

The long-run impact of early childhood intervention on non-cognitive skills ?

Evidence from a randomized experiment in Montreal using administrative data

Seminar INRICH, May 27th, 2024

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Presentation from series of articles with Elisabeth Beasley (Cepremap), Sylvana Côté , Richard Tremblay Franck Vitaro (Univ. Montréal Sainte-Justine Hospital) Including AER (2022)

Introduction

- Recent research shows that non-cognitive skills are associated with key life outcomes
- What is the ability of policy intervention to remediate non-cognitive skills deficits?
- Optimal time of intervention? Is school entry too late ?
- Long-term impact during adolescence and adulthood? Channels ?

What do we do ?

- Montreal Longitudinal Experimental Study
 - Randomized early childhood intervention at age 7-9 years, specifically targeted at non-cognitive skills *deficit*
 - Training in *self-control and social skills solely*
 - Longitudinal data on (non)-cognitive skills at age 10-17 years
 - Long-term outcomes: education, crime, employment, social capital

What do we do ?

- **Matching with Administrative Data :**

- **Statistic Canada – Tax returns from age 20-39:**
 - **Economics:** Employment, Earnings, Social Transfer,
 - **Social outcomes:** composition of household, professional organizations ...
- **Ministry of education – Quebec : secondary school degree**
- **Ministry of Justice – Quebec: Number of criminal offenses at age 24 for each subject**

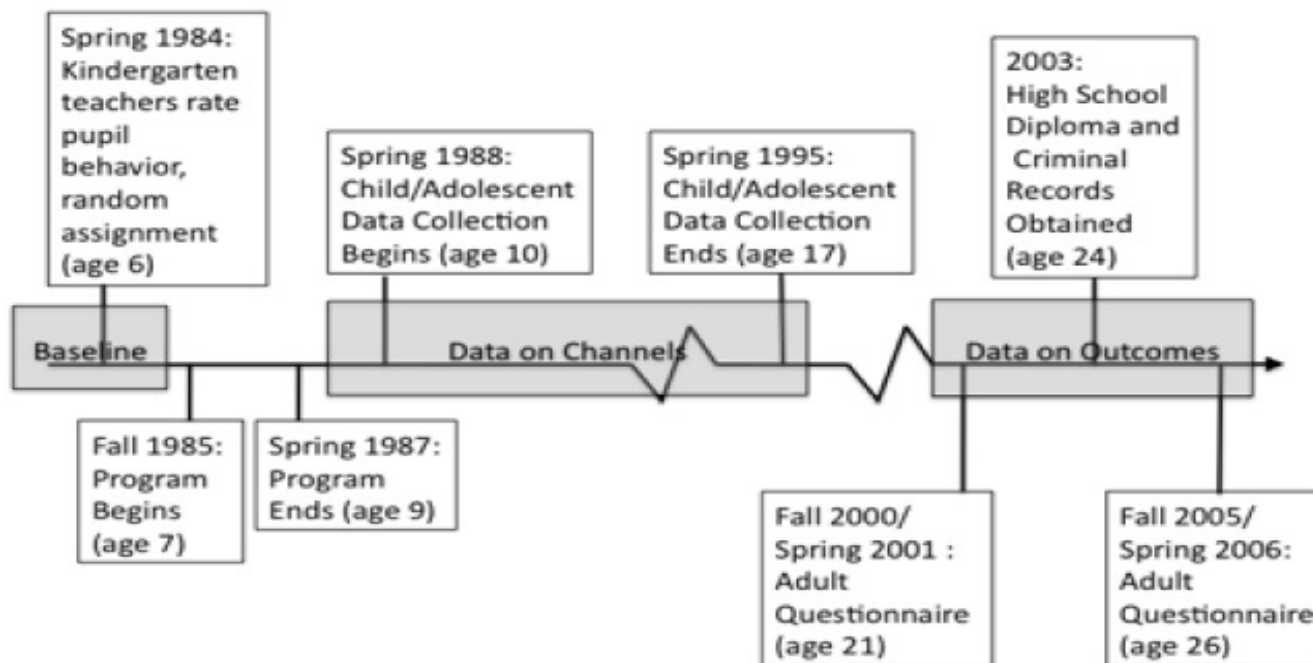
OUTLINE

- ① Introduction
- ② Montreal Longitudinal Experimental Study
- ③ Validity
- ④ Outcomes
 - ① Early Adolescent
 - ② Late Adolescent
 - ③ Parent
 - ④ Adult
- ⑤ Mechanisms
- ⑥ Cost-efficiency and Rate of Return
- ⑦ Conclusion

MLEs - Program Content

- Spring 1984: 1037 boys in kindergarten (age 6 years) evaluated by teachers using standardized behavioral inventory
- Randomized trial for the most disruptive: N=250, T=69, C=181
 - Data collected on larger non-disruptive group as well
- Two year intensive program: age 7-9 years
- Followed yearly from 10-17 years old
 - Psychological indicators, activities, behavior, grades (self, teacher)
- Administrative data on criminal record and secondary school completion + Self-reported socio-eco at age 17-26 years

EXPERIMENTAL DESIGN



Example:

Child component on self-control

- Session format: Example
 - Topic introduction and discussion : Self-Control
 - Example and presentation of strategies:
 - (Facilitator) I got tagged out first
 - Notice: I'm angry and disappointed, my body feels hot, I know an outburst is coming
 - Think why: I got tagged first, other kids will laugh
 - Chose how to avoid an angry outburst: count to ten, move away, tell myself to calm down, breathe
 - Act and praise myself
 - Role playing: Children perform other examples (bumped desk at school, someone turns off TV at home...)
 - "Homework": worksheet sent home to parents to reinforce

Child component on self-control

I identify



I think



I choose



I act and feel good about what I have done



Validity of the experiment

- Validity of the experimental design
 - 4 out of 32 variables measured at baseline are different (10%), included in controls (anxiety of father, age of father at birth, mother's employment, nb sisters)
- Attrition rate:
 - Little or no attrition in adolescent outcome data
 - Attrition rate is nil for criminal record and secondary education completion (admin data)

