP2 using AUSEI06, ANZSCO coding) on the Wave 6 release of the data for the Wave 2 to 6 data sets. This variable will have a different variable name (for example, 'bsep2' for the Wave 2 B file). SEP2 will be the way socioeconomic position is calculated from Wave 5 onwards, until there are other changes to component variables (that is, another new occupational coding system is introduced by ABS). We will also still provide SEP1 for Waves 1 to 4 and continue to provide the ANZSCO codes and AUSEI06 codes to users.

4.4 Considerations

Using SEP in longitudinal research

One issue is that SEP2 cannot be created for all waves (not available for Wave 1), limiting the ability for researchers to perform longitudinal socioeconomic position analysis across all waves. Where it is necessary to adjust for the confounding of socioeconomic position across all waves one alternative is to use parental income and education as separate covariates.

Missing data points

Further, large amounts of missing data on the component variables will impact the SEP score. Although this may not necessarily result in missing SEP cases, the data used to generate SEP will have only come from sources with information. For a single-parent family only two out of the three variables are required to compute SEP, and for a two-parent family only three out of the five variables are required. For example, for a single-parent family with no occupation code, only education and income will contribute to the family's SEP ranking. For a two-parent family where for example Parent 1's information is missing, only Parent 2's details will contribute to the family's SEP. Table 9 describes the amount of missing data on each component variable and the proportion of the observations for which SEP2 cannot be computed.

Large amounts of missing cases in SEP component variables were not evident for the waves analysed in this report. However, there were missing occupational values for both measures. For Waves 2 to 3, SEP2 had more missing cases and, for Wave 4, SEP1 had more missing cases. These missing cases accounted for most of the individual differences in scores between SEP1 and SEP2. We will also not be able to create occupational codes for those that are missing on ANZSCO but not ASCO (or visa versa), as there is no direct concordance between the two occupational codes. Therefore missing cases will remain in the dataset and are considered a limitation of both SEP measures. Missing data has the potential to become a greater issue in the future (for example, if the study child becomes the sole informant for income questions and does not know enough about the family income to respond). Future versions of SEP may consider imputation methods when deriving SEP (for example utilising existing imputed income values, see Mullan et al, 2014 for more information).

Table 9 Proportion of missing cases on SEP2 measure and on the components of SEP2 measure, Waves 2 to 5, B and K cohorts

	Wave 2	Wave 3	Wave 4	Wave 5
B Cohort	%	%	%	%
SEP2	0.46	0.39	0.42	0.73
Parental income	5.02	6.00	7.33	10.09
P1 highest education	0.04	0.02	0.09	0.27
P2 highest education	11.59	11.76	13.22	14.71
P1 occupation	41.01	34.66	30.60	25.95
P2 occupation	15.70	15.60	17.80	19.38
Total number of observations, N	4,606	4,386	4,242	4,085
K Cohort	%	%	%	%
SEP2	0.58	0.30	0.50	0.63
Parental income	5.65	6.83	9.52	11.63
P1 highest education	0.04	0.09	0.17	0.20
P2 highest education	15.30	15.75	16.98	18.38
P1 occupation	32.44	24.75	23.12	20.70
P2 occupation	19.53	18.40	21.16	23.08
Total number of observations, N	4,464	4,331	4,169	3,956

Choosing whether to use SEP1 or SEP2

Researchers will need to decide which version of SEP is most appropriate for their analyses. In general, SEP2 should be more accurate than SEP1, as ANZSCO better reflects the current job market compared with ASCO[22]. However SEP1 might alternatively be considered more accurate for Waves 2 and 3. For these waves, SEP1 values were based on more complete data, as more occupational codes were available and less SEP scores were based on income and education alone. This highlights that under some circumstances it might be advisable to use SEP1 rather than SEP2. For instance, if Wave 1 is of particular interest we would suggest using SEP1 and comparing Waves 1 to 4. However, if Wave 1 is not being included we suggest using SEP2.

Researchers could choose to compare SEP1 and SEP2 longitudinally (compare SEP1 Wave 1 to SEP 2 from Waves 2 onwards), however they should do so with caution as they will produce different SEP rankings. Wave 1 rankings may be lower than the following waves and it might be difficult to decipher whether this is due to the changes across waves (for example, mothers returning to the workforce) or occupational prestige ranking changes. If SEP is a central feature of the analyses, data users should conduct robustness tests by comparing models including SEP1 or SEP2. This will be particularly important when performing some longitudinal analyses such as fixed effects regression.

