

Title: Life Course Socioeconomic Determinants of Early Adulthood Cognition

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Intro: Memory performance is a primary component of overall cognitive ability and an important factor in the health and well-being of an individual. Short-term and working memory, two important measures of total memory ability, are necessary in order to carry out the everyday functions of life (Morgan et al. 2013), and lower levels of short-term and working memory in the early life course are associated with increased risk of developing dementia and Alzheimer's disease later in life (Peterson 2004). Though a bulk of the research on memory performance has focused on older populations with more visible cognitive deterioration, decline in both short-term and working memory can be seen as early as the late-twenties (Hartshorne and Germine 2015). Considering the predictive ability early-life memory impairment has on later life dementia and Alzheimer's disease diagnosis, understanding determinants of memory performance in early adulthood is necessary.

According to the Cognitive Reserve Hypothesis (Stern 2002), exposure to mentally stimulating environments in the early life course can increase the cognitive reserve of an individual. Higher levels of cognitive reserve can help to buffer against the natural deterioration of cognitive ability as people age, thus delaying symptoms of memory decline for individuals with higher past exposure to these stimulating environments. Though many activities and social experiences have been theorized to act as "stimulating environments" (Fratiglioni and Wang 2007), this study will focus on factors associated with the classification of one's socioeconomic status (SES); educational attainment, occupational status, and economic capital. Educational attainment is positively associated with performance on cognitive tests (Farfel et al. 2013), and time spent in education is perhaps the best example of being in a "stimulating environment" (Stern 2012). Work complexity can also increase cognitive reserve, with higher mental demand, challenge, and control being associated with higher cognitive ability (Fratiglioni and Wang 2007). Increased economic capital, while not a direct measure of time spent in a mentally stimulating environment, allows individuals to engage in stimulating activities known to be associated with increased cognitive reserve, such as recreational social and physical activity (Ibid). Additionally, stress due to poverty and economic hardship is known to negatively impact cognitive abilities (Mani et al. 2013), and the role of higher economic capital in determining well-being through increased access to health promoting resources can delay disease onset for many morbidities, including cognitive decline (Phelan et al. 2010).

In addition to measures of SES in adulthood that are known to determine cognitive reserve, these same factors in childhood, as measured by the SES of one's parent(s), can also determine cognitive reserve and cognitive ability later in the life course (Lyu and Burr 2016). What remains to be determined, at least in younger adult populations, is the pathway through which early life social conditions impact later cognitive ability. This study uses parent-reported prospective data collected when respondents were in childhood to investigate the possible independent effects of SES at multiple times during the life course on cognitive ability. Ultimately, the goal of this study is to determine the multiple life course measures of environment and SES that are associated with cognitive ability in early adulthood, a time in the life course for which little cognitive research has been done.

Data: Data come from the National Longitudinal Study of Adolescent to Adult Health (Add Health) (Harris et al. 2009). Information on cognitive ability was collected in 2008, during Wave IV of the project when respondents were between the ages of 24 and 32. Information on educational attainment, work environment, and economic capital were also collected at this time. At Wave I, in 1994, parents of the respondents were given a survey in which they were asked about the household SES of the respondent.

Variables: Dependent variables: Short-term memory is measured by the sum of two word-recall tasks in which respondents were asked to recall 15 words read to them from a word bank, once right after hearing them (immediate recall) and again about five minutes later (delayed recall). Working memory is measured by a task in which respondents were asked to recall sets of numbers in the reverse order in which they were read. Number sets became increasing longer as the task continued.

Independent variables: Respondent educational attainment is measured by highest level of school achieved. Occupational environment is measured by three variables. The first, *Work Complexity* is a measure of how repetitive a job is, with higher values indicating lower levels of repetition. The second, *Work Control* is a measure of how free a respondent is to decide how to do their job. The third, *Work Rank* is a measure of how many people a respondent supervises at work. Respondent household income and assets are measured in 1,000s of dollars, while *Welfare Receipt* is a marker of whether the respondent has received or is receiving welfare. *Parent Education*, *Parent Income*, and *Parent Welfare*, collected at Wave I from the parents of the respondents, are measured in the same manner as they were for the respondents.

Controls: Controls were added in each model for age, childhood IQ, gender, race/ethnicity, immigrant status, marital status, and BMI. Flags were also included to indicate whether the respondent was still in school or unemployed at the time of the Wave IV data collection.

Table 1 describes the focal variables.

Results: Because of the high level of missingness within the data, particularly for the SES variables of interest, multiple imputation was carried out using the MI suite in Stata 15 (StataCorp 2017). Missing values were imputed for all independent variables except those listed as control variables. **Table 2** shows the OLS regression results for short-term memory. In Model 1, the parental variables were added to the model, and only parental education was associated with short-term memory. In Model 2, respondent education was added. Inclusion of this variable explained much of the relationship between parental factors and short-term memory. In Model 3, occupational variables were added. Only *Work Complexity* was significantly associated with short-term memory. In the final model, Model 4, economic capital variables were added, and only income was associated with the dependent variable. Across all models, having a parent with a college degree, all levels of respondent education, work complexity and income were positively associated with short-term memory in early adulthood. As seen in **Table 3**, the same modeling strategy was used to look at the dependent variable of working memory. Results here mirror what was found when looking at short-term memory, however after inclusion of the occupational variables, parental education was no longer associated with working memory ability in early adulthood.

