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The role of the Built Environment in Child Psychopathy

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Abstract

This paper aims to uncover the link between the physical surroundings in which people live, work and play and the development of psychopathic traits in children. Using data from the Millennium Cohort Study (MCS), it examines how neighbourhood disorder, measured at age 3, may influence the emergence of callous and unemotional traits at age 11—traits often linked to psychopathy in adulthood.

Key characteristics of psychopathy, such as impulsiveness and other traits, are often seen as innate qualities of developing minds, which contribute to why child psychopathy is under-researched. Despite this, growing evidence suggests that callous and unemotional traits in childhood may signal a pathway to psychopathy later in life. Therefore, it is crucial to examine psychopathy in children through a different lens.

The built environment's role in this developmental trajectory is crucial yet similarly understudied, despite mounting evidence connecting it to children's cognitive and emotional development.

This research uncovers a subtle but important association between early exposure to neighbourhood disorder and callous-unemotional traits in children. It also highlights how key confounding factors such as the emotional climate at home, ethnicity, mothers' education contributes to this relationship. Additionally, these findings underscore the potential impact of early environmental factors on child development and suggest that improving neighbourhood conditions could be a valuable strategy in preventing the emergence of psychopathic traits.

Through this study we can begin to understand how the environments we live in and interact with daily can have lasting impacts on children's mental and emotional growth. This research contributes to understanding how the built environment affects child psychopathy and highlights the need for further exploration and intervention. With psychopathy linked to later life challenges, these findings could pave the way for early interventions to prevent harmful developmental outcomes.

Keywords: Callous and unemotional traits, Built environment, Neighbourhood disorder, psychopathy

Introduction

The built environment, encompassing human-made spaces such as neighbourhoods, streets, buildings, and schools, plays a crucial role in daily life and can significantly impact mental health and development, particularly in children (Kaklauskas, 2016). Recent research has increasingly focused on the role of the built environment on child cognitive development. Despite this being a relatively new field of study, evidence already suggests that there is a connection between with early child emotional development and specific features of the built environment (Collyer, 2022).

Psychopathy is a “neuropsychiatric disorder marked by deficient emotional responses, lack of empathy, and poor behavioural controls, commonly resulting in persistent antisocial deviance and criminal behaviour” (Anderson, 2014).

The majority of psychopathy research has focused on adults leaving its manifestation in children relatively underexplored. One probable reason for this is that some key mark traits that are associated with psychopathy in adults such as impulsivity, are normal traits in children. (Bjørnebekk ,2021). As a result of this, typically only those over eighteen are diagnosed with psychopathy. Nevertheless, growing evidence suggests that certain early behavioural patterns, such as callous and unemotional traits, are intricately linked to the development of psychopathy later in life (Christopher T, 2000).

Callous and unemotional traits in children refers to a set of personality characteristics. Children with these traits have limited empathy, lack guilt, and usually have muted emotional responses (Frick, 2014).

As a result, this paper will use callous and unemotional traits as a proxy to measure psychopathy in children (Schütz, 2023)

Despite its importance, exceptionally little is known about the role of the built environment in children callous and unemotional traits. This paper aims to investigate this relationship by examining how the built environment may contribute to the development of psychopathy through the assessment of callous and unemotional traits in children.

This will be done by utilising data collected from the Millenium Cohort Study (MCS). Specifically, focusing on data that was collected at 9 months, 3 years, and 11 years.

It will explore the long-term association between the built environment, measured during the age 3 interview, and the callous- unemotional traits, assessed during the age 11 interview.

The built environment will be measured by considering several measures simultaneously. These measures will include neighbourhood disorder, area green space, air pollution, and neighbourhood socio-economic disadvantage. Neighbourhood disorder will be assessed by MCS interviewers by direct observation of several physical and social aspects of the immediate neighbourhood. This study will also control for the homes emotional and physical environment at age 3. This will be measured by parental self-report and third-party observation.

Callous and unemotional traits will be measured by a questionnaire that will be self-completed at age 11.

The Ecological systems theory developed by Bronfenbrenner explains how human development is influenced by diverse types of environmental systems (Ettekal and Mahoney, 2017). In the context of this theory, the built environment is considered as

part of the microsystem directly impacting child development. This theory provides a conceptual framework on how the built environment can contribute to callous and unemotional traits in children.

Additionally, the built environment is associated with increased perceived psychosocial stress among young adolescent children, (Franklin et, 2020). Psychosocial stress occurrences in childhood can have lasting effects as it has the potential to disrupt neural stability of a child and impact their future development. (Rothenberger A; Hüther G, 2024).