Table 1. Baseline characteristics and randomization check

	Non-disruptive mean	Control			Disruptive			Difference	
		mean	N	sd	mean	N	sd	C-T	p-value
Age	6.00	6.03	181	0.30	5.97	69	0.29	0.05	0.20
Attended pre-school	0.16	0.21	181	0.41	0.19	69	0.40	0.02	0.71
Age of mother	25.69	23.99	180	4.18	24.01	68	4.71	-0.02	0.97
Age of father	28.67	26.90	161	5.34	28.28	56	5.33	-1.38	0.10
Mother education	10.67	9.97	180	2.23	9.90	68	2.28	0.07	0.83
Father education	10.81	9.70	160	2.45	9.93	60	2.42	-0.24	0.52
# of children in HH	1.14	0.97	181	0.90	1.07	68	0.80	-0.10	0.42
Adversity index	0.30	0.43	181	0.24	0.43	68	0.27	-0.00	0.96
Mother works	1.61	1.73	177	0.45	1.78	68	0.42	-0.05	0.42
Father works	1.12	1.21	148	0.41	1.20	49	0.41	0.01	0.86
Mother job prestige	39.35	36.03	161	11.02	33.16	60	10.13	2.87	0.08
Father job prestige	40.74	35.19	156	9.58	35.22	53	9.83	-0.03	0.99
Initial Aggression	4.00	14.51	181	4.78	14.62	69	4.58	-0.11	0.86
Initial Anxiety	2.65	3.55	181	2.73	4.26	69	2.82	-0.71	0.07
Initial Opposition	1.63	5.62	181	2.19	5.81	69	1.93	-0.19	0.53
Initial Prosociality	8.21	6.52	181	4.79	6.99	69	4.51	-0.47	0.49
Initial Combativeness	0.82	3.53	181	1.59	3.48	69	1.54	0.05	0.83
Initial Inattention	2.23	4.19	181	2.35	4.19	69	2.18	0.01	0.99
Initial Hyperactivity	0.98	2.79	180	1.21	2.96	68	1.19	-0.16	0.35
Initial Antisociality	0.84	0.99	181	1.11	1.21	68	1.23	-0.21	0.20

Data from MLES baseline data collection, 1984 (prior to randomization and program implementation). A joint significance test is not significant ($p=0.34$). The non-disruptive group is composed of those children who scored below the 70th percentile of anti-social behavior on the initial questionnaire in 1984. This non-disruptive group did not participate in the randomized evaluation and serves as a reference group. Those who scored above the 70th percentile were randomized into either the treatment or control groups.

Identification of skills during adolescence

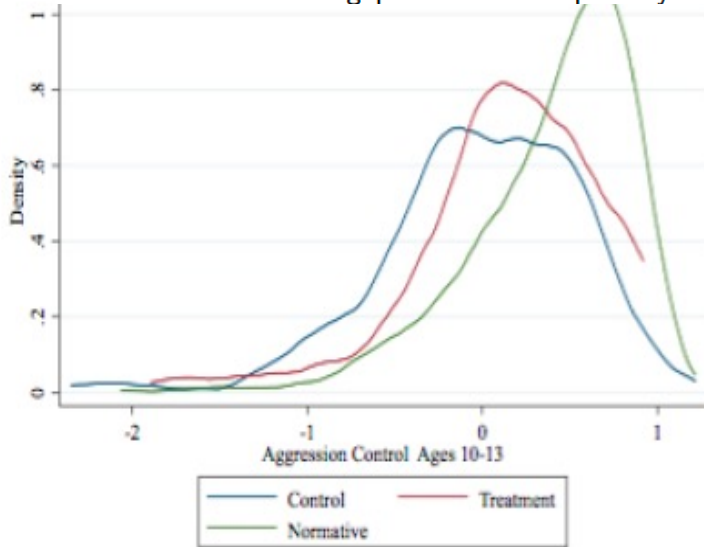
- Yearly data on cognitive and non-cognitive measures, ages 10-17
 - Thousands of observations (psychological scales, behaviors, grades)
 - Teacher and subject reported
 - No attrition and balance sample for most indicators
 - Data (from subject) on parent behavior
- Identify channels using EFA
- Divide into two periods: 10-13 and 14-17 (year where the divergence in “held back” starts), Early and Late Adolescence
- Channel = average of z-scores
 - PCA gives similar results

Adolescent outcomes

- Behavioral Skills
 - Self-control:
 - Attention-Impulse Control: Easily distracted, cannot concentrate,
 - Aggression Control: Bullying, fighting, vandalism
 - Social Skills :
 - Trust: Trust (others, strangers...) + Perspective taking (Angry when bumped by accident ...)
 - Friendship: Interactions with best friends, parents
 - Altruism: Helps others, cleans up messes..
- Cognitive skills and school performance: IQ (age 10/11) yearly grades in Math and French, Held back, Special education
- Group Membership (Late Adolescence only)
- Additional skills: Self-esteem, Emotional well-being....