[2] The latest edition of ASCO code was in 1997.

4.4.1 When is it better to use the component measure rather than the aggregate SEP measure?

Finally, whether or not researchers choose to use the global socioeconomic position measure or the individual component variables of education, occupation and income in their analyses, depends on the research question. Sometimes SEP will be more appropriate and sometimes the contribution of individual variables is an important consideration. Further, researchers may want to consider the influence household composition (e.g., single or two-parent households) or gender in the context of SEP rakings. Users should also keep in mind that the standardisation that occurs in generating SEP is performed separately for each sample (each wave and cohort). Therefore a family's resulting SEP rank is only relevant in the context of that particular sample. Despite these aspects to consider when using either version of SEP, the development of the new version of SEP means researchers can continue to utilise this important aspect of childrens' development in their analysis and in making policy recommendations.

In conclusion, the new SEP is not statistically different from the original SEP and can be used in the same way, however longitudinal analysis should compare results using SEP2 to SEP1.

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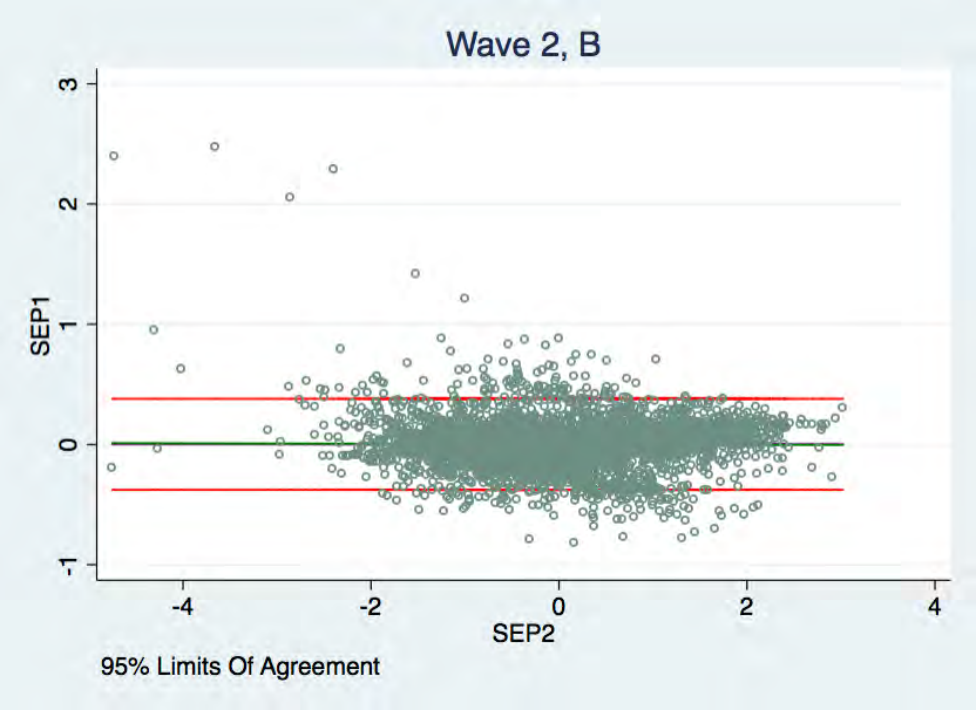
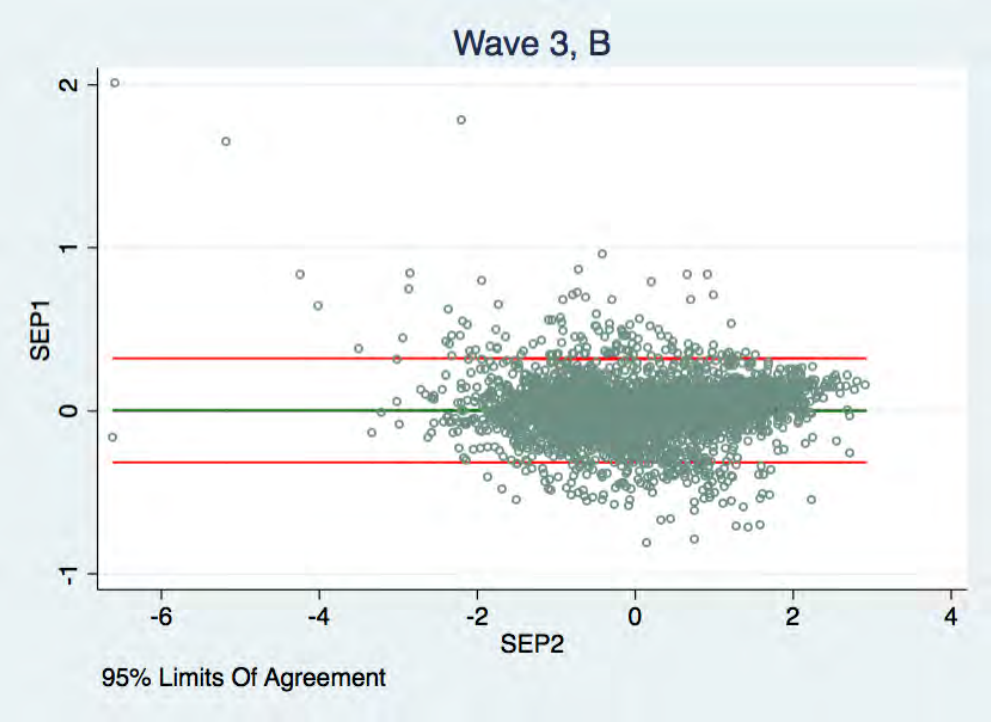
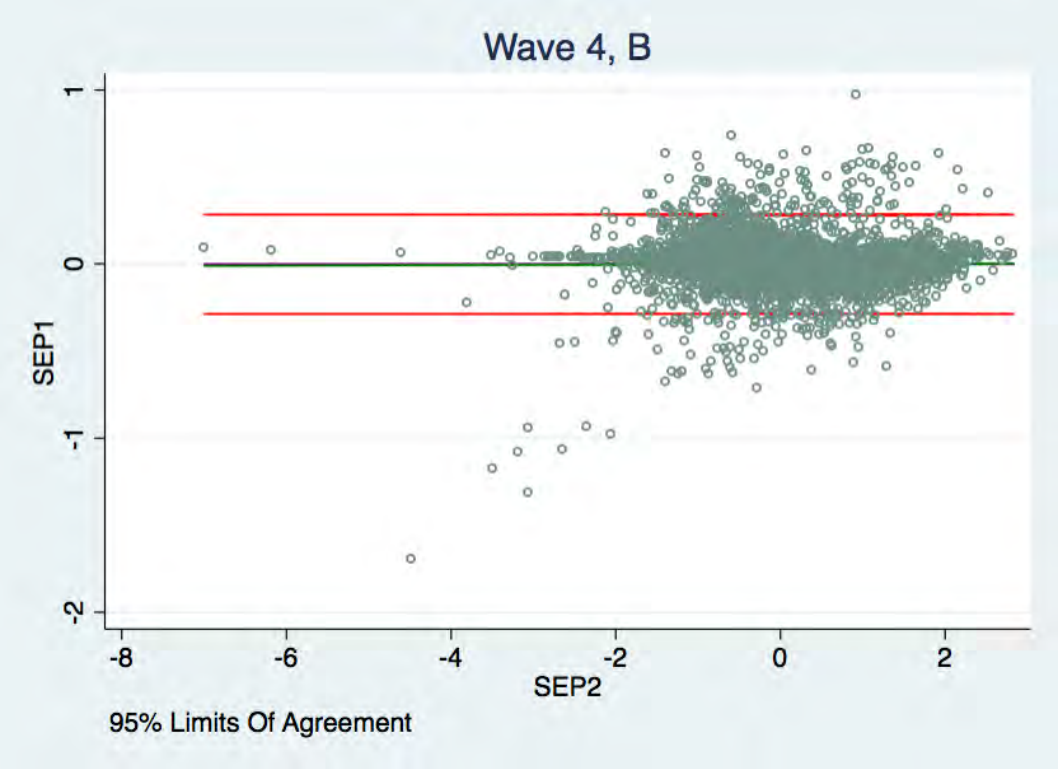
Appendix A: Bland-Altman plots, Cohort B