However, this becomes significant only if calloused unemotional traits are impacted by the built environment. Studies have shown that positive upbringings by parents acts as protective factor against callous unemotional traits (Hyde, 2016). This paper hopes to provide insight into the role of the built environment on callous and unemotional traits.

Methods

Study Sample

The MCS follows 19,000 children born in England, Wales, Scotland and Northern Ireland. These children were born during 2000 to 2002 (Connelly and Platt, 2014). Each child in this study is referred to as a Cohort Member (CM).

The sample of births in the MCS are spread over a year and are from an array of electoral ward. Furthermore, this study oversamples wards with high ethnic minority populations and children living in deprived areas. Additionally, samples have been boosted in Wales, Scotland and Northern Ireland. Mothers as well as fathers are interviewed throughout this study (Smith and Joshi, 2002), with majority of parents interviewed being mothers. The ethical approval for this study was granted by UK multi-centre ethics committee.

So far, there have been 7 weeps of the MCS. MCS children were 9 months old at Sweep 1, and 3, 5, 7, 11, 14 and 17 years old during sweep 2-7.

This paper will be using childhood waves from the MCS at age 9 months, 3 years and 11 years. At 9 months and 3 years consent was provided by parents, however at 11 years, consent has been provided by CMs.

In cases where multiple children from one family (MCSID) are identified, the eldest child is selected to be in the analytical sample (Cohort Member number one).

Additionally, throughout the different waves, only those whose mother answered for them in all three waves are also included in the analytical sample.

The analytical sample consists of children who have complete information on aspects of built environment as well as those who have answered all 4 questions associated

with callous and unemotional traits at age 11 (n = 10,302). The neighbourhood-built environment form was completed in the MCS when the participant was aged 3.

Measures

Callous and unemotional traits at age 11 years old

Callous and unemotional traits were measured at age 11 using a self-completion form completed by cohort members. This variable serves as the dependent variable in this study.

The questions used to identify callus and unemotional traits consisted of 4 items. The questions asked are I care how well I do at school; I feel bad or guilty when I have done something wrong, I do not show my emotions to others, I am concerned about the feelings of others. Each item is scored on a 4- point Likert scale of 1 (*Not at all true*), 2 (*Somewhat true*), 3 (*Very true*) and 4 (*Definitely true*). To ensure that higher scores consistently represent greater callous and unemotional traits across all questions, the third question has been reverse-coded. This means that originally high scores indicating more emotional expression have been adjusted in the analysis so that a higher overall score reflects more callous and unemotional traits. A callous and unemotional traits single score was derived using a principal components analysis (PCA). This helped remove dimensionality whilst capturing the variance in data. The higher the PCA score is, the more callous and unemotional traits are expressed by cohort members.

Neighbourhood disorder at 3 years old

In the MCS sweep 2 an assessment of the neighbourhoods-built environment was carried out. This assessment will be used in this paper as the independent variable.

11 items were recorded:

Conditions of the buildings in the neighbourhood ("well kept", "fair", "poor", "badly deteriorated") , presence of security blinds ("none", "some", "most"), presence of traffic calming measures ("yes", "no"), levels of traffic volume ("no", "light", "moderate", "heavy"), burnt-out cars in the street ("yes", "no"), presence of litter in the street or on the pavement ("almost none", "some", "about everywhere"), level of dog mess on the pavement ("none", "some", "a lot"), presence of graffiti on walls or on public spaces ("no", "a little", " a lot"), any evidence of vandalism ("yes", "no"), presence of people arguing or fighting in the street ("no-one seen", "none observed behaving in hostile ways", "yes, one or two arguing", "at least one group of three of more") own feelings in the street ("very comfortable - can imagine living/shopping here", "comfortable – a safe and friendly place", "fairly safe and comfortable", "uncomfortable living/shopping here", "felt like an outsider looked on suspiciously", "felt afraid for my personal safety").

A PCA was used to combine these 11 items into a single score of the immediate area's-built environment. Higher scores represented worse neighbourhood conditions, therefore greater neighbourhood disorder.

Covariates

We controlled for variables that have been previously associated with exposure and outcome. Neighbourhood air pollution was measured using particulate matter smaller than 10 micrometres at ward level from the multiple environmental deprivation index (MEDix).

Ethnicity was measured as a binary variable, categorising CMs as either "White" or "Other." The "White" category included individuals who identified as being of White ethnicity, while the "Other" category encompassed all other ethnic groups, including but not limited to Black Caribbean, Black African, and Black Other or 'Asian' (Indian, Pakistani, and Bangladeshi). This simple classification allowed for a broad comparison between the majority White group and individuals from a diverse range of ethnic backgrounds facilitating analysis of potential ethnic differences in the outcomes of interest.