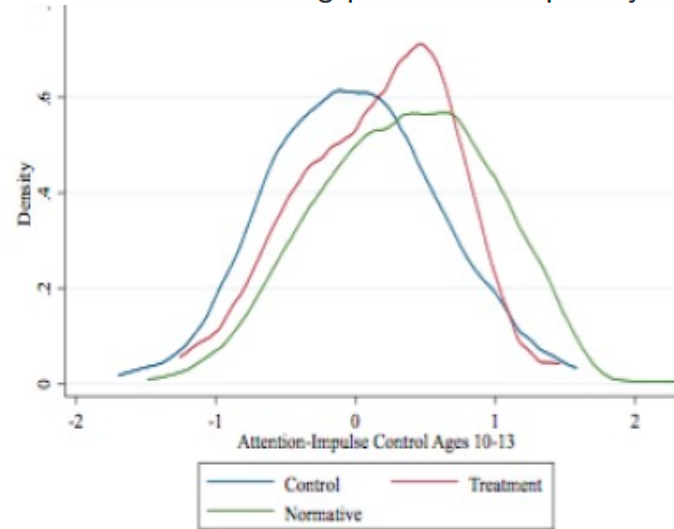
Illustration: Early adolescence self-control and trust

Treatment reduced the gap with non-disruptive by 36%



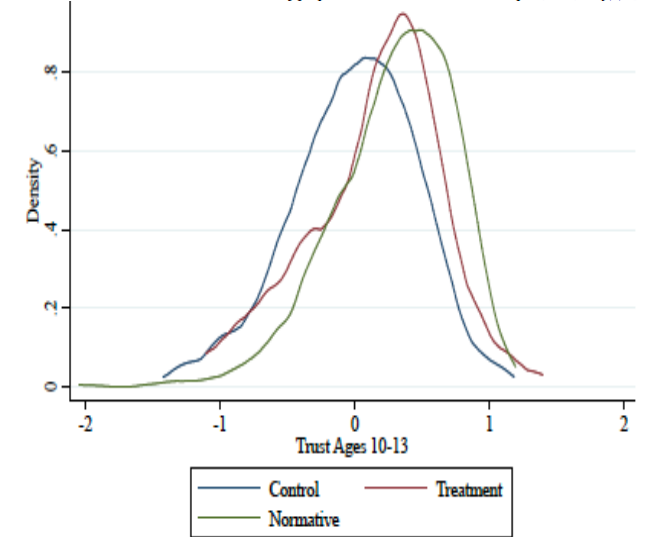
KS p-value=0.04; ttest p-value=0.05

Treatment reduced the gap with non-disruptive by 60%



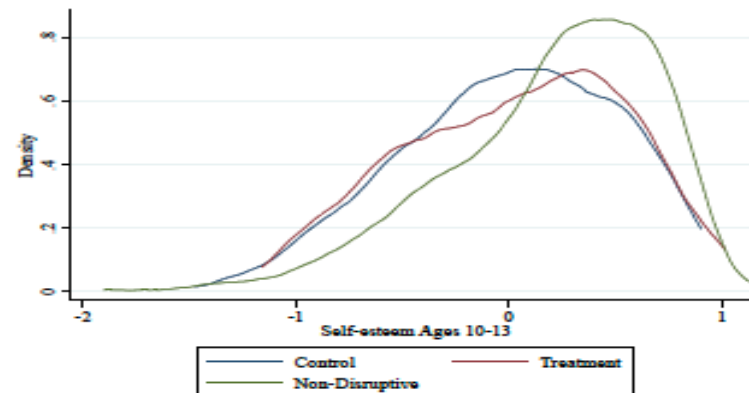
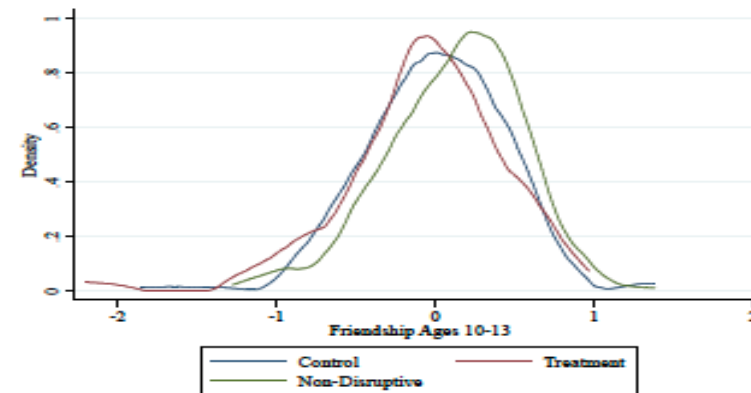
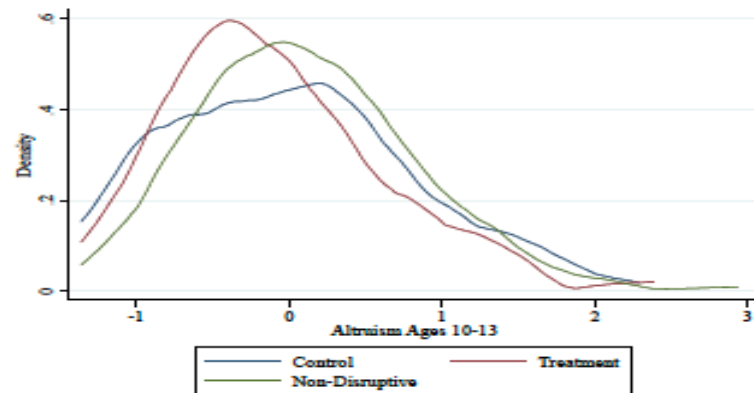
KS p-value=0.02; ttest p-value=0.06

