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Life Course Effects of The Lanham Preschools: What the First Government Preschool Effort Can Tell Us About Universal Early Care and Education Today

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Abstract

Derrington, Huang, and Ferrie examine the effects of WWII Lanham Act Nursery Schools (LNS) on high school and young adult educational and labor outcomes of participants in the landmark Project Talent (PT) study. All PT places that received funding for LNS schools and all PT places that did not were identified by examining program records and contemporaneous newspaper accounts. Focusing on students who in 1960 attended high school in the same city or town where they were born, the authors estimate intent to treat effects of access to LNS preschool on high school academic and social emotional outcomes and on educational attainment and labor outcomes at five and eleven years following high school graduation. Preschool boosts high school academic outcomes for men and (in at least one specification) income 11 years after high school graduation. For women, preschool exposure had a negative effect on some social emotional outcomes in high school. The researchers found no or inconsistent effects for other outcomes. The Lanham experience demonstrates that even with the less sophisticated understanding of child development of the early 1940s, the first universal, government-funded preschool program had positive impacts on boys' outcomes at least through high school. Given today's expanded understanding of child development and focus on the quality of early care and education programming, these findings provide some optimism as communities, states, and the federal government contemplate expanding funding for today's early learning environments.

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1 Introduction

There is growing support for increasing public investment in preschool programs for children ages three and four years (U.S. Office of the Press Secretary, 2013; U.S. Office of the Press Secretary, 2021). Universal, government-supported early childhood (EC) programs represent a shift away from the programming provided over the past seven decades predominantly targeted to children at risk of poor development due to socioeconomic (e.g., experiencing poverty) and health factors (e.g., low birthweight, prematurity, disability/developmental delay). This paper examines the impact of the Lanham Nursery Schools (LNS), the first universal preschool program in the United States, established during World War II under the National Defense Housing Act of 1940 (popularly known as the Lanham Act). This federal funding supported locally planned and operated "nursery" schools (for children ages 2-6) and after school programs (for children ages 6-12) programming for children to support women's participation in the war production effort from 1942-1946 (Stoltzfus, 2000).[1]

The current push for universal preschool programming is driven by the considerable evidence for positive EC program impacts on cognitive and behavioral/social-emotional outcomes in childhood and educational attainment, health, behavioral health, labor force participation, income, disciplinary outcomes, and criminality in high school and early and middle adulthood (Englund, White, Reynolds, Schweinhart, and Campbell, 2014; Gray-Lobe, Pathak, & Walters, 2021; Heckman & Karapakula, 2019a; Kilburn, Cannon, Mattox, and Shaw, 2014; Reynolds, Temple, Robertson, and Mann, 2001). These efforts are also motivated by evidence of the high return on investment in EC programs (Barnett and Masse, 2007; García, Heckman, Leaf, and Prados, 2016; Grunewald and Rolnick, 2007; Heckman, 2006; Heckman, Moon, Pinto, Savelyev, and Yavitz, 2010; Lynch, 2007; Reynolds, Temple, White, Ou, and Robertson, 2011).

The existing evidence used to assess the long-term benefits and return on investment of EC programs largely consists of several seminal but small-scale privately funded and narrowly targeted programs for economically disadvantaged children (e.g., Perry Preschool, Abecedarian, Chicago Child-Parent Centers; D'Onise, McDermott, and Lynch, 2014; Heckman and Karapakula, 2019b). There are far fewer studies of universal programs (Gray-Lobe, Pathak, & Walters, 2021; Karoly and Bigelow, 2005; Lynch, 2007), though several U.S. cities and states have launched universal pre-kindergarten programs (e.g., Boston in 1998, Charlotte in 1998, San Antonio in 2013, Georgia in 1995, Oklahoma in 1998, and Florida in 2005).

[1] Herbst (2017) analyzed the long-run effects of Lanham funding by examining 1970-90 U.S. Census data across cells defined by state of birth, year of birth, and whether Lanham Act funding per capita was high or low in the state of birth. He examines as an outcome a composite of 5 outcomes. The analysis does not distinguish between exposure to LNS (for children under age 6) and exposure to Lanham after school programs (for children ages 6-12). We are able to focus on the preschool aspect of Lanham funding, examine a broader set of outcomes, and exploit a more disaggregated source of variation (whether particular cities and towns received LNS).

The Early Childhood Longitudinal Study (U.S. Department of Education, 2002) has also been underway for the past two decades to examine the effects of participation in EC programs in a nationally representative sample of children. Except for the Perry and Abecedarian projects, all of the EC studies are also limited in how long they have followed participants (e.g., the Tulsa study finds positive academic effects for middle schoolers; Gormley, Phillips, and Anderson, 2018).[2] A retrospective longitudinal study of access to LNS allows us to address these shortcomings.[3]

A second important gap in this literature is that most of the existing methodologically rigorous longitudinal studies of targeted programs have small sample sizes — considerably fewer than 200 participants — which threatens generalizability and prohibits exploration of the heterogeneity of treatment effects. A third and related weakness is that most programs studied were provided in only one site or one city and do not cover the entire country, with the exception of the previously mentioned Early Childhood Longitudinal Study (U.S. Department of Education, 2002). In this study, we have a sample of just under 100,000 individuals from 46 states.

This paper analyzes life course educational and labor outcomes of individuals who lived in places where LNS operated. More than 3,000 federally subsidized child care centers were established in counties, cities, and towns, in every state but New Mexico (funding also went to Alaska and Hawai`i, which were not yet states), with estimates of the number of participating communities ranging from more than 450 (Bremner, 1974) to as many as 635 (Stoltzfus, 2000). In 1944, the program funded 1,700 nursery schools serving more than 50,000 children ages 2-6 years (Federal Works Agency, 1944). This preschool enrollment peaked at 73,600 in May 1945 (Stoltzfus, 2000). As children cycled in and out of the program, about 300,000 may have passed through these nursery schools during the four years of operation (Bremner, 1974, 3:691).

This study is possible due to the ability to assess outcomes from high school through early adulthood by linking participants in the nationally representative Project Talent (PT) study with the cities and towns across the U.S that received LNS (Lanham places) or no such schools (non-Lanham places). In the PT data, we identified 56 cities/towns that received Lanham funding (Lanham places) and 511 places that did not receive LNS funds (non-Lanham places). The former served as the treatment locations, and the control group consisted of both individuals in non-Lanham places and individuals in Lanham places but outside the 2-6 years age eligibility range during the years of LNS operation. The PT data linkages allow

[2] This is of course not the fault of the study designers. Rather, it is a consequence of the need to wait as much as 70 years after treatment in order to evaluate the full life-course benefits of EC. With the earliest prospective studies only beginning in the late 1960s and early 1970s, outcomes at ages much above 50 will only become available over the coming decade. Even then, attrition and recontact of participants are costly and scale poorly.

[3] Bailey et al. (2020) adopt an approach similar to ours in their retrospective analysis of Head Start: linking outcomes that can be observed at dates closer in time to today back to information on whether the same individuals were "treated" by a particular intervention.

us to study the impact of LNS exposure on indicators of high school cognitive and social emotional functioning and on educational attainment and labor outcomes at 5 and 11 years post high school. We use entropy balancing (Hainmueller, 2012), a statistical method to balance the observable characteristics of our "treated" (LNS) and "control" (non-LNS) locations. We address the following research questions:

1. Is access to LNS preschools predictive of high school academic and social emotional outcomes and of educational attainment, employment, and income 5 years and 11 years post-high school graduation?
2. Are the effects of LNS access heterogeneous across participant socioeconomic status (SES), sex, and age?

It is important to note that we are unable to determine whether any individual PT participant attended an LNS. Actual class rosters exist for only a handful of cities — for example, we have attendance records for the set of LNS locations in Schenectady, NY and Sioux City, IA. We are thus measuring access, or potential exposure, so our analysis is of the "intent to treat" (ITT) variety. The nursery schools never served more than 13 percent of the eligible population, so any effect estimates we find will combine the outcomes of those who attended and those who did not. The actual effect on the treated could be 7 or more times the effect size we estimate for any outcome.

The structure of this paper is as follows. Section 2 presents information on the data and methods, including descriptions of the datasets, linkages, statistical methods, and regression equations to estimate effects. Section 3 presents the results to address both research questions. Section 4 discusses the results in relation to existing literature and presents implications for current EC policy and programming.

2 Data and methods

2.1 Data

This study links data from multiple administrative and survey data sources. Data from the National Archives, state reports, and contemporaneous newspaper accounts were used to identify places which received LNS. Long-term educational and labor outcomes of children who lived in places which received LNS were ascertained through Project Talent, a nationally representative survey of 377,016 American high school students. Beginning in 1960, students attending 1,063 senior high schools from all states except Alaska (Wise, McLaughlin, and Steel, 1979) were assessed. There were three follow-up data collections at 1, 5, and 11 years post-high school; this study analyzed the 5- and 11-year follow-ups. Further details on the data sources and measures used for this study are provided in the sections below.

2.1a Lanham Schools data

The current study necessitated the identification of PT high schools located in places that received LNS facilities.[4] Students who attended these high schools, given inclusion and exclusion criteria detailed below, were considered to have had the opportunity to be exposed to LNS in early life. This was accomplished by assigning codes for populated places from the Geographic Names Information System (GNIS) maintained by the U.S. Geological Survey to all PT locations and all LNS locations. Only a handful of places had changed their names over the twentieth century, and these were flagged by the GNIS. The lists were then merged by GNIS code.

It was next necessary to determine the characteristics in the 1940 U.S. Census of Population of the places that did and did not receive LNS facilities.[5] This presented a greater challenge, as the published census tabulations identified just over 3,000 distinct places (cities or towns), and even then, restricted attention to those with 2,500 or more inhabitants. Many 1960 PT locations fell below this threshold in 1940 and were not separately identified. In fact, half of all PT places had fewer than 1,250 inhabitants in 1940.

In order to generate place-level characteristics for all PT locations from the 1940 census, then, we had to determine the "place" that corresponded to each 1940 census enumeration district (ED). EDs are the forerunner of modern census tracts. The assignment of EDs to places was done by parsing the ED description file for each of the 154,000 EDs delineated in 1940 to determine the district(s) containing each of the 200,000 places listed in the GNIS. In many cases, it was also necessary to consult the collection of 1940 ED maps retained by the National Archives. This process resulted in the identification of 40,295 places.