I also controlled for several key factors in our models, including family poverty status (whether the family was below the poverty line), maternal education (whether the mother had attained a university degree), access to a domestic garden, relative poverty line, substance use during pregnancy (Alcohol and smoking). Maternal mental health was assessed using the 6-item Kessler scale. Additionally, I considered family structure (whether the household was headed by a lone parent), the presence of partner violence (whether the mother’s partner used force in the relationship), and the emotional atmosphere of the home. This included factors such as whether the home environment was quiet enough to “hear yourself think” and whether the child was subjected to physical discipline**.**

Sample bias and missingness

The analytic sample had no missing data on sex, ethnicities, callous and unemotional traits and the measures of the built environment.

Similar to the typical non-response patterns and attrition observed in the Millennium Cohort Study, those excluded from the analytical sample (47.9%) had a less diverse ethnic background. In contrast, individuals included in the analytic sample were more likely to be white (Cohen's d=9.97)

Overall, the built environment conditions reported by the analytical sample varied by approximately 3-7% compared to the non-analytical sample, with the analytical sample generally indicating more favourable conditions. This may be partly due to only those individuals who have complete data on the built environment being included in the analytical sample. Overall, in the analytical sample 3% of the data is missing.

The variable with the most missing data (17.12%) is ‘Whether partner ever used force in relationship’.

For the dependent variable (callous and unemotional traits) children in the analytical and non-analytical sample the answers vary by less than 2%.

2.3 Statistical analysis

Analytic strategy

The analytical strategy taken can be broken down into multiple steps. First, I calculated unweighted, descriptive statistics to be able to see level of missingness and to assess sample bias. To do this, I compared participants in the analytic sample against those in the non-analytical sample. This allowed me to check if there were any systematic reasons for missing data. Next I examined the correlations between the built environment variables and c. ous and unemotional traits variable. I did this by using a principal components analysis (PCA) for both independent and dependent variables.

Finally, I calculated simple and multiple linear regression to analyse the relationship between the built environment and callous-unemotional traits whilst also accounting for covariates.

Statistical methods

I first explored the difference between the analytical (n= 10, 302) and the non-analytical sample (n = 9472) on the study variables at $p < 0.05$.

Categorical variables were compared using chi square tests and continuous variables were compared using one- way analysis of variance test. Correlation between study variables were also studied. The PCA for both neighbourhood disorder and callous and unemotional traits is described in detail as they are both a focus in this paper.

In order to decide if a PCA was useful for callous and unemotional traits, a crohms box analysis (KMO) was carried out. The Kmo value result was 0.64 was indicated that PCA would be useful in this instance.

PCA

PCA is a statistical technique used to reduce the dimensionality of data by transforming it into a set of linearly uncorrelated variables known as principal components.

Callous and Unemotional Traits: The first two components (‘I care about how well I do at school’, ‘I feel bad or guilty when I have done something wrong’) account for about 66.27% of the variance, Emotional expressiveness and concern for others are also important but to a lesser degree.

The Built Environment: The first component (‘Condition of building in neighbourhood’) is the most significant, followed by security measures and traffic conditions. Together, the first four components explain about 64.63% of the variance, indicating that multiple environmental factors contribute significantly to the overall variability in this domain.

Eigenvalue shows the magnitude of variance in the data that a specific principal component explains. A higher eigenvalue indicates that the principal component captures more the of the data’s variability.

Discussion of results

The regression tables have shown that there is a significant relationship between the built environment and callous and unemotional traits.

In the simple linear regression model, the correlation calculated was 0.06. Callous and unemotional traits was the dependent variable. The 95% Confidence Interval (CI) for this coefficient is [0.03, 0.06]. This means that there is a positive relationship between the built environment and the criterion variable (callous and unemotional traits), and this effect is statistically significant (as indicated in table 4). The standardised regression coefficient for the built environment is +0.06. This indicates there is a weak positive relationship between variables. For each standard deviation increase in the built environment, callous and unemotional traits are expected to increase by 0.06 standard deviations. Despite the small magnitude, the relationship is statistically significant meaning the chance of the relationship being due to random chance is low.

To further explore this relationship multiple linear regression was carried out whilst accounting for covariates (table 6).

The results demonstrate that while several predictors have significant relationships with the built environment, their overall impact is relatively small. The model explains a modest portion of the variance, suggesting that other factors not included in the model might also contribute to variations in the built environment. It also similarly shows that the relationship is statistically significant.