Treatment reduced the gap with non-disruptive by 62%



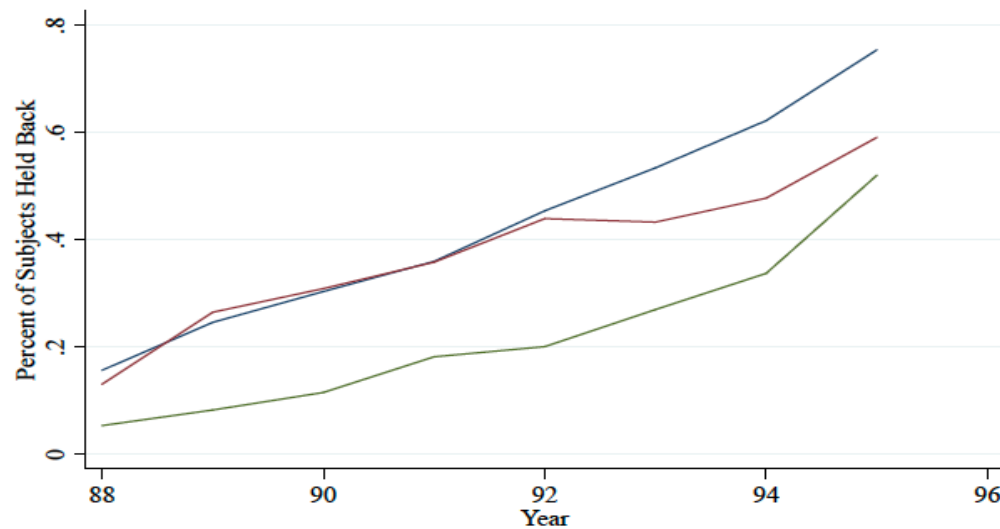
KS p-value=0.003; ttest p-value=0.02

Additional adolescent outcomes: no impact

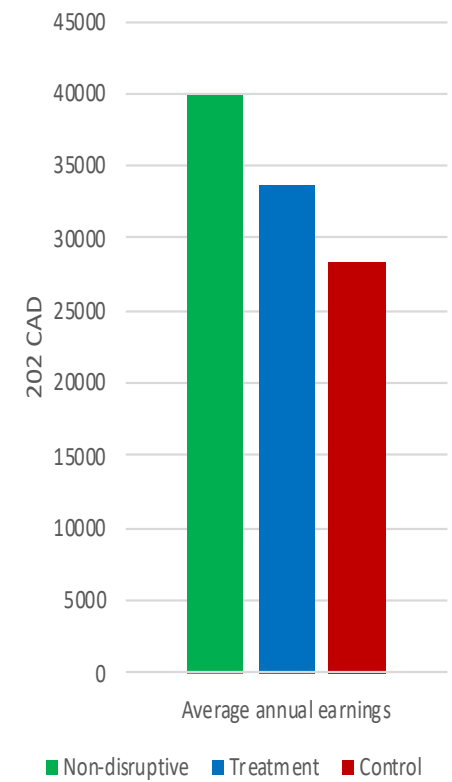
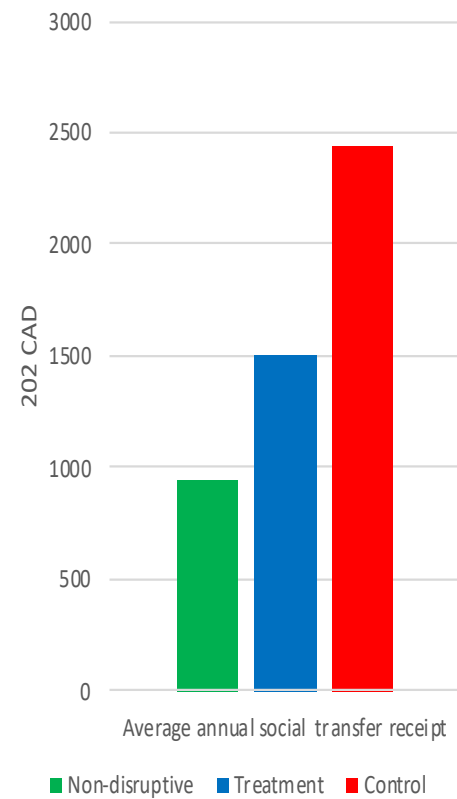
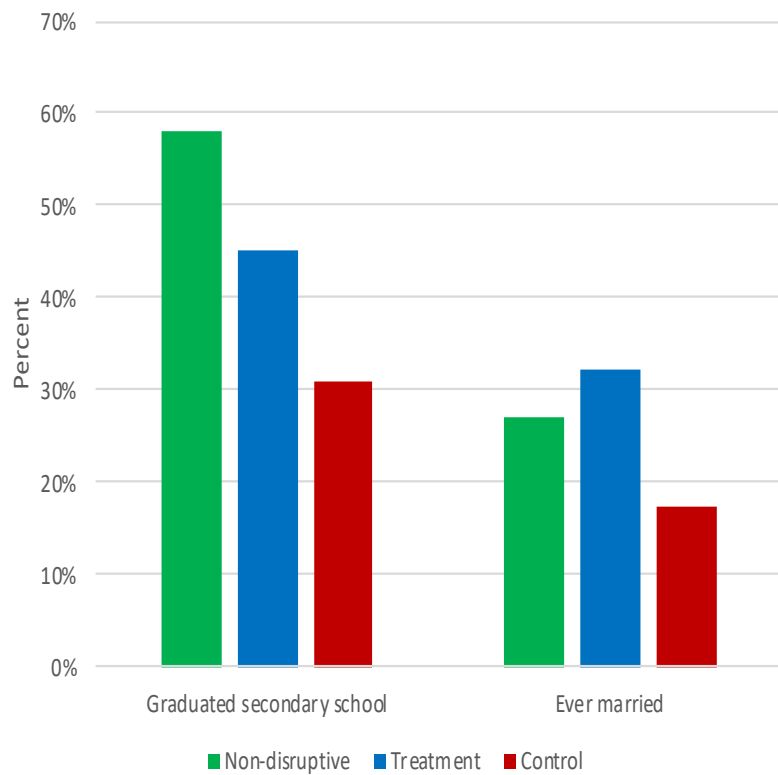