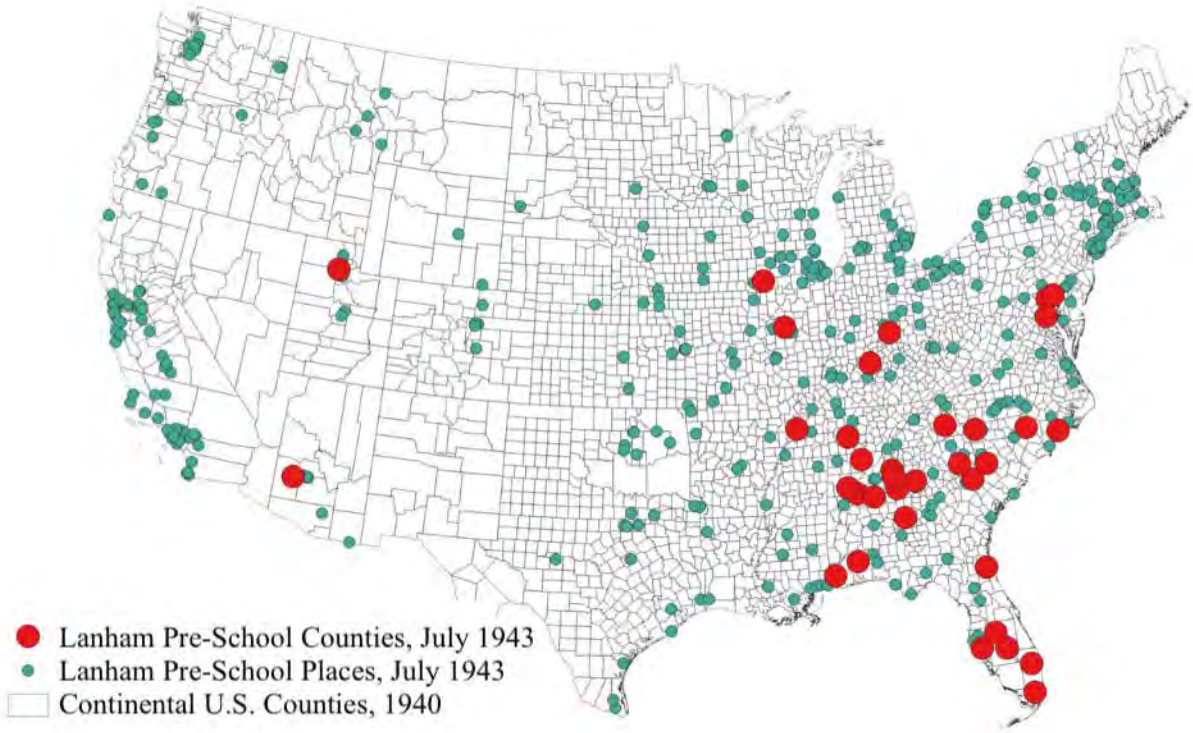
These were then used to collapse the 1940 census 100% file down to PT places (LNS and non-LNS) and non-PT places. For the PT places, we then calculated a set of 1940 characteristics (e.g., population, wage and salary income, educational attainment) and a set of characteristics associated with World War Two (the value of war-time contracts with the federal government and the draft rate of young men in the county containing each place). These place-level characteristics were then merged onto the PT places

[4] The LNS locations were identified in (1) the Federal Works Agency's Lanham Act card file records (date approved, amount of funding approved, projected numbers of classrooms and students) for each place (city/town) receiving Lanham pre-school funds prior to July 31, 1943 (Federal Works Agency, 1943); (2) a 1947 report to the California State Legislature — as it contemplated state funding to keep the state's LNS in operation — on preschools established across the U.S. during the war ("Technical Staff Report to the Joint Committee on Preschool and Primary Training," January 17, 1947, pp. 289-304; California Legislature Joint Committee on Preschool and Primary Training, 1947); and contemporary newspapers.

[5] The term "places" here refers to specific cities and towns that applied individually for LNS funds. In a number of cases, entire counties applied together. We have dropped from our analysis any city or town within these "LNS counties" if they did not also appear in the list of Lanham places that applied individually. This restriction was imposed because within LNS counties we cannot identify the places that received funds unless they also applied individually. The inclusion of LNS counties in their entirety would generate imprecision in our assignment of treatment status (LNS vs. non-LNS) if there were places in the LNS counties that did not receive LNS funds. This led to the exclusion of 1,631 places from further consideration.

(LNS and non-LNS) by GNIS code. Figure 1 shows the geographic distribution of Lanham places and Lanham counties across the U.S. in July 1943.

Figure 1. Places and Counties Receiving Funding for Lanham Preschools



2.1b Project Talent data

The PT dataset available for this project provided high school and early adult outcomes data for 362,070 participants. For high school, these included nationally normed measures of academic functioning (IQ, academic aptitude, verbal composite, mathematical composite, effective expression, and height) and social emotional functioning (sociability, social sensitivity, impulsivity, vigor, calmness, tidiness, culture, leadership, confidence, and maturity; measured by the Student Activities Inventory). For the early adult period, data were available from the 5- and 11-year follow-ups when participants would have been approximately 23 and 29 years old, respectively, assuming they graduated at age 18 years. These data include income at the 11-year follow-up adjusted to 1974 dollars (when the final 11-year follow up data collection was completed) for comparability across the grades, and dichotomous variables to indicate whether the participant had attended any college, graduated college, or worked in a blue-collar job, as well as job satisfaction and whether they had experienced any periods of unemployment if they were employed. See Wise, McLaughlin, and Steel (1979) for a complete description of the study and measures.

Tables 1 and 2 present descriptive statistics for continuous and dichotomous variables, respectively. Finally, all high schools were geocoded based on city/town name and state for linkage to LNS data.

Table 1. Continuous Dependent Variable Descriptive Statistics

	Overall			Men			Women		
	N	x̄	SD	n	x̄	SD	n	x̄	SD
High school academic [a]									
IQ	103,036	100.2	9.4	50,315	100β	9.5	52,721	100.4	9.4
Academic composite	99,597	100.2	9.3	48,592	100.0	9.3	51,005	100.5	9.3
Verbal composite	99,944	100.2	9.1	48,766	100.0	9.2	51,178	100.4	9.0
Effective expression	102,823	8.5	2.3	50,169	8.2	2.4	52,654	8.9	2.1
Math composite	101,925	100.1	9.6	49,775	99.9	9.6	52,150	100.3	9.7
Height	100,478	100.3	9.6	48,100	100.4	9.6	52,378	100.3	9.5
High school social emotional [a]									
Sociability	103,075	100.5	9.9	50,202	100.4	10.0	52,873	100.6	9.9
Social sensitivity	101,183	99.8	10.0	48,796	99.7	9.9	52,387	99.9	10.0
Impulsivity	83,193	99.7	9.7	40,448	99.8	9.8	42,745	99.5	9.6
Vigor	96,406	100.4	9.9	47,552	100.3	9.9	48,854	100.4	9.9
Calmness	98,819	100.0	10.0	48,152	100.1	10.0	50,667	100.0	10.0
Tidiness	102,076	100.1	10.0	49,400	100.0	10.0	52,676	100.3	10.0
Culture	102,901	99.9	9.9	49,805	99.9	9.9	53,096	99.9	9.9
Leadership	63,940	99.6	9.8	30,643	99.6	9.9	33,297	99.6	9.8
Confidence	102,729	99.9	9.9	50,303	99.9	9.9	52,426	99.9	9.9
Maturity	103,975	100.0	10.0	50,731	100.0	9.9	53,244	100.0	10.0
Year 11 post-H.S.									
Income [b]	21,663	9,871	6,655	13,357	12,364	6,467	8,306	5,862	4,709

[a] All scores are normed with the exception of effective expression, which has 12 items and is one of 6 sub-scales of the English test.
[b] 1974 dollars.
Abbreviations: x̄ = mean, SD = standard deviation

Table 2. Dichotomous Independent Variable Descriptive Statistics

	Overall		Men		Women	
	N	%	n	%	n	%
Year 5 post-H.S.						
Graduated H.S.	41,711	96.9%	20,398	97.3%	21,313	96.5%
Attended any college	41,708	49.6%	20,399	57.2%	21,309	42.4%
Graduated college	41,711	28.0%	20,398	30.2%	21,313	26.0%
Year 11 post-H.S.						
Graduated H.S.	27,548	96.6%	13,116	97.1%	14,432	96.1%
Attended any college	29,540	48.5%	14,193	55.7%	15,347	41.9%
Graduated college	27,548	32.6%	13,116	39.9%	14,432	25.9%
Blue collar job	27,263	19.9%	13,002	32.7%	14,261	8.2%
Satisfied with job	20,394	83.0%	13,278	82.3%	7,116	84.2%
Any unemployment	28,341	7.3%	13,983	7.4%	14,358	7.3%

2.1c Independent Variables

The independent variable of interest was a dichotomous variable for whether the PT high school was in a town selected to receive LNS programming, which we term a Lanham school place (LNS) or not (non-LNS); as described above in the exclusion criteria, this excludes places that were in a county that received Lanham funding for the entire county unless the place also received its own Lanham funds through an application as a city or town. Sex (male, female), grade (9, 10, and 11 and 12 combined), and father's educational attainment (our SES proxy) were included to examine heterogeneity. Grade (ninth, tenth, eleventh, and twelfth) also served as a mechanism to identify dose-response effects (due to their age, 9th graders would not have been old enough to be eligible to attend before LNS closed in March 1946; 10th graders had potential partial exposure depending upon their birthdate in relation to LNS opening in June 1943 and closure, and 11th and 12th graders were pooled and had the potential for full exposure). Comparison of 9th graders to their older peers in LNS and to their non-LNS counterparts also allowed for the examination of the added effects of the LNS above and beyond the effects of living in a Lanham place. Table 3 presents descriptive statistics for these variables.