Specifically, as the built environment deteriorates, there is a small but significant increase in the expression of callous-unemotional traits. Children residing in more disordered and less favourable environments are more likely to exhibit characteristics

such as a lack of guilt, emotional coldness, or diminished empathy. However, other factors, such as ethnicity and mothers' highest academic qualification, play a substantial role in shaping these traits. These covariates had significant negative effects on the relationship between the built environment and callous and unemotional traits. This means that when these factors are accounted for, the impact of the built environment in these traits is less strong. The relationship between the built environment and callous and unemotional traits changes depends on the child's ethnicity and mother educational level.

Predictors such as sex, harsh discipline (smacking child) and a disorganised home environment show significant relationships with callous and unemotional trats.

Additionally, whilst care has been taken with covariates, a proportion of the variance in results still remains unexplained suggesting there is a presence of other influential factors that could possibly cause the omitted variable bias effect and account for remaining variance.

Next steps

Given the significant statistical relationship observed, further research could investigate additional factors that might influence the relationship between the built environment and callous-unemotional traits. This is due to the covariates explored throughout this paper only accounting for part of the variance in the results. This would help investigate additional factors and reduce the omitted variable bias effect.

These next steps will contribute to a deeper understanding of how the built environment affects psychological outcomes and help inform more effective interventions and policies.

Table 1:

Bias analysis of study variables between analytical (n = 10, 302 (52.1%) and non-analytical (n= 9472 (47.9%))

			Analytical sample		*Non analytical sample*		
Description	**Missing values (NAs)**	**Label**	**Count**	**Percentage**	**count**	**Percentage**	**Chi-square test**
Measured at 9 months							
Sex	0	Male	5082	49.33%	4551	53.7%	Na
		Female	5220	50.67%	3924	46.3%	
Ever tried to breastfeed	324	Yes	7125	71.41%	4925	60.82 %	225.09
Ethnicity	0	White	8784	85.26%	6699	79.49%	21930
		Other	1472	14.27%	1943	20.51%	
Birth weight in kilos (numerical)	14	Mean	3.35kg	-	3.31kg	-	-
Gestation time in days (numerical)	102	Mean	275.80 days	-	275.00	-	-
Does child have access to garden	323	Yes,	9407	91.31%	7997	84.43%	7471.60
		No	867	8.69%	1262	15.57%	
Whether anyone smokes in the same room as cm	319	Yes	1256	12.58%	1210	14.90%	20.288

Description	Missing values (NAs)	Label	Count	Percentage	count	Percentage	Chi-square test
		No	8727	87.42%	6910	85.10%	
Alcohol consumption during pregnancy	326	Yes	3239	31.44%	2399	25.33%	14406
		No	6840	68.56%	6047	74.67%	
Partner ever used force in relationship	1953	Yes	297	3.53%	225	3.69%	6066.3
		No	8052	95.93%	5675	92.99%	
Highest academic qualification (mothers' education)	1589	Other	9823	95.35%	9217	97.31%	3789.9
		Higher Degree	417	4.65%	226	2.69%	
Poverty line	12	Live above poverty Line	7267	70.62%	3171	60.09%	175.41
		Live below poverty Line	3023	29.38%	2108	39.94%	

Description	Missing values (NAs)	Label	Count	Percentage	count	percentage	Chi-square test
Measured at 3 years old.							
Condition of building in neighbourhood	0	Well Kept	5773	56.04%	2211	47.54%	3911

Description	Missing values (NAs)	Label	Count	Percentage	count	percentage	Chi-square test
		Fair Condition	3985	38.68%	2057	44.23%	
		Poor condition	506	4.91%	355	7.63%	
		Badly deteriorated	38	0.37%	28	0.60%	
Presence of security blinds	0	None	9183	89.14	4010	86.22%	6073.6
		Some	992	9.63	553	11.89%	
		Most	127	1.23	88	1.89%	
Volume of traffic	0	No traffic permitted	547	5.31	247	5.31%	528.4
		Light	7693	74.67	3457	74.33%	
		Moderate	1567	15.21	716	15.39%	
		Heavy	495	4.80%	231	4.97%	
Burnt out cars on the street	0	Yes	213	2.07%	123	2.64%	272.42
		No	10089	97.93%	4528	97.36%	
Presence of litter on the street	0	None or almost none	7689	74.64%	3079	66.20%	5050.4
		Yes some	2342	22.73%	1381	29.69%	
		Yes, just about everywhere you look	271	2.63%	191	4.11%	
Presence of graffiti on walls or in public	0	No	9157	88.89%	3909	84.05%	5993.2
		A little	1050	10.19%	683	14.69%	
		A lot	95	0.92%	59	1.27%	
Any evidence of vandalism	0	No	9763	94.77%	4290	92.24%	6392.4