School performance

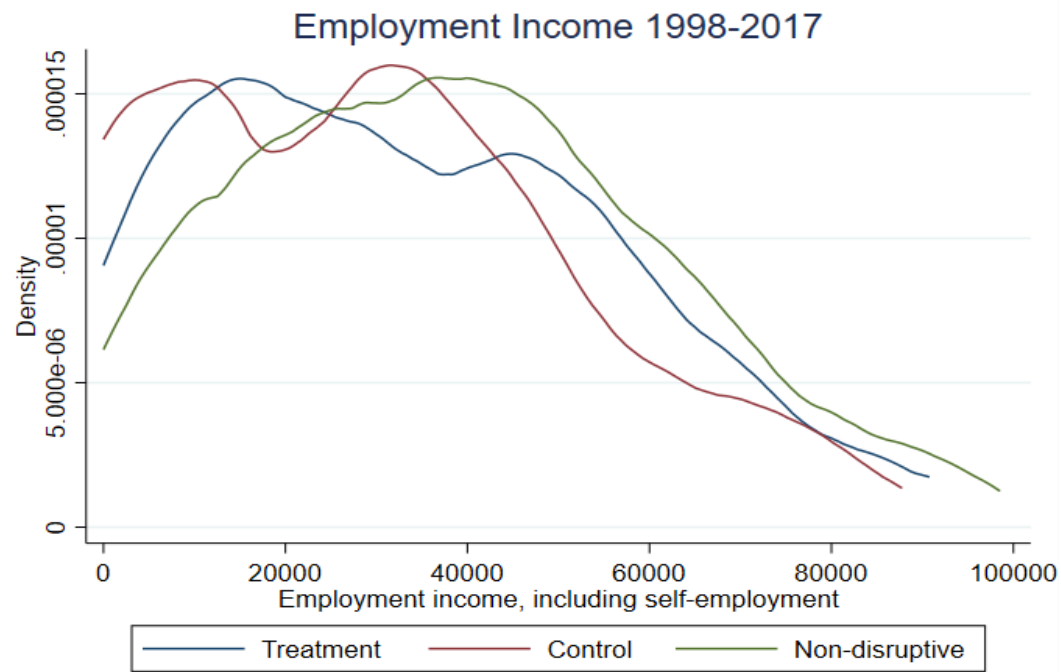
- No initial impact on IQ (age 10-11), grades, held back or special ed in Early Adolescence
- Significant impact in Late Adolescence: Grades (0.30 std dev) , Held Back (16%), Special Ed (15%)



Adult outcomes

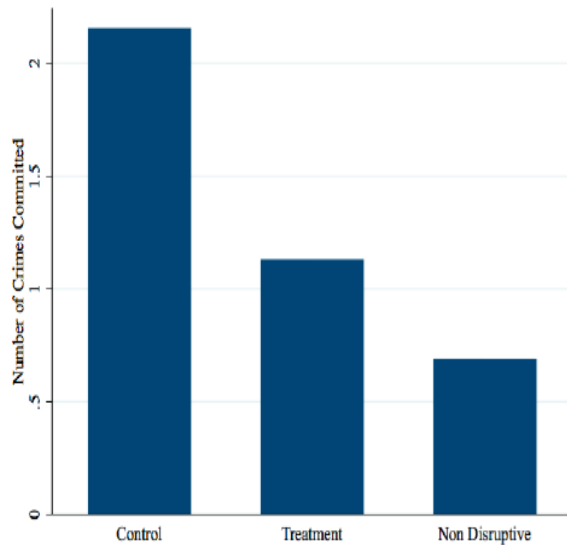


Employment income

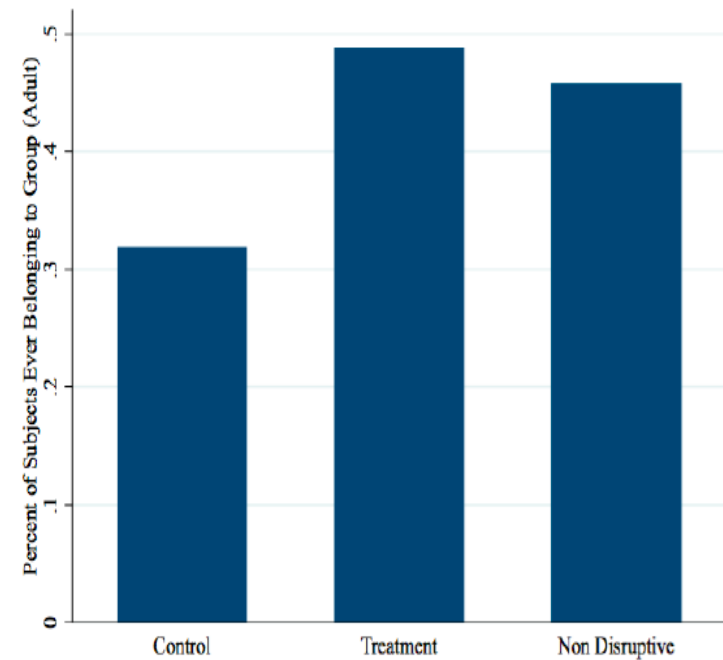


Criminal records and Group Membership

Number of crimes committed at 23 years



- Regression with controls: treatment coefficient is -1.09^*
- Treatment reduces the gap with non-disruptive by 79%