Table 3. Independent Variable Descriptive Statistics

	Overall		Men		Women	
	N	% [a]	n	% [b]	n	% [b]
Total Project Talent observations	98,547	100.0	48,039	48.8	50,433	51.2
Lanham Area	29,427	29.9	14,019	47.6	15,408	52.4
Non-Lanham Area	69,120	70.1	34,020	49.3	35,025	50.7
Grade						
9th	23,836	24.2	11,473	48.1	12,363	51.9
10th	26,486	26.9	13,162	49.7	13,324	50.3
11th & 12th	48,150	48.9	23,404	48.6	24,746	51.4

[a] Column percent of total population
[b] Row percent within stratum

A second independent variable of interest was months of potential exposure to LNS. We calculated the date the PT participant attained the ages of 2 and 6 years, which were the LNS preschool eligibility bounds. Next, we calculated the number of months the participant could have attended an LNS preschool using those age eligibility dates in relation to the start (June 1, 1943 for the purposes of this study; the range was February 19, 1943 to October 15, 1943) and end dates of LNS (March 1, 1943 for the purposes of this study; the federal government funded the program through February 28, 1946; Stoltzfus, 2000, pp. 3-4, describes the termination of the program in March 1946). The mean length of exposure was 8.0 months (standard deviation of 9.3 months; range 0-33.1, 0 represents the 9th graders in LNS and all grades in non-LNS). The distribution exhibited a spike at 0 and then was relatively flat to 30 months, with an uptick at 33 months.

Finally, we selected two sociodemographic variables as controls. The first was the highest level of education attained by the participant's father, as reported in the 1960 base year, coded dichotomously as more than high school or not (n = 75,664, 76.8% more than high school). PT collected several sociodemographic variables, but in exploratory models, father's educational level was the most predictive of the participants' outcomes. The second was the presence of an older sibling coded dichotomously (n = 63,317, 64.3% had at least one older sibling) in order to examine, and if needed, control for any potential trickle-down effect of having an older sibling attend LNS preschool for the 9th graders.

2.1d Exclusion/Inclusion Criteria

Participants were excluded from the analytic sample if they attended high school in California, New York City, or New Mexico (as previously mentioned, Alaska had no PT participants and is therefore not represented). California continued the LNS schools post-war, and New York City, which did not receive Lanham funding[6] but set up their own preschools and continued them post-war, providing further opportunity for preschool exposure to students, so we excluded them entirely (CA: n = 20,842; New York City: n = 22,017) (Stoltzfus, 2020). New Mexico was excluded (n = 1,570) because the state did not receive any LNS funding (Stoltzfus, 2020). Participants were also excluded if there was a discrepancy between the birth date reported in the base year data collection and that reported at any follow-up (n = 10,893). Finally, 4,113 participants were excluded because they were born earlier than 1937 (they would have been too old to be eligible for LNS) or later than 1946 because these students would have been unusually older or unusually younger than typical 1960 U.S. high school students.

PT participants were included in the analytic sample if their high school student body composition was ≥ 80% white. This exclusion was made due to the poor quality of individually reported data on race, making distinctions between white and African American/black students unreliable, and driving the decision to focus on schools that had a clear majority of white students. Only PT participants who indicated in the base year 1960 that they lived in the town in which they were currently attending high school their entire lives as we could confidently impute LNS exposure only for students who had lived their entire lives in a place. We are unable to capture exposure to LNS in participants who may have moved prior to high school. In order to increase the homogeneity of participants' high school experience, we further limited the sample to those attending a public, senior, and academic (non-vocational) high school (197,534 did not meet these criteria).

[6] New York City could not make the case for labor market shifts that would justify the need for Lanham funding. Throughout the war, New York City was never declared a labor deficit area (U.S. War Manpower Commission, 1942-1949).

Finally, we included only participants who went to schools in towns that actually received funding for an LNS or that did not receive funding. Some LNS funding was distributed at the county level, but we could not identify the town(s) where schools actually opened (Federal Works Agency, n.d.).[7] Because we could not determine actual LNS attendance and could only identify the potential for exposure to LNS by virtue of going to a high school in a town chosen for LNS, we excluded 6,554 participants from 39 schools in communities adjacent to Lanham places.

The final analytic sample of participants in Lanham and non-Lanham places was 98,472 participants from 649 schools.

2.1e Trends

First, we examined trends by year and quarter of birth in LNS and non-Lanham places for two outcomes, academic aptitude at the beginning of PT (1960), and income at 11 years post-graduation in Figures 2a-d. Because of the distribution of year and quarter of birth among students in high school in 1960, the oldest students we observe were born in 1938Q1 and the youngest were born in 1947Q1. Those born 1940Q1 through 1941Q2 were exposed to the maximum amount of LNS (33 months), and those born 1944Q1 and later had zero exposure. Note as well that students in PT who were born prior to 1940 would have been 20+ years of age if still in high school in 1960, while students in PT who were born after to 1947 would have been < 14 years of age if already in high school in 1960. Therefore, our sample includes only the cohorts born 1940Q1 through 1946Q4.

In all four figures, a gap is apparent between LNS and non-LNS locations beginning with 1942Q1 births and ending no earlier than 1944Q1 births. The gap appears to open with the 1940Q2 birth cohort, a group that could have had the maximum preschool exposure (33 months). We lack data for cohorts born much before 1940Q1, so it is difficult to assess what the trends were in these outcomes prior to the application of the "Lanham preschool treatment." We do, however, have some evidence on the cohorts born late enough that the treatment was turned off by the time they reached age 2 and who therefore received zero exposure. The post-1944Q1 through 1946Q1 "untreated" birth cohorts show convergence between Lanham and non-Lanham places, though for income 11 years post-graduation, the gap persists for several cohorts after the first totally unexposed cohort (1944Q1).

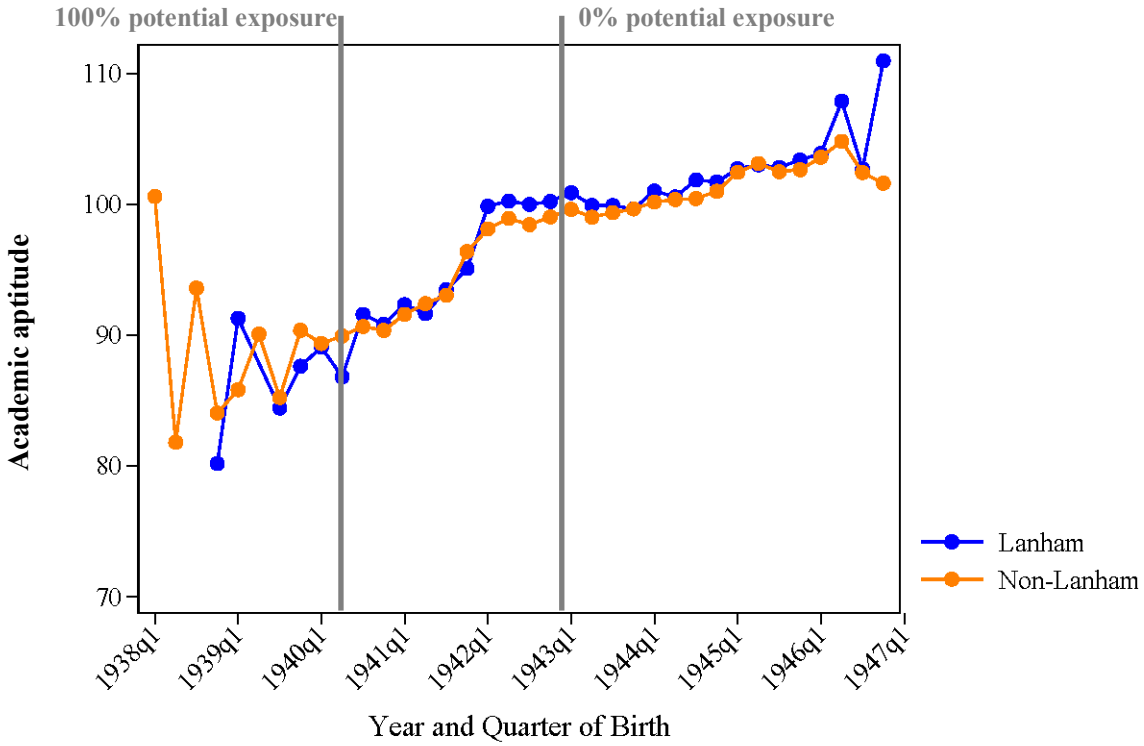
2.2 Entropy weighting

The places that received Lanham Nursery Schools (LNS) were not chosen randomly. Instead, their selection was the result of a community's decision to apply and the Federal Works Agency's determination that the community was both affected by war-time labor market pressure and willing to

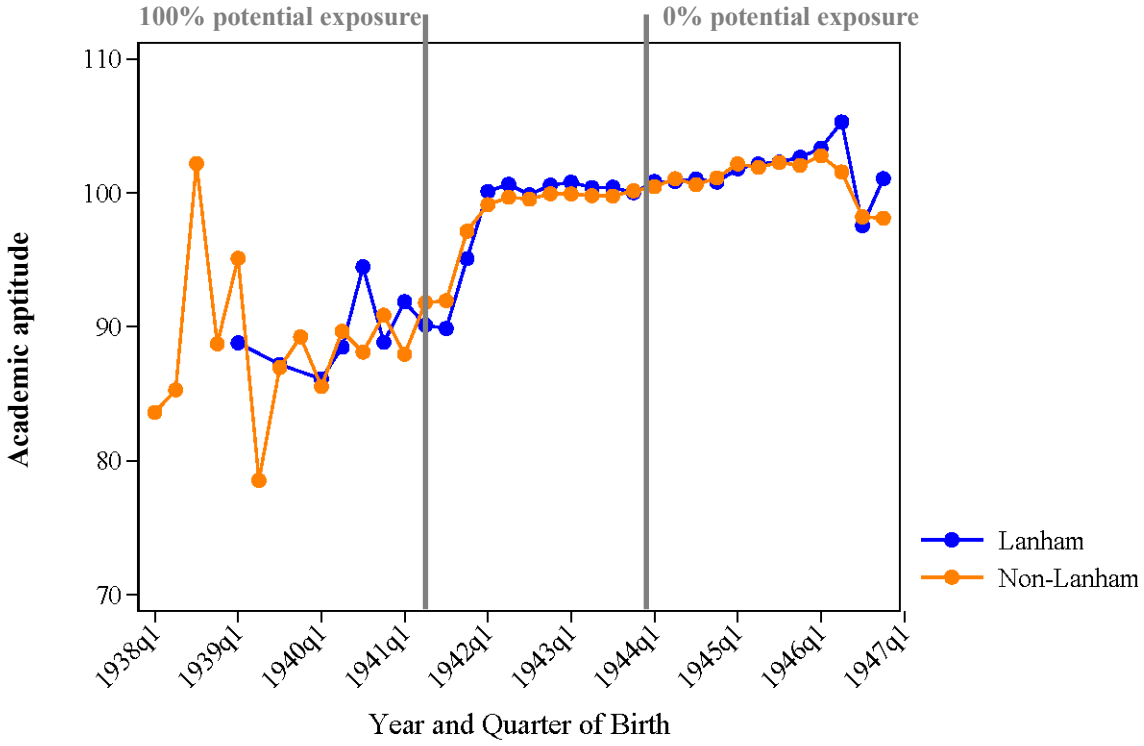
[7] For example, Escambia County, Alabama applied for Lanham funds as a single entity, so it is not possible based on any of the records we have seen to determine which places within Escambia County did and did not receive LNS.