Description	Missing values (NAs)	Label	Count	Percentage	count	percentage	Chi-square test
		Yes	539	5.23%	361	7.76%	
Presence of people arguing or fighting	0	No-one seen in the street or pavement	6477	62.87%	2608	56.07%	4409.7
		None observed behaving in hostile ways	3780	36.64%	1999	42.98%	
		Yes, one or two arguing etc.	30	0.29%	30	0.65%	
		Yes at least one group of three or more	15	0.15%	14	0.30%	
People's own feelings	0	Very comfortable can imagine living/shopping here	3421	33.21%	1130	24.30%	2349.1
		Comfortable - a safe and friendly place	2902	28.17%	1275	27.41%	
		Fairly safe and comfortable	2947	28.17%	1501	32.27%	
		I would be uncomfortable living/shopping here	907	8.80%	646	13.89%	
		I felt like an outsider looked on suspiciously	105	1.02%	80	1.72%	
		I felt afraid for my personal safety	20	0.19%	19	0.41%	
Presence of dog mess on pavement	0	None	9397	91.22%	4129	88.78%	6202.4
		Some	877	8.51%	501	10.77%	
		A lot	28	0.27%	21	0.45%	
Particulate matter decile	1	Least Polluted Decile	6339	61.53%	1933	20.40%	
		Polluted a lot?	3963	38.47%	7540	79.60%	
		Somewhat true	3944	37.38%	682	34.07%	

Description	Missing values (NAs)	Label	Count	Percentage	count	percentage	Chi-square test
		Very true	1818	17.23%	389	19.43%	
		Definitely true	423	4.00%	88	4.40%	
Ignore child if being naughty	1788	No	1832	6.55%	988	23.23%	4903.1
		Yes	7956	93.45%	7272	76.77%	
How often smacks cm when naughty	1586	No	2854	32.26%	1485	34.91%	7098.1
		Yes	5904	67.74%	6165	65.09%	
How often shouts at cm when naughty	1620	No	255	2.88%	172	4.04%	5321.2
		Yes	8431	97.12%	9089	95.96%	
How often sends cm to bedroom when naughty	1565	No	2130	24.08%	1098	25.81%	5082.4
		Yes	6633	75.92%	7027	74.19%	
Takes away treats if child is being naughty	1456	No	1193	13.49%	1408	14.87	4113.7
		Yes	7880	86.51%	8064	85.13%	
How often tells cm off when being naughty	1688	No	51	0.58%	55	1.29%	5023.1
		Yes	8564	99.42%	9350	98.71%	
How often bribes cm when naughty	1702	No	2544	28.75%	1345	31.62%	5986.3
		Yes	6143	71.43%	6477	63.38%	
Atmosphere of home, really disorganised	1672	Agree	204	2.36%	125	2.50%	4447.8
		Disagree	8426	97.64%	9235	97.50%	

Description	Missing values (NAs)	Label	Count	Percentage	count	percentage	Chi-square test
Atmosphere of home cannot hear yourself think	2241	Agree	219	2.20%	160	3.20%	3581.1
		Disagree	7884	97.80%	9169	96.8%	

Measured at 11 years old

I care about how well I do at school	0	Not at all true	6095	57.77%	1190	59.44%	6.5
		Somewhat true	3192	30.26%	552	27.57%	
		Very true	1078	10.22%	217	10.84%	
		Definitely true	185	1.75%	43	2.15%	
I feel bad or guilty when I have done something wrong	0	Not at all true	5065	48.01%	969	48.40%	9.9
		Somewhat true	3714	35.20%	647	32.32%	
		Very true	1407	13.34%	303	15.13%	
		Definitely true	364	3.45%	83	4.15%	
I do not show my emotions to others	0	Not at all true	2517	23.86%	482	24.08%	9.4
		Somewhat true	4895	46.40%	849	42.41%	
		Very true	2022	19.17%	303	15.13%	
		Definitely true	1116	10.58%	83	4.15%	
I am concerned about the feelings of others	0	Not at all true	4365	41.37%	843	42.11%	10.6

Table 2:

Correlation matrix for numerical variables

Variable	*M*	*SD*	1	2	3	4
1. Birth weight (Kg)	0.31	0.46	-.47 [-.96, .70]			
2. Gestation period (days)	0.30	0.46	-.51 [-.96, .68]	.77 [-.35, .98]		
3. Kessler's depression scale	0.18	0.46	-.08 [-.90, .86]	-.47 [-.96, .71]	-.41 [-.95, .74]	-.44 [-.95, .72]

Note. M and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * Indicates $p < .05$. ** indicates $p < .01$.