- Regression with controls: Treatment coefficient is 0.216^{**}



Cost – Benefits

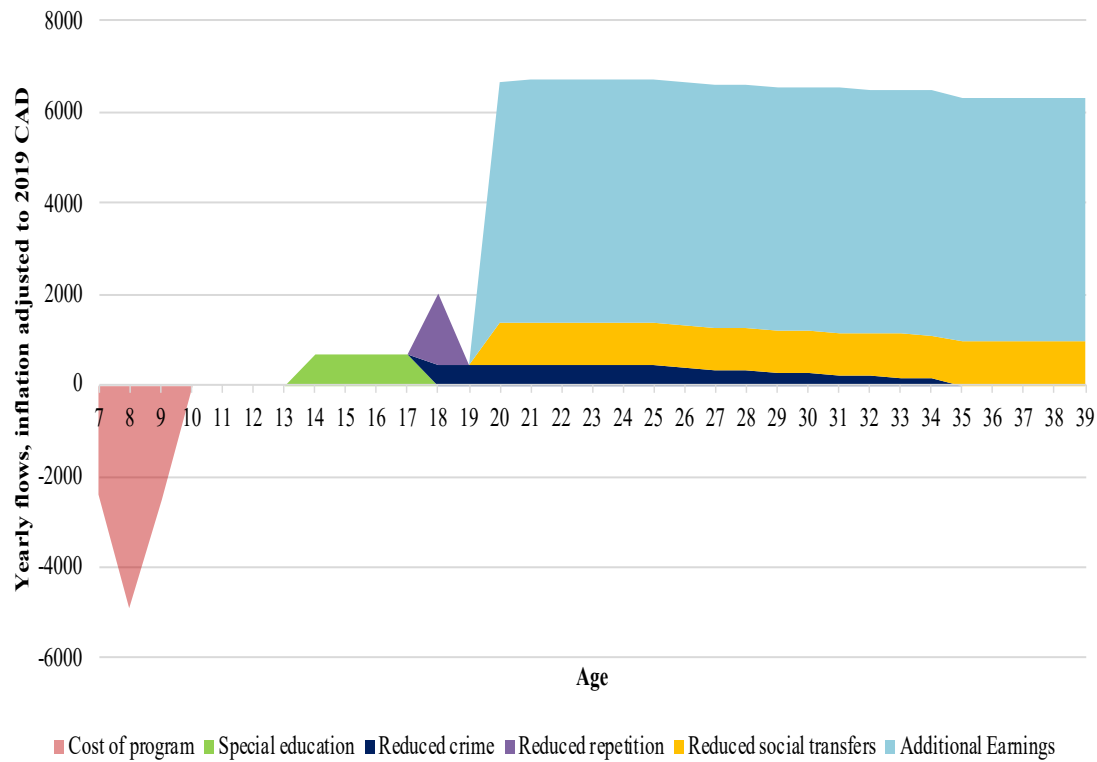


Cost – Benefits analysis

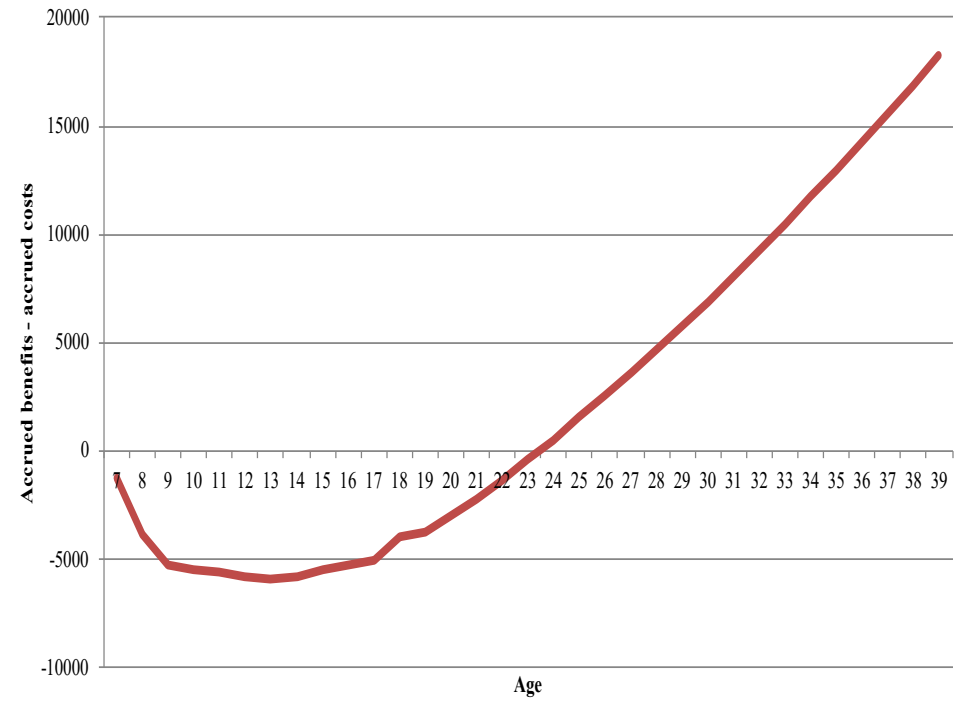
- Initial Cost of the program
 - Team: 1 full time social worker, 2 full time childcare specialists (BA level), 1 psychologist, and 1 half-time program administrator.
 - Additional program costs: 30% of salaries
 - Total cost per person: 9,240 in 2013 USD
- Two ways to compare costs to benefits
 - Cost-efficiency : measure the efficiency of a program in terms of the cost of attaining a desired outcome
 - Benchmark to compare programs with the same goal
 - Rate of Return : monetize benefits to estimate overall rate of return
 - General idea of return to social investment

Costs – Benefits

Cost and Benefit Flows Until Age 39



Net accumulated benefits in social expenditure over time



CONCLUSION

- **Adult outcomes**

- Increase average early income by 20%, decrease yearly social transfers by 40%
- Increase 15% probability of being married, and being part of an professional organization
- Increase by 19% probability of high-school graduation , and reduction in crime
- 1 \$ invested at age 8 yields 11\$ in benefits at age 39. IRR=17%

- **Adolescent outcomes**

- Self-control and Trust boosted in early adolescent, no impact on other non-cognitive skills/IQ
- Impact on grades and academic achievement in a second phase, late adolescence
- Tentative interpretations on channels: knock-out analysis shows that academic achievement and later adult outcomes are highly correlated with the boost in self-control and trust

CONTRIBUTION

- Large impacts of preschool childhood development programs targeted mainly at cognitive skills , pyshiological stimulation or combination with non-cognitive skills
 - Surveys: Almlund et al.(2011), Heckman and Kautz(2013)
 - Abecedarian (Campbel et al 2002; Campbel et al., 2014)
 - Perry Preschool (Heckman et al, 2010, 2012....)
 - Jamaican study (Campbel et al., 2014)
 - Project Star (Krueger 1999, Chetty et al. 2011)
- Recent short-term intervention , better designed and with larger sample....but no long-run evaluation
 - Growth mindset and goal-setting (Dobronyi et al. 2019, Alan et al. 2019, Yeager et al. 2019, Huillery et al., 2023),
 - Emotional and social competence (Domitrovich et al. 2007; Conduct Problems Prevention Research Group 2010), prosociality (Kosse et al. 2019), automaticity during high school (Heller et al. 2017)...