Figure 2. General Trends

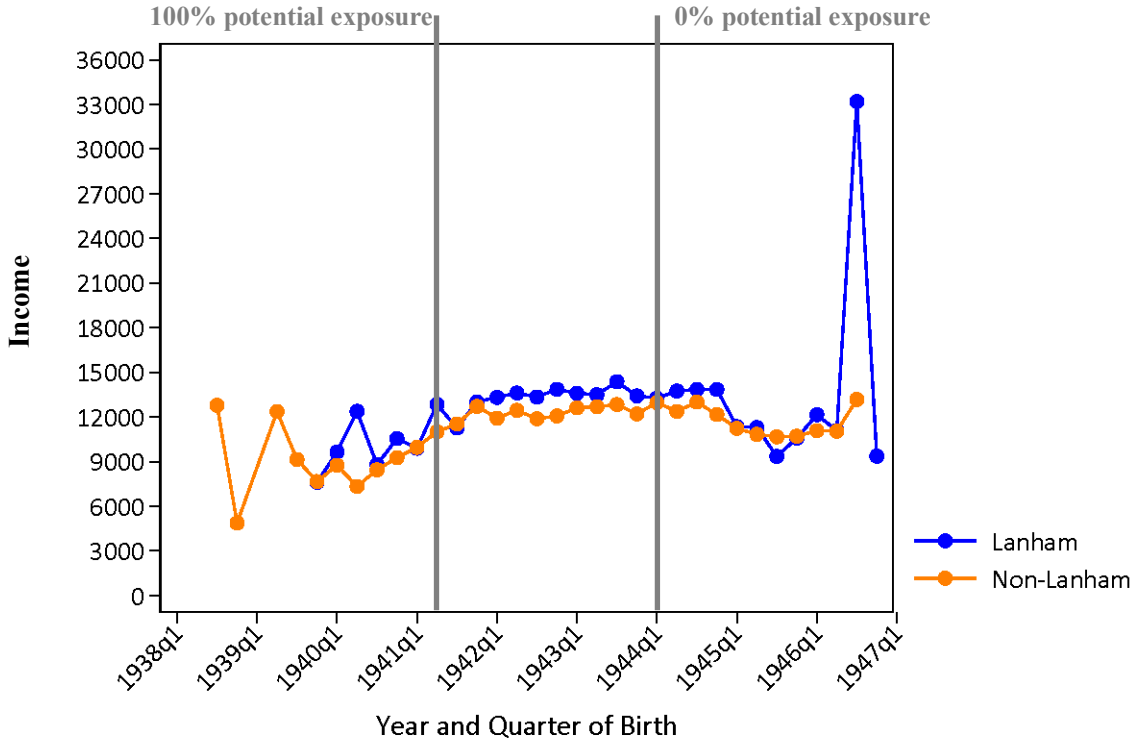
a. Men, high school academic aptitude



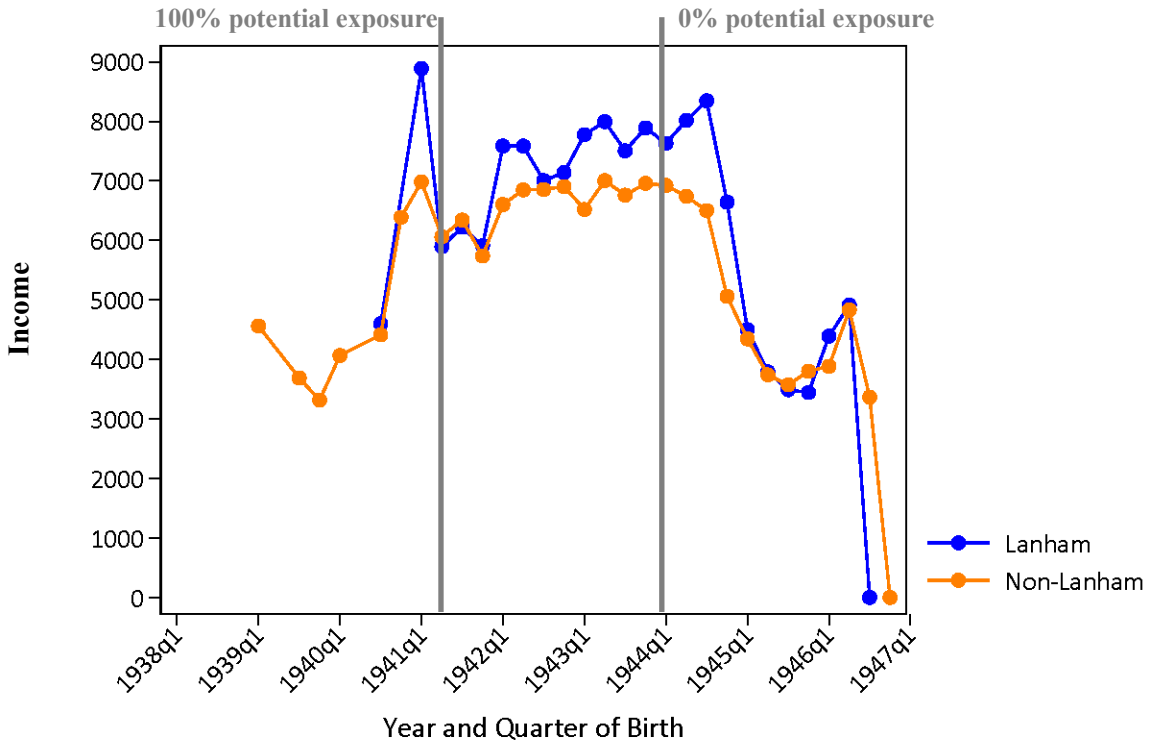
b. Women, high school academic aptitude



c. Men, Year 11 Income (1974 Dollars)



d. Women, Year 11 Income (1974 Dollars)



support a nursery with financial and logistical resources of its own. We would not expect the characteristics associated with these decisions to be those of a randomly-drawn subset of the nation's cities and towns.

Differences in observable characteristics between Lanham and non-Lanham places might then be expected and need to be addressed if they are not otherwise accounted for in the analysis. Though the identification strategy we employ in the body of the paper relies instead on a difference-in-differences approach, we have nonetheless provided in the Appendix (Table A1) results from models that balance treated and control units on the basis of observables to eliminate any differences in characteristics across these two groups that might confound a causal interpretation of simple difference between them in our outcomes of interest.

One simple way to achieve balance based on observables is entropy weighting (Hainmueller, 2012). Building on the insights of Rosenbaum and Rubin (1983), this technique generates weights directly as a result of a well-defined convex maximization problem. It maximizes the entropy of the weights subject to a set of balancing constraints, making it possible to achieve balance across numerous moments of the observables and to do so in a single step rather than the iterative process of generating propensity scores in the conventional way.

Table 4 shows for both Lanham and non-Lanham places the first three moments of several observable place-level characteristics we might expect to differ across these two groups based on the site selection mechanism described above. Compared to places that did not receive a Lanham nursery, places that did receive Lanham nurseries were on average larger (over 80% of non-Lanham places had populations of less than 5,000 compared with less than 10% of Lanham places, while less than 1% of non-Lanham places had populations of more than 100,000, compared with over 60% of Lanham places), more likely to be in the Northeast and less likely to be in the South, received a higher value of war-time contracts from the government, were in counties that had higher draft rates, had a higher percentage Black population, and had a smaller percentage of its under age 18 children who were under age 6. The penultimate column shows that several of these differences are both substantial in magnitude and statistically significant at less than the 5% level. When the entropy weights are imposed on the non-Lanham places, these difference are reduced dramatically and none of them are any longer statistically significant at the 5% level. The second and third moments are also generally more balanced when these weights are imposed.

2.3 Analytic Strategy

In this paper, we present estimated effects of LNS preschool exposure using an intent to treat (ITT) framework. This is necessary because we do not observe whether any particular PT participants actually attended an LNS – we know only whether they were resident during the relevant years and at the relevant

Table 4: Entropy Balance Table

	Lanham Places (N=56)			Non-Lanham Places (N=511)						Probability [a]	
				Unweighted			Weighted				
1940s Characteristic	**Mean**	**Variance**	**Skew**	**Mean**	**Variance**	**Skew**	**Mean**	**Variance**	**Skew**	**Unweighted**	**Weighted**
log (population)	11.550	3.124	-0.559	7.353	1.455	0.721	10.880	0.629	-1.111	0.000	0.065
Northeast	0.179	0.149	1.679	0.151	0.128	1.953	0.186	0.151	1.618	0.583	0.963
Midwest	0.357	0.234	0.596	0.350	0.228	0.628	0.342	0.225	0.668	0.919	0.939
South	0.375	0.239	0.516	0.423	0.245	0.313	0.390	0.238	0.453	0.493	0.952
West	0.089	0.083	2.881	0.076	0.071	3.191	0.083	0.076	3.018	0.731	0.936
log (WWII contract value)	10.650	12.840	-1.410	1.151	7.843	2.286	9.268	10.830	-1.458	0.000	0.178
County Draft Rate	0.178	0.005	-0.731	0.157	0.004	0.185	0.176	0.001	-1.547	0.014	0.907
Percent Black	0.109	0.014	1.360	0.067	0.017	2.239	0.098	0.013	1.339	0.022	0.766
Percentage of children < 6 out of # children < 18	0.306	0.000	-0.582	0.317	0.002	0.356	0.307	0.001	-1.076	0.049	0.872

[a] Probability for equality of means in a bivariate regression with a constant and a dichotomous variable for Lanham Place (Yes=1).

ages in places that received an LNS. What we are calling the "treated" population is in fact the population that had *access* to the treatment, which *ex post* will include both children who *did* attend the LNS that was available and those who *did not* attend even though an LNS was available. A rough estimate of the proportion of the population in Lanham places who took up the treatment is no more than 13 percent, so point estimates of effect sizes should be inflated by a factor of 7+ to determine the average effect of treatment on the actually treated.