Table 3: PCA Results for Callous and Unemotional Traits

Principal Component for callous and unemotional traits	Eigenvalue	Proportion of Variance	Cumulative Proportion
I care about how well I do at school	1.6513344	0.4128336	0.4128336
I feel bad or guilty when I have done something wrong	0.9996625	0.2499156	0.6627492
I do not show my emotions to others	0.6809014	0.1702254	0.8329746
I am concerned about the feelings of others	0.6681017	0.1670254	1.0000000

Table 4: PCA Results for the Built environment

Principal Component for the built environment	Eigenvalue	Proportion of Variance	Cumulative Proportion
Condition of building in neighbourhood	3.5023656	0.35023656	0.3502366
Presence of security blinds	1.1051784	0.11051784	0.4607544
Volume of traffic	0.9765591	0.09765591	0.5584103
Burnt out cars on the street	0.8788455	0.08788455	0.6462949
Presence of litter on the street	0.8121483	0.08121483	0.7275097

Principal Component for callous and unemotional traits	Eigenvalue	Proportion of Variance	Cumulative Proportion
Presence of graffiti on walls or in public	0.7811523	0.07811523	0.8056249
Any evidence of vandalism	0.6454049	0.06454049	0.8701654
Presence of people arguing on fighting	0.5047592	0.05047592	0.9206413
People’s own feelings	0.4779971	0.04779971	0.9684410
Presence of dog mess on pavement	0.3155896	0.03155896	1.0000000

Table 5:

Simple Regression results using Callous and unemotional traits as the criterion n=10,302

Predictor	*b*	*b* 95% CI [LL, UL]	*beta*	*beta* 95% CI [LL, UL]	sr^2	sr^2 95% CI [LL, UL]	*r*	Fit
(Intercept)	0.00	[-0.02, 0.03]						
PC1	0.05**	[0.03, 0.06]	0.07	[0.05, 0.09]	.00	[.00, .01]	.07**	
								R^2 = .004** 95% CI [.00,.01]

Note. A significant *b*-weight indicates the beta-weight and semi-partial correlation are also significant. *b* represents unstandardized regression weights. *beta* indicates the standardized regression weights. sr^2 represents the semi-partial correlation squared. *r* represents the zero-order correlation. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively.
* indicates $p < .05$. ** indicates $p < .01$.

Table 6:

Regression results using callous and unemotional traits as the criterion n=7317

Predictor	*b*	*b* 95% CI [LL, UL]	*beta*	*beta* 95% CI [LL, UL]	sr^2	sr^2 95% CI [LL, UL]	*r*	Fit
(Intercept)	1.68**	[0.92, 2.44]						
Built environment	0.03**	[0.01, 0.05]	0.04	[0.02, 0.07]	.00	[-.00, .00]	.06**	
Sex	-0.52**	[-0.58, -0.46]	-0.21	[-0.23, -0.19]	.04	[.03, .05]	-.21**	
Breastfed	0.03	[-0.03, 0.10]	0.01	[-0.01, 0.03]	.00	[-.00, .00]	.04**	
Ethnicity	-0.06**	[-0.08, -0.03]	-0.05	[-0.07, -0.03]	.00	[.00, .00]	-.05**	
Gestation period	-0.00	[-0.00, 0.00]	-0.01	[-0.04, 0.02]	.00	[-.00, .00]	-.02	
Access to Garden	-0.02	[-0.08, 0.04]	-0.01	[-0.03, 0.01]	.00	[-.00, .00]	.00	
Smoking around baby	-0.13*	[-0.22, -0.03]	-0.03	[-0.05, -0.01]	.00	[-.00, .00]	-.07**	
Alcohol consumption during pregnancy	-0.00	[-0.03, 0.02]	-0.00	[-0.02, 0.02]	.00	[-.00, .00]	-.00	
Force in relationship	-0.03	[-0.15, 0.09]	-0.01	[-0.03, 0.02]	.00	[-.00, .00]	-.00	
Mothers Education	0.00**	[0.00, 0.00]	0.03	[0.01, 0.06]	.00	[-.00, .00]	.06**	
Particulate matter	-0.02**	[-0.03, -0.01]	-0.04	[-0.07, -0.02]	.00	[-.00, .00]	-.05**	
Really disorganised atmosphere of home	-0.04*	[-0.07, -0.01]	-0.03	[-0.05, -0.01]	.00	[-.00, .00]	-.07**	
Cannot hear yourself think in home	-0.05**	[-0.08, -0.01]	-0.04	[-0.06, -0.01]	.00	[-.00, .00]	-.08**	
Takes away treat if child is naughty	0.01	[-0.02, 0.03]	0.01	[-0.02, 0.03]	.00	[-.00, .00]	.04**	
Ignore child if naughty	0.01	[-0.01, 0.03]	0.01	[-0.01, 0.04]	.00	[-.00, .00]	.03*	
Smacks child	0.05**	[0.02, 0.08]	0.04	[0.01, 0.06]	.00	[-.00, .00]	.07**	
Shouts at child	0.02	[-0.01, 0.05]	0.02	[-0.01, 0.04]	.00	[-.00, .00]	.05**	