ANNEX - TABLES

Early Adolescent Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Non-disruptive mean	Control mean	Treatment mean	Raw diff ND-C	Raw diff T-C (ITT)	Minimum detectable effect (absolute value)	p-value of raw diff	Conditional treatment effect on averages (OLS)	Number of obs. (T and C)
Trust	0.29 (0.02)	0.00 (0.03)	0.15 (0.06)	0.30 (0.04)	0.16 (0.07)	0.11	0.02	0.18 (0.07)	243
Aggression Control	0.40 (0.02)	-0.01 (0.04)	0.14 (0.07)	0.41 (0.04)	0.15 (0.08)	0.13	0.05	0.14 (0.08)	248
Attention Control	0.36 (0.02)	-0.01 (0.04)	0.15 (0.07)	0.37 (0.05)	0.16 (0.08)	0.14	0.06	0.17 (0.08)	248
Sociability	0.14 (0.02)	0.01 (0.03)	-0.07 (0.07)	0.13 (0.04)	-0.08 (0.07)	0.11	0.27	-0.04 (0.07)	248
Self Esteem	0.20 (0.02)	0.00 (0.04)	0.03 (0.06)	0.20 (0.04)	0.03 (0.07)	0.12	0.68	0.04 (0.08)	232
Altruism	0.11 (0.03)	0.00 (0.06)	-0.11 (0.09)	0.11 (0.06)	-0.11 (0.11)	0.18	0.32	-0.09 (0.11)	248
Verbal IQ	9.18 (0.08)	8.57 (0.19)	8.54 (0.35)	0.61 (0.19)	-0.03 (0.37)	0.61	0.95	0.18 (0.39)	204
Grades	0.38 (0.04)	-0.01 (0.07)	0.11 (0.12)	0.39 (0.08)	0.11 (0.14)	0.23	0.42	0.17 (0.15)	220
Special education	0.08 (0.01)	0.21 (0.02)	0.20 (0.04)	-0.12 (0.02)	0.00 (0.05)	0.08	0.96	-0.03 (0.05)	250
Years held back	0.11 (0.01)	0.26 (0.03)	0.26 (0.04)	-0.16 (0.02)	0.00 (0.05)	0.09	0.96	-0.04 (0.05)	250
Ever held back	0.20 (0.01)	0.40 (0.04)	0.39 (0.06)	-0.20 (0.03)	0.01 (0.07)	0.11	1.00	-0.05 (0.07)	250

Standard errors in parentheses. Each cell of column (1) provides the mean for the non-disruptive group, column (2) the mean of the control group, and column (3) the mean of the treatment group. Column (4) provides the raw difference between the non-disruptive and the control group, column (5) the raw difference of the treatment and control group (ITT), column (6) gives the minimum detectable effect using a one-sided t-test ($1.65 \times SE$ of column 5), column (7) gives the p-value of the T-C difference using a permutation (randomization) test. Column (8) is the conditional treatment effect from an OLS regression controlling for baseline differences between the treatment and control groups, with robust standard errors. Column (9) gives the number of observations in the treatment and control groups. The non-disruptive group is composed of those children who scored below the 70th percentile of anti-social behavior on the initial questionnaire in 1984. This non-disruptive group did not participate in the randomized evaluation and serves as a reference group.

ANNEX - TABLES

Late Adolescent Outcomes

Table 3. Late adolescent outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Non-disruptive mean	Control mean	Treatment mean	Raw diff ND-C	Raw diff T-C (ITT)	Minimum detectable effect (absolute value)	p-value of raw diff	Conditional treatment effect on averages (OLS)	Number of obs. (T and C)
Trust	0.22 (0.02)	-0.04 (0.05)	0.14 (0.07)	0.25 (0.04)	0.18 (0.09)	0.14	0.04	0.19 (0.09)	213
Aggression Control	0.26 (0.02)	-0.01 (0.05)	0.17 (0.07)	0.27 (0.04)	0.19 (0.09)	0.15	0.04	0.15 (0.09)	213
Attention Control	0.25 (0.02)	0.00 (0.05)	0.04 (0.07)	0.25 (0.05)	0.04 (0.09)	0.15	0.65	0.00 (0.09)	210
Sociability	0.12 (0.02)	0.01 (0.04)	0.02 (0.06)	0.12 (0.04)	0.01 (0.07)	0.11	0.83	0.05 (0.07)	213
Self Esteem	0.12 (0.02)	-0.01 (0.03)	-0.01 (0.06)	0.13 (0.04)	0.00 (0.07)	0.11	0.98	0.01 (0.07)	202
Altruism	-0.01 (0.03)	0.00 (0.06)	-0.04 (0.11)	-0.02 (0.07)	-0.04 (0.12)	0.20	0.74	-0.08 (0.13)	199
Grades	0.43 (0.03)	-0.01 (0.07)	0.21 (0.11)	0.44 (0.08)	0.22 (0.13)	0.22	0.10	0.27 (0.13)	215
Special education	0.21 (0.01)	0.46 (0.03)	0.36 (0.05)	-0.25 (0.03)	-0.10 (0.06)	0.10	0.11	-0.14 (0.06)	248
Years held back	0.34 (0.01)	0.60 (0.03)	0.50 (0.06)	-0.26 (0.03)	-0.10 (0.06)	0.10	0.12	-0.14 (0.06)	249
Ever held back	0.54 (0.02)	0.77 (0.03)	0.62 (0.06)	-0.23 (0.04)	-0.15 (0.06)	0.10	0.03	-0.17 (0.07)	249

Standard errors in parentheses. Each cell of column (1) provides the mean for the non-disruptive group, column (2) the mean of the control group, and column (3) the mean of the treatment group. Column (4) provides the raw difference between the non-disruptive and the control group, column (5) the raw difference of the treatment and control group (ITT), column (6) gives the minimum detectable effect using a one-sided t-test ($1.65 * SE$ of column 5), column (7) gives the p-value of the T-C difference using a permutation (randomization) test. Column (8) is the conditional treatment effect from an OLS regression controlling for baseline differences between the treatment and control groups, with robust standard errors. Column (9) gives the number of observations in the treatment and control groups. The non-disruptive group is composed of those children who scored below the 70th percentile of anti-social behavior on the initial questionnaire in 1984. This non-disruptive group did not participate in the randomized evaluation and serves as a reference group.