Discussion: These preliminary findings show that the multiple facets of what we usually define as “SES” can have independent effects on cognitive ability, and that these differences in cognitive ability appear as early as early adulthood. These findings are in line with the arguments of the Cognitive Reserve Hypothesis, as well as data that has shown memory ability to peak around the same time as the transition into adulthood, before slowly declining for the remainder of the life course. Education appears to have the largest effect, while having a job that is not repetitive is also protective for memory ability. Looking at life course models of health and aging, these results support a pathway model of life-course health and SES (Pudrovska and Anikputa 2014), in which early life circumstances lead to adulthood status attainment, which in turn predicts health outcomes.

Future Directions: Building off these preliminary results, future work on this project will be to investigate the potential interaction effects between the SES focal variables to see if there are additional protective effects for having both high education and a complex job in addition to the positive effects of both independently. Additionally, in order to create more detailed measures of work complexity, control, and rank, information on the exact occupation of Add Health respondents will be linked with outside data that more accurately measures the mental stimulation that results from working in a particular occupation.

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Short-Term Memory	Continuous
Working Memory	Continuous
Parent Education	Categorical: Less than HS, High School Diploma, Some College, College Degree
Parent Income	Continuous, log transformed to account for a right skew
Parent Welfare	Dichotomous: 0=No, 1=Yes
Respondent Education	Categorical: Less than HS, High School Diploma, Some College, College Degree
Work Complexity	Continuous
Work Control	Continuous
Work Rank	Continuous
Income	Continuous
Assets	Continuous
Welfare Receipt	Dichotomous: 0=No, 1=Yes

Table 2: Ordinary Least Squared Regression of Short-Term Memory on Early Life Factors, Educational Attainment, Occupational Factors, and Socioeconomic Status

	Model 1		Model 2		Model 3		Model 4		
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	
Parental Education									
Less than High School	0	-	0	-	0	-	0	-	
High School Degree	0.33	0.18	0.25	0.19	0.26	0.19	0.25	0.19	
Some College	0.53	0.19 **	0.36	0.19	0.36	0.19	0.34	0.19	
College Degree	0.70	0.18 ***	0.41	0.18 *	0.40	0.18 *	0.38	0.18 *	
(log)Parent Income (1,000s)	0.06	0.04	0.04	0.04	0.03	0.04	0.02	0.04	
Parent Welfare	-0.03	0.16	0.11	0.16	0.12	0.16	0.18	0.16	
Respondent Education									
Less than High School			0	-	0	-	0	-	
High School Degree			0.65	0.17 ***	0.64	0.17 ***	0.59	0.17 **	
Some College			1.14	0.16 ***	1.12	0.16 ***	1.04	0.15 ***	
College Degree			1.63	0.17 ***	1.57	0.17 ***	1.43	0.17 ***	
Occupation									
Work Complexity					0.11	0.05 *	0.09	0.05 *	
Work Control					0.05	0.04	0.04	0.06	
Work Rank					0.05	0.06	0.03	0.06	
Socioeconomic Status									
Income (1,000s)							0.00	0.00 *	
Assets (1,000s)							0.00	0.00	
Welfare Receipt							-0.17	0.10	
Conditional r2	.119		.133		.134		.139		
n	13,922		13,922		13,922		13,922		

$p \leq .05 = *$, $p \leq .01 = **$, $p \leq .001 = ***$

All models control for Age, Childhood IQ, Gender, Race/Ethnicity, Immigrant Status, Marital Status, BMI, School Enrollment, and Unemployment

Table 3: Ordinary Least Squared Regression of Working Memory on Early Life Factors, Educational Attainment, Occupational Factors, and Socioeconomic Status

	Model 1		Model 2		Model 3		Model 4		
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	
Parental Education									
Less than High School	0	-	0	-	0	-	0	-	
High School Degree	0.12	0.07	0.10	0.07	0.10	0.07	0.10	0.07	
Some College	0.21	0.08 **	0.14	0.08	0.14	0.08	0.14	0.08	
College Degree	0.25	0.07 ***	0.14	0.07 *	0.14	0.07	0.13	0.07	
(log)Parent Income (1,000s)	0.04	0.02 *	0.02	0.02	0.02	0.02	0.02	0.02	
Parent Welfare	-0.01	0.07	0.04	0.07	0.05	0.07	0.06	0.07	
Respondent Education									
Less than High School			0	-	0	-	0	-	
High School Degree			0.17	0.07 *	0.16	0.07 *	0.15	0.07 *	
Some College			0.39	0.07 ***	0.38	0.07 ***	0.35	0.07 ***	
College Degree			0.60	0.07 ***	0.57	0.07 ***	0.52	0.07 ***	
Occupation									
Work Complexity					0.05	0.02 *	0.04	0.02 *	
Work Control					0.03	0.02	0.03	0.02	
Work Rank					-0.01	0.03	-0.02	0.03	
Socioeconomic Status									
Income (1,000s)							0.00	0.00 ***	
Assets (1,000s)							0.00	0.00	
Welfare Receipt							0.00	0.04	
Conditional r2	.099		.111		.112		.115		
n	13,953		13,953		13,953		13,953		

$p \leq .05 = *$, $p \leq .01 = **$, $p \leq .001 = ***$

All models control for Age, Childhood IQ, Gender, Race/Ethnicity, Immigrant Status, Marital Status, BMI, School Enrollment, and Unemployment