Sends child to room	-0.00	[-0.02, 0.02]	-0.00	[-0.03, 0.02]	.00	[-.00, .00]	.04**	
How often tells of child when naughty	-0.02	[-0.05, 0.02]	-0.01	[-0.04, 0.01]	.00	[-.00, .00]	.03*	
How often bribes child when naughty	0.01	[-0.01, 0.03]	0.01	[-0.01, 0.03]	.00	[-.00, .00]	.02*	
Relative Poverty Line	0.09*	[0.01, 0.17]	0.03	[0.00, 0.05]	.00	[-.00, .00]	.06**	
Kessler's depression scale	0.00	[-0.01, 0.01]	0.00	[-0.02, 0.03]	.00	[-.00, .00]	.04**	
Birth weight	-0.05	[-0.11, 0.01]	-0.02	[-0.05, 0.00]	.00	[-.00, .00]	-.00	
								R^2 = .067** 95% CI [.05,.08]

Note. A significant *b*-weight indicates the beta-weight and semi-partial correlation are also significant. *b* represents unstandardized regression weights. *beta* indicates the standardized regression weights. sr^2 represents the semi-partial correlation squared. *r* represents the zero-order correlation. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively.
* indicates $p < .05$. ** indicates $p < .01$.

Table 7: Pearsons Correlation matrix of variables in analytical sample

PCA1	PC1	AHCSEX00	ACBFEV00	ACIMAN00	ACIMMU00	ACADMO00	ADC11E00	ADBWGT00	ADGEST00	APLPEV0M	APGDAC00	APILPR00	APOBCO00	APSMUS0A	APSMKR00	APDROF00	APFORC00	APACQU00	APVCQU00	BPWSO2D	BPWPM10D	BPWNO2D
--	r = 0.07***	r = -0.21***	r = 0.06***	r = -0.01	r = 0.03*	r = 0.01	r = -0.04***	r = -0.01	r = -0.02*	r = -0.02	r = 0.01	r = 0.00	r = 0.01	r = 0.04***	r = -0.07***	r = 0.00	r = 0.00	r = 0.06***	r = 0.03**	r = -0.02*	r = -0.05***	r = -0.05***
r = 0.07***	--	r = -0.01	r = 0.16***	r = 0.02*	r = 0.08***	r = -0.01	r = 0.22***	r = -0.08***	r = -0.01	r = -0.11***	r = 0.23***	r = 0.00	r = 0.00	r = 0.08***	r = -0.22***	r = 0.09***	r = -0.01	r = 0.27***	r = 0.16***	r = 0.16***	r = 0.19***	r = 0.20***
r = -0.21***	r = -0.01	--	r = 0.03**	r = 0.00	r = -0.01	r = -0.06***	r = 0.00	r = -0.10***	r = 0.01	r = 0.02	r = 0.01	r = 0.00	r = 0.01	r = -0.02	r = -0.01	r = 0.03*	r = -0.01	r = 0.02*	r = 0.00	r = 0.01	r = 0.00	r = 0.00
r = 0.06***	r = 0.16***	r = 0.03**	--	r = -0.01	r = 0.03**	r = -0.01	r = -0.12***	r = -0.04***	r = -0.02	r = -0.04***	r = 0.02	r = 0.00	r = -0.01	r = 0.06***	r = -0.18***	r = 0.07***	r = 0.01	r = 0.16***	r = 0.09***	r = 0.06***	r = -0.10***	r = -0.09***
r = -0.01	r = 0.02*	r = 0.00	r = -0.01	--	r = NaNNA	r = 0.00	r = 0.02	r = -0.01	r = -0.01	r = 0.00	r = 0.04***	r = 0.01	r = 0.01	r = 0.00	r = -0.01	r = -0.01	r = -0.03**	r = 0.00	r = 0.01	r = 0.01	r = 0.04***	r = 0.03**
r = 0.03*	r = 0.08***	r = -0.01	r = 0.03**	r = NaNNA	--	r = 0.02*	r = 0.02	r = -0.02*	r = -0.02	r = -0.05***	r = 0.02*	r = -0.02	r = 0.01	r = 0.03**	r = -0.09***	r = -0.01	r = -0.02	r = 0.08***	r = 0.04***	r = 0.02*	r = 0.02*	r = 0.02*