ANNEX - TABLES

Young Adult Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Non-disruptive mean	Control mean	Treatment mean	Raw diff ND-C	Raw diff T-C (ITT)	Minimum detectable effect (absolute value)	p-value of raw diff	Conditional treatment effect on averages (OLS)	Number of obs. (T and C)
Group membership	0.36 (0.02)	0.22 (0.03)	0.38 (0.07)	0.13 (0.04)	0.16 (0.07)	0.11	0.02	0.15 (0.08)	159
Percent of years occupied fulltime	0.83 (0.01)	0.77 (0.03)	0.83 (0.04)	0.06 (0.03)	0.06 (0.05)	0.09	0.25	0.11 (0.06)	153
Percent of years receiving transfers	0.07 (0.01)	0.14 (0.02)	0.10 (0.03)	-0.07 (0.02)	0.04 (0.04)	0.07	0.39	-0.05 (0.04)	153
Post-secondary education	0.27 (0.02)	0.13 (0.03)	0.07 (0.04)	0.14 (0.04)	-0.06 (0.06)	0.09	0.40	-0.04 (0.05)	159
Voted (2001)	0.55 (0.02)	0.49 (0.05)	0.48 (0.08)	0.06 (0.05)	0.01 (0.09)	0.15	1.00	0.01 (0.10)	147
Volunteered (2001)	0.30 (0.02)	0.38 (0.05)	0.45 (0.08)	-0.08 (0.05)	0.07 (0.09)	0.15	0.46	0.07 (0.10)	148
Number of crimes committed by age 24 (administrative data)	0.68 (0.10)	2.15 (0.43)	1.13 (0.36)	-1.47 (0.29)	-1.02 (0.73)	1.21	0.17	-1.09 (0.58)	250
Secondary school diploma (administrative data)	0.58 (0.02)	0.31 (0.03)	0.45 (0.06)	0.27 (0.04)	0.14 (0.07)	0.11	0.05	0.19 (0.08)	250

*Standard errors in parentheses. Each cell of column (1) provides the mean for the non-disruptive group, column (2) the mean of the control group, and column (3) the mean of the treatment group. Column (4) provides the raw difference between the non-disruptive and the control group, column (5) the raw difference of the treatment and control group (ITT), column (6) gives the minimum detectable effect using a one-sided t-test (1.65*SE of column 5), column (7) gives the p-value of the T-C difference using a permutation (randomization) test. Column (8) is the conditional treatment effect from an OLS regression controlling for baseline differences between the treatment and control groups, with robust standard errors. Column (9) gives the number of observations in the treatment and control groups. The non-disruptive group is composed of those children who scored below the 70th percentile of anti-social behavior on the initial questionnaire in 1984. This non-disruptive group did not participate in the randomized evaluation and serves as a reference group.*

ANNEX - TABLES

Adult Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Non-disruptive mean	Control mean	Treatment mean	Raw diff ND-C	Raw diff T-C (ITT)	Minimum detectable effect (absolute value)	p-value of raw diff	Conditional treatment effect on averages (OLS)
Household income	87015 (1797)	61480 (2611)	69950 (4855)	25534 (3881)	8469 (5193)	8568	0.11	12172 (5532)
Individual income	44598 (885)	35027 (1569)	40050 (2813)	9571 (1963)	5023 (3085)	5090	0.10	7010 (3241)
Years with any employment income	15.8 (0.2)	12.7 (0.5)	14.9 (0.8)	3.1 (0.5)	2.2 (1.0)	1.6	0.03	2.8 (0.9)
Employment income	39932 (936)	28752 (1681)	34459 (2996)	11180 (2079)	5708 (3298)	5442	0.08	8091 (3414)
Years contributing to unemployment insurance	14.8 (0.2)	11.9 (0.5)	13.9 (0.8)	2.9 (0.5)	2.0 (1.0)	1.6	0.04	2.7 (0.9)
Contributions to unemployment insurance	545 (11)	419 (23)	489 (37)	126 (24)	70 (44)	72	0.11	102 (44)
Years receiving social benefits	1.8 (0.1)	3.9 (0.4)	2.8 (0.5)	-2.1 (0.4)	-1.1 (0.8)	1.3	0.16	-1.7 (0.7)
Amount of social benefits	948 (88)	2436 (277)	1507 (333)	-1488 (225)	-929 (495)	817	0.06	-1322 (425)

Number of observations is 245. Each cell of column (1) provides the mean for the non-disruptive group, column (2) the mean of the control group, and column (3) the mean of the treatment group. Column (4) provides the raw difference between the non-disruptive and the disruptive group, column (5) the raw difference of the treatment and control group (ITT), column (6) gives the minimum detectable effect using a one-sided t-test ($1.65 * SE$ of column 5), column (7) gives the p-value of the T-C difference using a permutation (randomization) test. Column (8) is the conditional treatment effect from an OLS regression controlling for baseline differences between the treatment and control groups, with robust standard errors. The non-disruptive group is composed of those children who scored below the 70th percentile of anti-social behavior on the initial questionnaire in 1984. This non-disruptive group did not participate in the randomized evaluation and serves as a reference group. Those who scored above the 70th percentile were randomized into either the treatment or control groups. Employment income includes self-employment.