A second complication in drawing causal inferences from our data is that the "treatment" we are observing (even if we knew the specific PT participants who were actually treated by attending an LNS) is actually a bundle of treatments, with at least two components: (1) the child's preschool attendance; and (2) the mother's labor force status. It was not a requirement of LNS attendance that the child's mother be employed, but many of the mothers in these places did in fact go to work when they had not done so previously. In subsequent work, we have the capacity to separate these effects (by examining when mothers entered the labor force, so we can separate LNS children into those with mothers who remained at home from those whose mothers entered the workforce). But in what follows, we must bear in mind that what we are calling an effect of preschool is in fact an effect of preschool itself and a possible change in circumstances in the child's household occasioned by the mother's entry into the labor force. For brevity, we are going to refer to this "bundle" as a preschool effect.

Finally, even among PT participants who attended LNS and whose mother's labor force status could be determined, the LNS experience itself was multidimensional: it included stories, playtime, arts and crafts, nap time, up to three full meals per day, and routine examinations by health professionals (U.S. Department of Agriculture, 1943, pp. 12-13). We lack sufficient detail on the mix of these elements of the daily LNS program to assess the contribution of each to any observed outcomes.

We know that the LNS were not assigned randomly. As Table 4 shows, LNS and non-LNS sites differed substantially in several respects, such as size, racial make-up, and the value of war contracts received. As a result of this non-random treatment assignment, the specific analytic strategy we adopt is a "difference-in-differences" (DiD). Suppose we represent an outcome Y for students in grade g in 1960 given treatment status a as $Y^a(g)$. For 10th graders in 1960, the Average Treatment Effect on the Treated (ATT) is

$$\text{ATT} \equiv \text{E}\left[Y^{LNS}(10) - Y^{non\text{-}LNS}(10) \mid LNS = 1 \right]$$

where the second term is the expected outcome for 10th graders in Lanham places if they had not had access to LNS. We do not observe this term. But with another grade in both Lanham and non-Lanham places that is *not* exposed in either place and the assumption that the change from grade 9 to grade 10

would be the same in both places in the absence of the treatment (the "parallel trends" assumption), we can re-write this as

$$\text{ATT} \equiv \text{E}\left[Y^{LNS}(10) - Y^{non\text{-}LNS}(10) \mid LNS = 1\right]$$

$$= \{ \text{E}\left[\text{Y}^{LNS}(10) \mid LNS = 1\right] - \text{E}[\text{Y}^{\text{LNS}}(9) \mid LNS = 1] \} -$$

$$\{ \text{E}\left[\text{Y}^{\text{non-}LNS}(10) \mid LNS = 0\right] - \text{E}[\text{Y}^{\text{non-LNS}}(9) \mid LNS = 0] \}$$

This, in turn, can be re-written as the 10th grade difference between LNS and non-LNS minus the 9th grade difference between LNS and non-LNS.

We use two approaches to examining the impact of potential LNS participation. The first uses a dichotomous indicator of potential exposure to preschool, coded as Lanham Nursery School place (LNS) or not (non-LNS). The second adds the number of months a participant spent between the ages of 2 and 6 years during the LNS period of operation, defined as June 1, 1943 through March 1, 1946, and an interaction term between the dichotomous LNS place indicator and the number of months. For participants in LNS places, this count represents the number of months of potential exposure to LNS preschool. For brevity, we call this term exposure.

In both approaches, models were stratified by participant sex and a three-level indicator of the grade of the participant in the 1960 base year data collection (9th, 10th, and 11th plus 12th grades) to investigate heterogeneity among men and women and across participants' grades. PT participants in 11th plus 12th grades in 1960 had full potential exposure to LNS (they were age-eligible for the entire period of LNS operation); 10th graders had partial potential exposure, and 9th graders had no potential exposure. This stratification allowed assessment of the effect of being in a Lanham place (dichotomous model: LNS vs. non-LNS grade-level counterparts in 9th, 10th, and 11th plus 12th grades; exposure model: LNS 9th graders vs. non-LNS 9th graders) and the added effect of potential LNS preschool exposure (in the dichotomous model: LNS 9th vs. LNS 10th, and LNS 9th vs. LNS 11th and 12th; in the exposure model: the estimate of the interaction term).

We did not have any *a priori* hypothesis regarding heterogeneity across men and women. Our hypotheses regarding grade heterogeneity were:

1. Agnostic about the difference between 9th graders in Lanham and non-Lanham places. Any difference would indicate a Lanham place effect.
2. Coefficients on the Lanham place indicator in separate regressions by grade would follow this pattern: $\beta_{9th} < \beta_{10th} < \beta_{11th\text{ and }12th}$. This pattern would indicate an LNS preschool effect, and the difference between the 10th or 11th/12th grade β and the 9th grade β would approximate the effect

of preschool exposure (since the 9th graders were unexposed and their β measures the baseline difference in outcome between Lanham and non-Lanham places present when there is no preschool available in either place).

For the continuous exposure variable, we pooled all four grades and used as regressors the dummy for Lanham place, the total months of potential exposure (the number of months the child was age 2 to 6 between June 1, 1943 and March 1, 1946), and an interaction between the exposure measure and the Lanham place dummy.[8]

We then performed several sensitivity tests to assess the robustness of our results to different potential explanations for effects other than preschool.

1. Suppose the difference between Lanham and non-Lanham places is that, for unspecified reasons, children in Lanham places experience different outcomes simply because during the 33 months from June 1943 through March 1946 they pass through a particular phase of development in Lanham places that would lead to different outcomes even in the absence of an actual LNS preschool effect. Then looking at the amount of time spent in *any* 33-month window during which a child was age 2 to 6 would show an advantage for Lanham places. Shifting the LNS window back (1942-45) and forward (1944-47) assesses the plausibility of this challenge in our causal interpretation by examining whether the baseline Lanham place effect is attenuated if the window shifts. Attenuation argues against this challenge.[9]
2. Suppose differences apart from preschools between Lanham places and non-Lanham places are driving any differential effects on outcomes (across grades or across exposure levels). Then non-Lanham places that are "similar" to Lanham places in a propensity score sense should also show grade or exposure effects compared with the other non-Lanham places. This exercise compares, among the non-Lanham places, (1) those that based on their observables (size, racial make-up, war contracts, region) are "like" the actual Lanham places; and (2) those that are not "like" Lanham places.

[8] In addition to the DiD model, we also fit the following series of progressively more complex ordinary least squares models: (1) Weighted: PT weights × entropy balancing; (2) Standard errors clustered at the school level; (3) State fixed effects; (4) Controlling for father's education (more than high school, less) and having one or more older siblings (yes, no); (5) Clustered standard errors, fixed effects, controls; (6) Weights, clustered standard errors, fixed effects, controls; (7) Model (6) plus an interaction between father's education and LNS; (8) Model (6) plus an interaction between having an older sibling and LNS. Detailed tables of results are available from the first author upon request. In addition, for dichotomous outcomes, we ran the models using the logit specification rather than the linear probability specification shown here and obtained the same estimated effect sizes and significance pattern.

[9] Note that shifting the LNS operating window back (forward) a year and maintaining the age 2 to 6 eligibility band is functionally equivalent to keeping the operating window at 1943-46 but lowering (raising) the eligibility age to 1 to 5 (4 to 7). As a result, this sensitivity test also assesses the plausibility of a challenge to our identification based on innate differences between children in LNS and non-LNS places even in the absence of preschool exposure, as it subtracts children who would have been eligible based on age and replaces them with children who would not have been eligible based on their age.

3 Results

3.1 Base model using dichotomous treatment variable

Figure 3 presents the results of an analysis by grade and sex of PT outcomes by Lanham vs. non- Lanham place. Each dot is the point estimate on an indicator variable for whether the PT participant was located early in life in a location that received an LNS (a "Lanham place"). The error bars correspond to the 95% confidence intervals on that point estimate. The point estimates themselves appear as the Baseline Model (BM) in Table 6 below.

The figure lends itself to a simple visual "difference-in-differences" interpretation. Consider IQ, for example. In the top three lines of Figure 3a, the point estimate for IQ on the Lanham place dummy for ninth graders is 0.674 (s.e.=0.205), while for $11^{th}/12^{th}$ graders, it is 1.444 (s.e.=0.137). As the ninth graders were too young to have attended LNS, they are effectively unexposed, even in places that received LNS, so 0.674 represents the baseline Lanham place vs. non-Lanham place outcome difference net of any effect of actual preschool exposure. It represents the effect of the whole range of dimensions (apart from exposure to preschool) along which Lanham and non-Lanham places differed on how the IQ of ninth graders in 1960 differed between Lanham and non-Lanham places. We will call this difference between unexposed ninth grades a "Lanham place effect." Subtracting this 9^{th} grade difference from the $11^{th}/12^{th}$ grade difference yields what we will call a "preschool effect" of 1.444 – 0.674 = 0.770 IQ points. Further, the confidence intervals do not overlap, so the effect is statistically as well as substantively significant – the latter being true in an "Intent to Treat" sense (given that we do not know exactly which PT students actually attended an LNS) with the corresponding need to inflate the observed effect size by a factor of as much as 7 to account for the LNS participation rate.

The "parallel trends" assumption underlying this conclusion is that the difference between Lanham place 9th graders and non-Lanham place 9th graders captures any differences between these places arising from the non-random assignment of Lanham places. As Figure 2a, which charts the raw averages across the cohorts shows, in all but one of the first nine birth quarters following the last quarter with any LNS exposure (1944Q1), the Lanham place and non-Lanham place outcomes are virtually identical (the last four data points are outliers, as very few individuals had > 29 exposure months, causing more noise in the average). It thus appears that the "post-trends" are not just parallel but identical. Recall that we have no "pre-trend" data to assess because the oldest students in PT in 1960 had significant LNS potential exposure based on their birth quarter cohorts.