r = 0.01	r = -0.01	r = -0.06***	r = -0.01	r = 0.00	r = 0.02*	--	r = -0.04***	r = -0.02*	r = -0.05***	r = -0.03*	r = 0.02	r = -0.09***	r = 0.01	r = 0.00	r = -0.01	r = -0.02*	r = 0.00	r = -0.03**	r = -0.04***	r = 0.04***	r = 0.05***	r = 0.04***
r = -0.04***	r = 0.22***	r = 0.00	r = -0.12***	r = 0.02	r = 0.02	r = -0.04***	--	r = -0.12***	r = -0.03**	r = -0.05***	r = 0.21***	r = 0.03***	r = 0.00	r = -0.02	r = 0.05***	r = 0.13***	r = 0.02*	r = 0.22***	r = 0.12***	r = 0.06***	r = 0.35***	r = 0.37***
r = -0.01	r = -0.08***	r = -0.10***	r = -0.04***	r = -0.01	r = -0.02*	r = -0.02*	r = -0.12***	--	r = 0.60***	r = 0.03**	r = -0.04***	r = 0.08***	r = -0.03***	r = -0.05***	r = 0.05***	r = -0.06***	r = -0.01	r = -0.09***	r = -0.03**	r = -0.05***	r = -0.09***	r = -0.10***
r = -0.02*	r = -0.01	r = 0.01	r = -0.02	r = -0.01	r = -0.02	r = -0.05***	r = -0.03**	r = 0.60***	--	r = 0.02	r = 0.00	r = 0.14***	r = -0.05***	r = 0.00	r = -0.01	r = -0.04***	r = -0.01	r = -0.02	r = -0.01	r = -0.02	r = -0.02	r = -0.03**
r = -0.02	r = -0.11***	r = 0.02	r = -0.04***	r = 0.00	r = -0.05***	r = -0.03*	r = -0.05***	r = 0.03**	r = 0.02	--	r = -0.12***	r = 0.02	r = 0.00	r = -0.05***	r = 0.10***	r = -0.01	r = 0.00	r = -0.05***	r = -0.02*	r = -0.02*	r = -0.03**	r = -0.04***
r = 0.01	r = 0.23***	r = 0.01	r = 0.02	r = 0.04***	r = 0.02*	r = 0.02	r = 0.21***	r = -0.04***	r = 0.00	r = -0.12***	--	r = 0.02*	r = 0.00	r = 0.03**	r = -0.07***	r = 0.04***	r = 0.00	r = 0.11***	r = 0.09***	r = 0.02	r = 0.12***	r = 0.15***
r = 0.00	r = 0.00	r = 0.00	r = 0.00	r = 0.01	r = -0.02	r = -0.09***	r = 0.03***	r = 0.08***	r = 0.14***	r = 0.02	r = 0.02*	--	r = -0.03*	r = -0.02*	r = 0.01	r = -0.02*	r = 0.01	r = 0.04***	r = 0.05***	r = -0.01	r = 0.01	r = 0.00
r = 0.01	r = 0.00	r = 0.01	r = -0.01	r = 0.01	r = 0.01	r = 0.01	r = 0.00	r = -0.03***	r = -0.05***	r = 0.00	r = 0.00	r = -0.03*	--	r = 0.00	r = 0.00	r = 0.00	r = 0.00	r = 0.01	r = 0.02	r = 0.00	r = -0.01	r = -0.01
r = 0.04***	r = 0.08***	r = -0.02	r = 0.06***	r = 0.00	r = 0.03**	r = 0.00	r = -0.02	r = -0.05***	r = 0.00	r = -0.05***	r = 0.03**	r = -0.02*	r = 0.00	--	r = -0.09***	r = -0.06***	r = -0.01	r = 0.06***	r = 0.02	r = 0.00	r = -0.01	r = -0.02
r = -0.07***	r = -0.22***	r = -0.01	r = -0.18***	r = -0.01	r = -0.09***	r = -0.01	r = 0.05***	r = 0.05***	r = -0.01	r = 0.10***	r = -0.07***	r = 0.01	r = 0.00	r = -0.09***	--	r = 0.00	r = 0.01	r = -0.16***	r = -0.08***	r = -0.05***	r = 0.02	r = 0.01
r = 0.00	r = 0.09***	r = 0.03*	r = 0.07***	r = -0.01	r = -0.01	r = -0.02*	r = 0.13***	r = -0.06***	r = -0.04***	r = -0.01	r = 0.04***	r = -0.02*	r = 0.00	r = -0.06***	r = 0.00	--	r = 0.04***	r = 0.10***	r = 0.05***	r = 0.04***	r = 0.03**	r = 0.03**

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