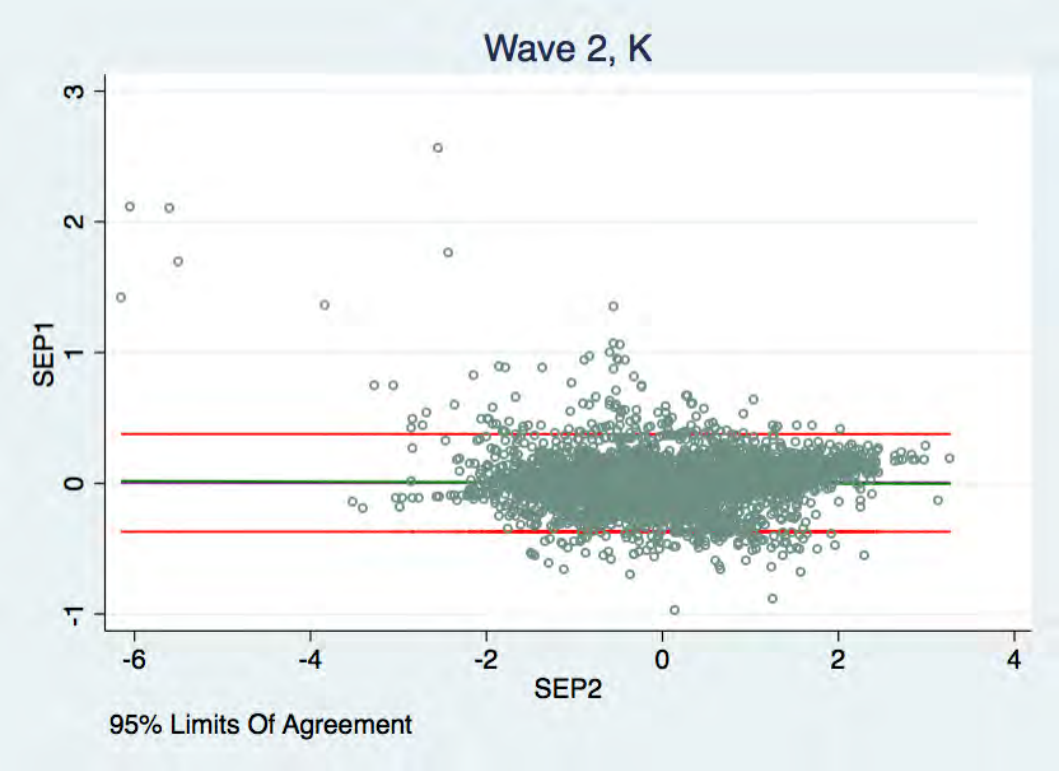
Bland and Altman plots were used to assess the systematic differences between SEP1 and SEP2 and identify outliers. Even though the majority of points are within the average difference ± 1.96 standard deviation of the difference, there are a large number of outliers across all waves in both cohorts. This result suggests that these measures cannot be used interchangeably in longitudinal analysis across all waves.