Overall, men who lived in Lanham places did better on all high school academic measures than their non-Lanham place counterparts (i.e., the "Lanham place effect" in the absence of exposure captured by the 9th grade difference was positive), with a weaker effect observed for effective expression (Figure 3a).

Height, measured in high school but not technically an academic measure, showed a different pattern, but we did not hypothesize a relationship between LNS and height. The significant difference between Lanham place and non-Lanham place 11th and 12th graders, as well as the significant difference from their non-Lanham place grade 9 peers, indicates an added preschool effect. For women, the math composite, which has historically been a noteworthy subject area for improvement in girls, was the only academic outcome to show a positive LNS preschool effect.

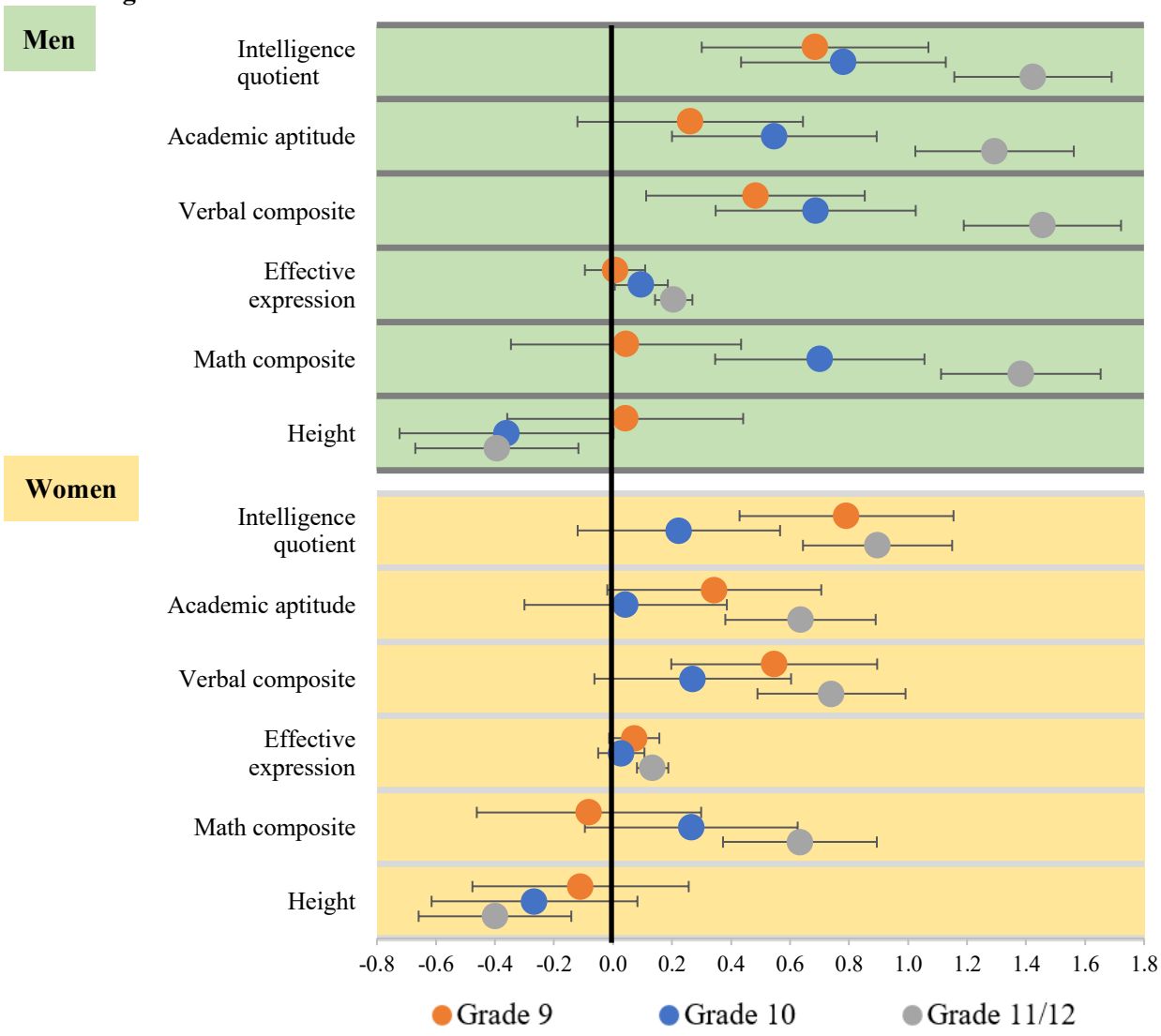
Figure 3b shows the results for high school social emotional measures. Men who grew up in Lanham places had higher scores on 4 of the 9 positive personality traits (social sensitivity, tidiness, leadership, and confidence) and the single less positive trait (impulsivity) than men who grew up in non-Lanham places. There was no added LNS preschool effect, as demonstrated by all three Lanham place grades scoring higher than their non-Lanham place counterparts, specifically grade 9 participants who were too young to be eligible for LNS, and by the non-significant difference between Lanham place 9th and 11th and 12th graders. We see the reverse from our hypothesized pattern (11th and 12th graders < 10th graders < 9th graders) for men's sociability, vigor, and calmness, and vigor was the only outcome with a significant difference between 9th graders and their older Lanham place peers. For impulsivity, all grades in Lanham places were significantly worse, as seen by higher scores, than their non-Lanham place counterparts.

For women, Figure 3b shows that those who grew up in Lanham places had higher scores on 5 positive personality traits than women who grew up in non-Lanham places, but there was no LNS preschool effect. Grades 9 (no potential exposure) and 10 (partial potential exposure), had higher sociability scores than their counterparts in non-Lanham places, and 11th and 12th graders with full potential exposure were not different from their non-Lanham counterparts or Lanham place peers. Significantly higher impulsivity was observed for female 11th and 12th graders in Lanham places than their non-Lanham place counterparts. Because impulsivity is a negative attribute, we have the reverse pattern than hypothesized, and we see the reverse pattern for vigor, leadership, and maturity.

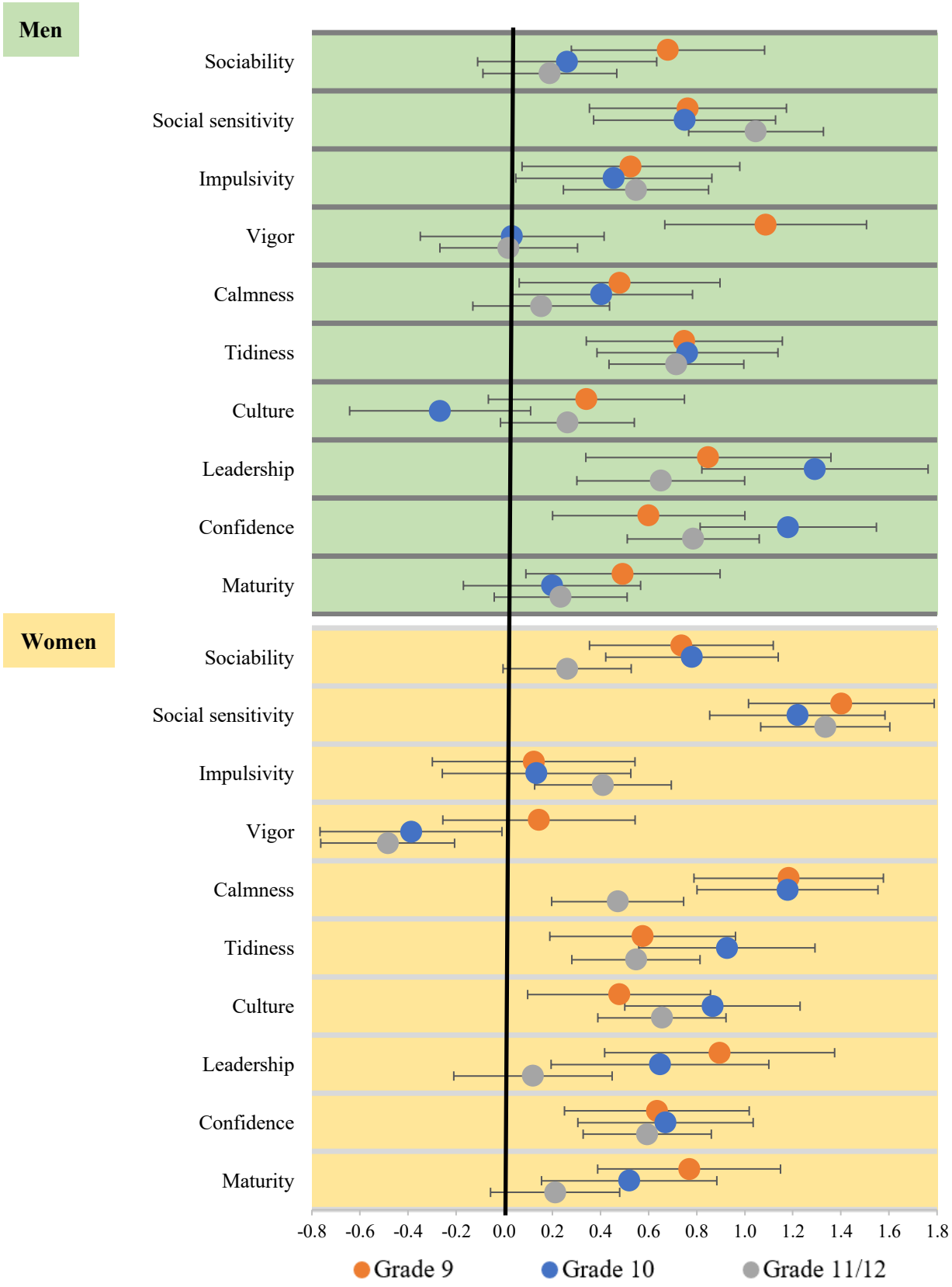
In Year 5 post-graduation results (Figure 3c), only one set of the point estimates aligns as hypothesized in the presence of a preschool effect ("Graduated College" for women). The confidence intervals overlap, so we will conservatively take this as the absence of a preschool effect across this set of outcomes. In Year 11 post-graduation (Figure 3d), however, the Lanham place advantage in income for both men and women in Lanham places was higher for the group with maximum exposure ($11^{th}/12^{th}$ graders) than for the unexposed group (9^{th} graders). The point estimates in the figure are scaled to fit in the range -0.15 to +0.20, but the differences in the point estimates shown in the last panel of Table 6d are substantial. For men, they suggest a preschool effect of $1,600 (13%) per year; for women, they suggest a preschool effect of $786 (13%) per year.

Figure 3. Coefficients and 95% confidence intervals of effect estimates of Lanham Schools on high school and young adult outcomes

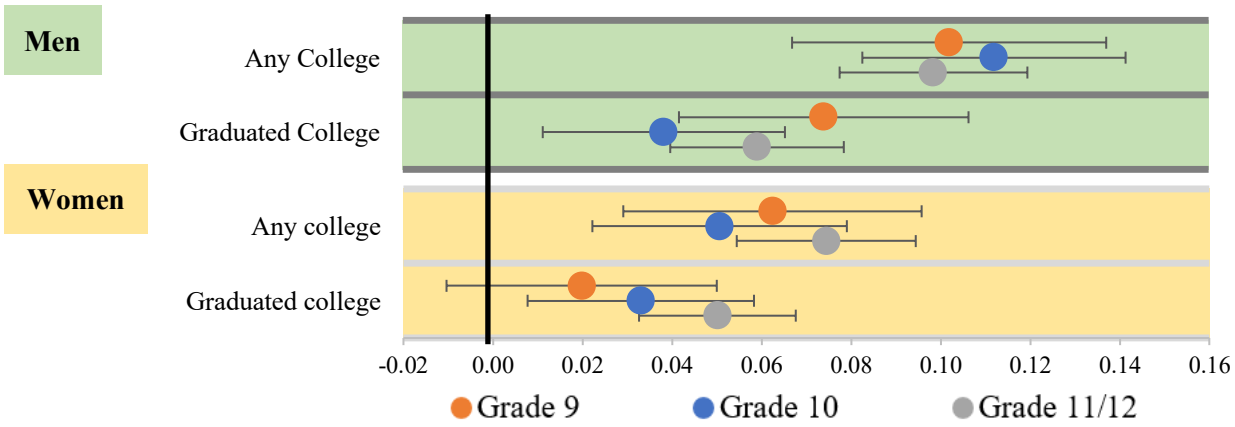
a. High school academic measures



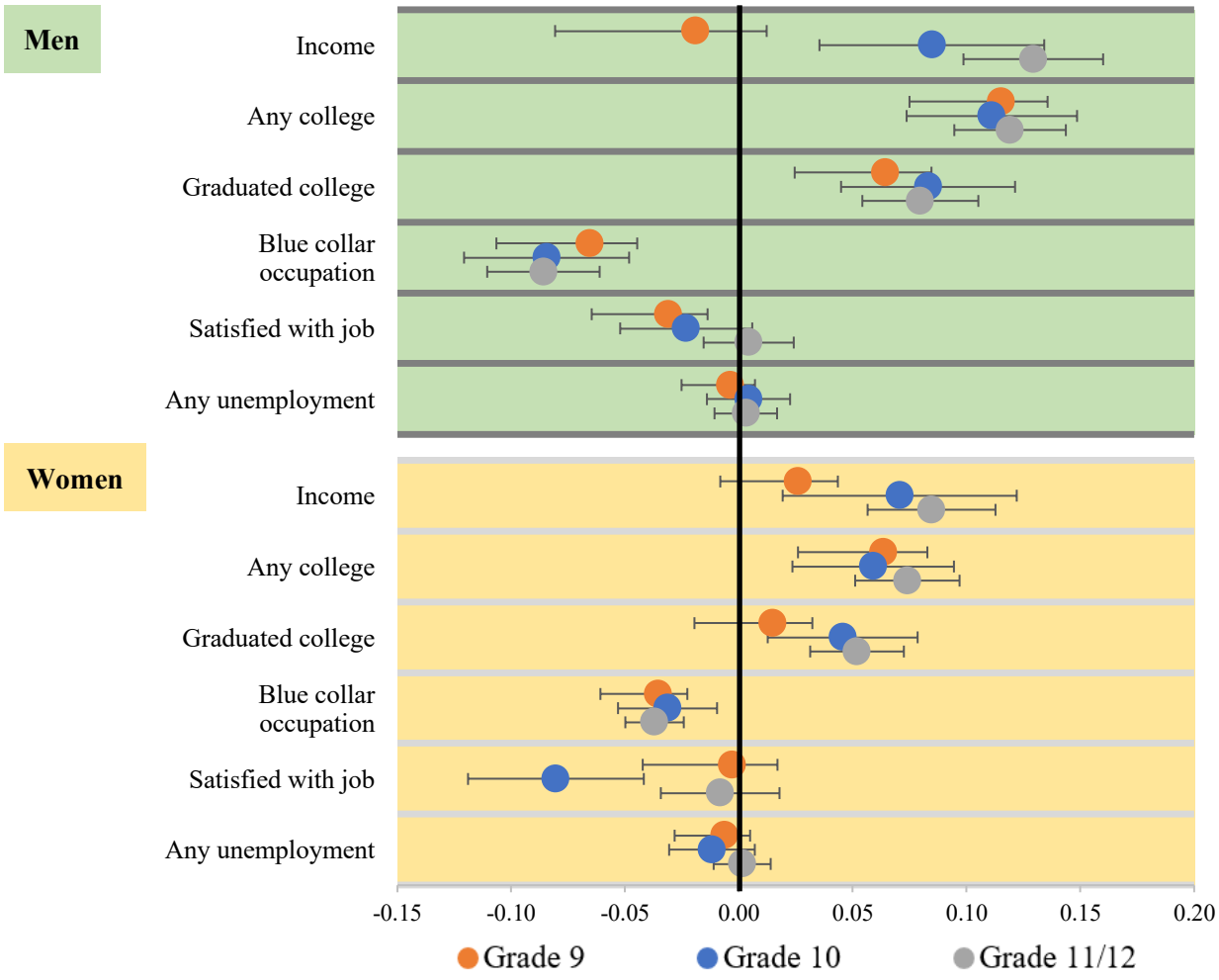
b. High school social emotional measures



c. Year 5 post-high school outcomes



d. Year 11 post high school outcomes



3.2 Exposure base model using dichotomous treatment and continuous exposure variables

We fit the following model, which we will call the exposure base model (EBM), for all outcomes as follows:

$$\text{Outcome} = \alpha + \beta_{\text{Lanham place}} \text{ x } (\text{LNS}=1) + \beta_{\text{exposure}} \text{ x exposure} + \beta_{\text{preschool}} \text{ x } ((\text{LNS}=1) \text{ x exposure} + \varepsilon \quad \text{[Exposure Base Model]}$$

As with the base model in section 3.1, $\beta_{\text{Lanham place}}$ shows the effect of living in a Lanham place vs. a non-Lanham place. Exposure is the number of months that a child was age 2 to 6 in the period June 1, 1943 to March 1, 1946. The interaction term, $\beta_{\text{preschool}}$, shows the effect attributable to preschool (while in the base model, we used stratification to identify the preschool effect based upon differences between 11th and

12th graders and 9th graders). In subsection 3.2a, we begin with an explanation of how to read and interpret the EBM results in the context of the section 3.1 base model results using two outcomes for illustrative purposes. In section 3.2b, we present the EBM regression results for all outcomes

Figure 4 shows the results for academic aptitude and Year 11 income. The predicted scores at 0 exposure months represents the Lanham place effect. If the 95% confidence intervals (95CIs) for the two groups overlap, we conclude no Lanham place effect was present. The differences in the slopes of the line at exposure months > 0 between Lanham and non-Lanham places represent the preschool effect. We compare Lanham place and Lanham preschool effects in these models to the base model results, as well as to the results of sensitivity tests presented in section 3.4, to make conclusions about the presence and strength of a preschool effect.

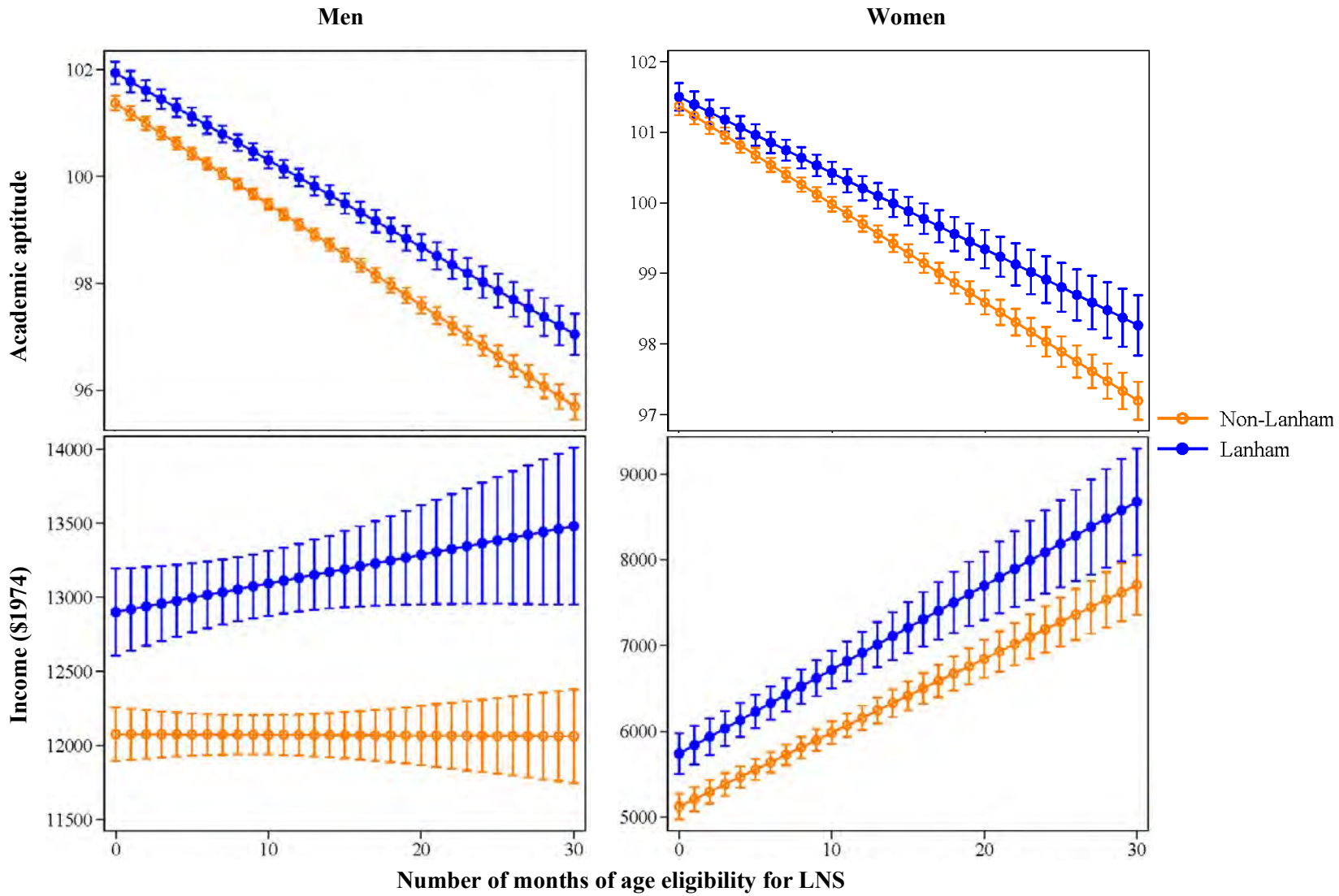
Men from Lanham places had higher academic aptitude scores (Table 5) than their non-Lanham counterparts (Figure 4, estimate at exposure month 0). There was no Lanham place effect for women, but the interaction was significant for both men and women, showing a slower decline with each additional exposure month for Lanham place participants. This corroborates the findings for men from the base model of a preschool effect of exposure (per Figure 3a). For women, the base model did not show a preschool effect (grade 9 was not significantly lower than grades 11 and 12). The magnitude of the interactive effect was equivalent across men and women in this EBM.