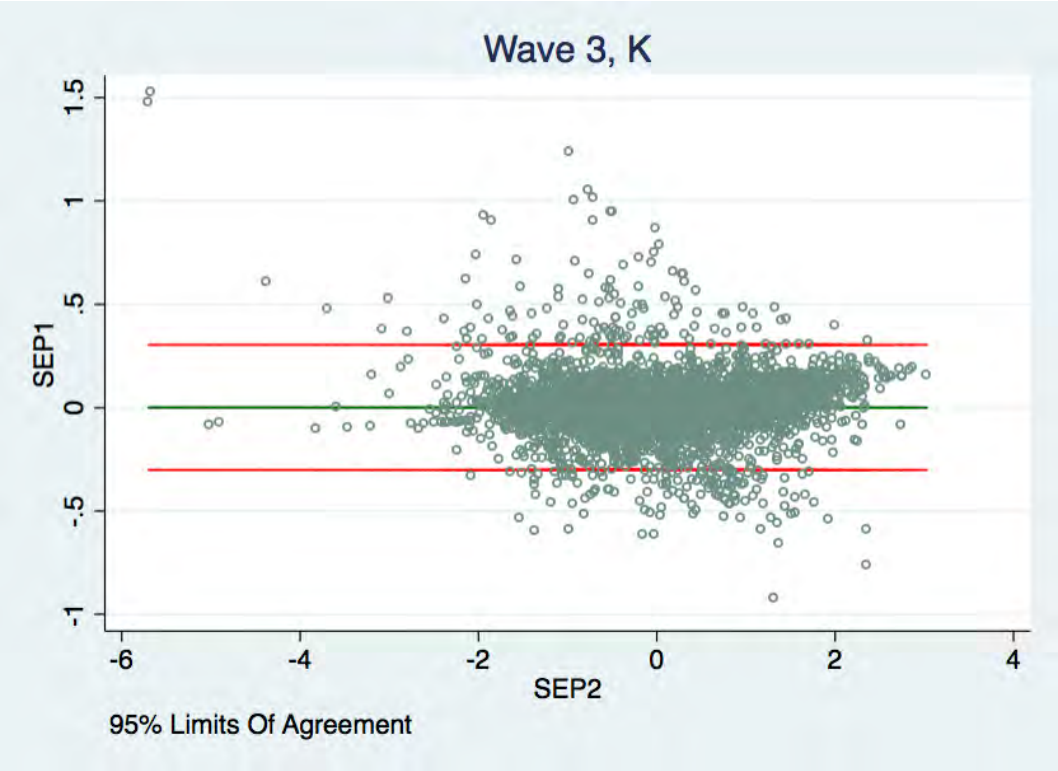


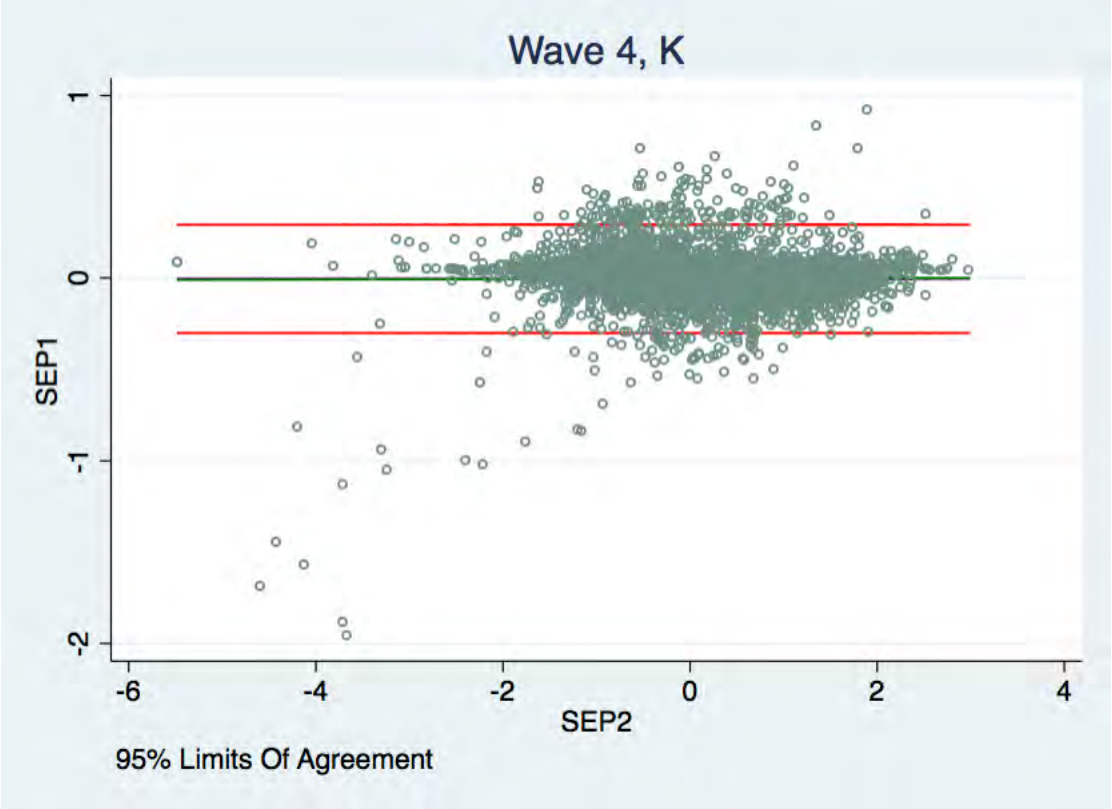



Wave 4, B
SEP1
1
0
-1
-2
-8
-6
-4
-2
0
2
SEP2
95% Limits Of Agreement

Appendix B: Bland-Altman plots, Cohort K






Wave 4, K
SEP1
1
0
-1
-2
-6
-4
-2
0
2
4
SEP2
95% Limits Of Agreement