Income 11 years post-high school showed a Lanham place effect for both men and women, but no preschool effects. The base model indicated a preschool effect for men and women (Figure 3d).

Table 5. Regression results for exposure base model, academic aptitude & income

Outcome	Men		Women	
	Academic aptitude	Income (1974 $)	Academic aptitude	Income (1974 $)
$\beta_{\text{Lanham place}}$	0.57***	$824.33***	0.13	$617.29***
	[0.13]	[176.60]	[0.12]	[143.85]
β_{exposure}	- 0.19***	-$0.46	-0.14***	$86.08***
	[.005]	[6.96]	[0.005]	[7.10]
$\beta_{\text{preschool}}$	0.03**	$19.83	0.03**	$11.78
	[0.01]	[13.57]	[0.01]	[14.30]
Constant	101.37***	$12,075.23***	101.37***	$5,122.37***
	[.07]	[92.17]	[0. 07]	[76.98]

Figure 4. Linear predictions of exposure effect by Lanham/non-Lanham place, all grades pooled



3.3 Heterogeneity by father's education

We have already described differential effects across two dimensions (sex and grade). Here we assess a third dimension—father's educational attainment. Differences in the effect of preschool exposure across this dimension have implications for projecting how this early-life treatment can reduce inequity: if the effects of preschool exposure accrue primarily to those from higher SES households with more educated fathers, then this intervention might merely exacerbate inequity across generations.

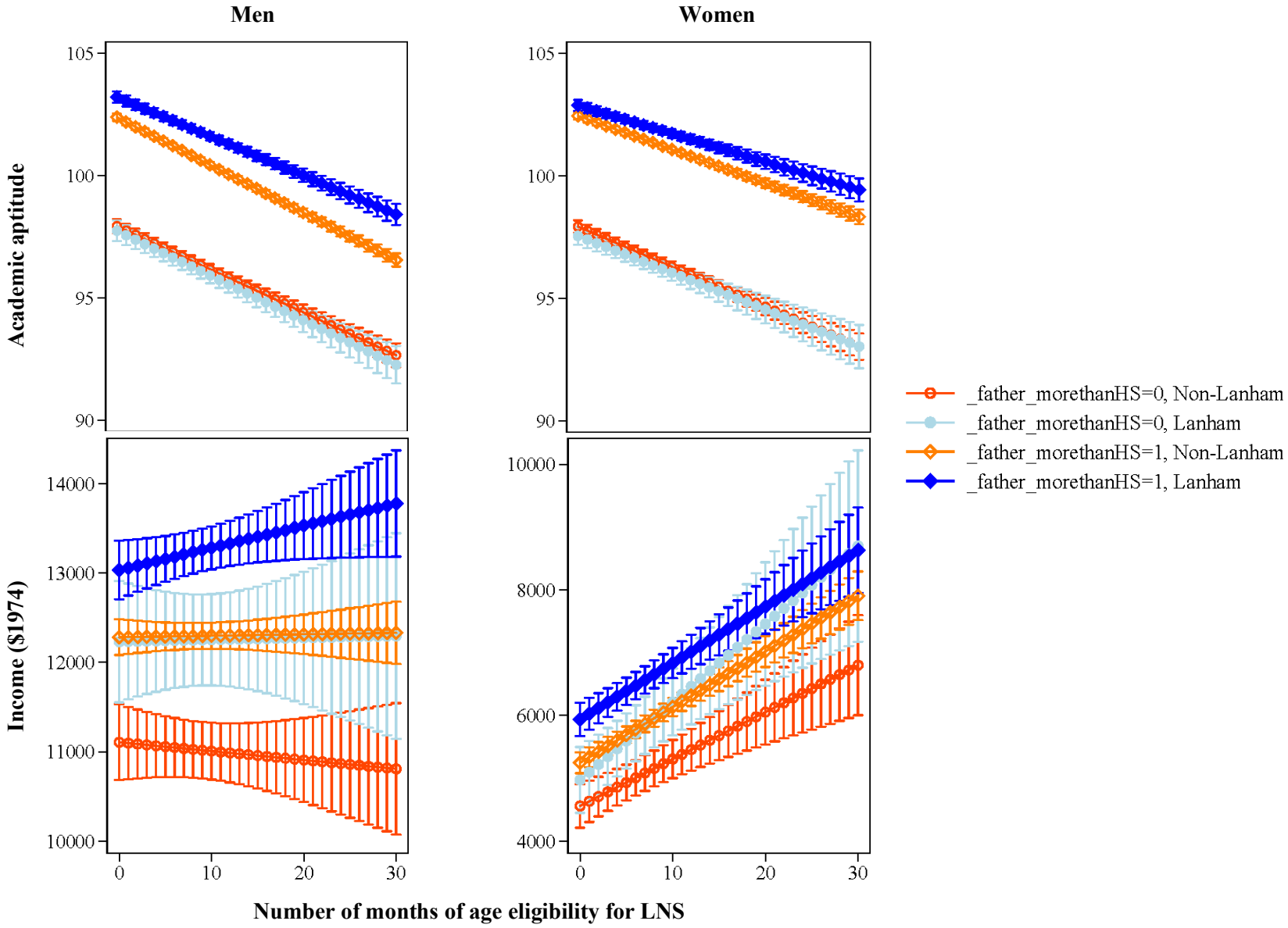
To determine whether the preschool effects we have seen above differ by father's education, we introduce an additional indicator variable (for whether the father had more than a high school education) which we then interact with the Lanham place x exposure interaction on which we focused above. Here, a differential effect of preschool on an outcome would appear graphically as an exposure gradient difference (LNS vs. non-LNS) that in turn differed between those with a father with less than a high school education and those with a father having at least a high school education. Such a differential effect would appear in the regression coefficients themselves for the three-way interaction (Lanham place) x (exposure) x (father > high school). Figure 6 shows the graphical results for academic aptitude and Year 11 income for men and women. In these four cases, only one (Year 11 Income for women) shows a difference by father's education in the gradient difference. As exposure increases in Figure 6d, the income gap between LNS and non-LNS widens for women whose father had no more than a high school education, while the gap remains constant for women with better-educated fathers. The three-way interaction coefficient underlying this figure, however, was neither large nor precisely estimated.

Of the other outcomes (for which the regression coefficients appear in Appendix Table A4), the most striking effect of heterogeneity appears for men's verbal aptitude (the impact of exposure LNS vs. non-LNS is higher for sons of more educated fathers) and men's height (where there is no preschool effect for sons of more educated fathers and an unexpected negative preschool effect for the sons of less educated fathers). We take this general absence of differential outcome-exposure gradient differences as an absence of pronounced effect heterogeneity along the dimension of father's education.

3.4 Sensitivity tests

In order to explore other potential explanations for any preschool effects we observed in the exposure base model, we examined three additional models. This section will present the results of two models where the time period that LNS were open was shifted back one year (1942-1945) and forward one year (1944-1947), and the result of a model comparing non-Lanham places that are "like" Lanham places based on their propensity score to the rest of the non-Lanham places. The year shifts allow us to examine the alternative explanation that findings of "preschool" effects can be attributed to some community feature other than LNS preschool that advantaged Lanham places in high school and young

Figure 5. Heterogeneity by father's education in linear predictions of exposure effect by Lanham/non-Lanham place, all grades pooled



adult educational and labor outcomes. If, for example, the K-12 schools in Lanham places are simply *better* than those in the non-Lanham places, we would observe effects over any 33-month interval when PT participants were age 2-6 years equivalent with those observed using 1943-1946 because school quality is driving the difference.

For the readers reference as we iterate through these sensitivity tests, Table 6 in section 3.2b presents these sensitivity model results for comparison to the EBM. At the end of this section, we take stock of the results across all models to make final conclusions on the presence (and direction) or absence of effects.

3.4a Sensitivity model 1 (SM1): LNS open window shifted back one year (1942-1945)

If some community feature other than preschool can explain any preschool effects observed in the EBM, the results of the sensitivity test in this section and in section 3.4b would show similar Lanham place and preschool effects. Shifting the open date to a year when children did not actually have access to preschool exposure (1942) yet finding a significant exposure interaction as large in magnitude as the original EBM effect would indicate that something else that is correlated with preschool exposure explains at least part of the effect. Attenuation compared to the original effect, however, provides evidence against an alternative mechanism unrelated to preschool. As in section 3.2a, we present graphs of the linear predictions of academic aptitude and Year 11 income from SM1.

Figure 6 shows a Lanham place effect for men on both academic aptitude ($\beta = 0.72$, $p < 0.001$) and income ($\beta = \$952.00$, $p < 0.001$; Table 6a). For women, the regression indicated no Lanham place effect for academic aptitude ($\beta = 0.26$, $p < 0.01$) but a positive effect on income ($\beta = \$639.40$, $p < 0.001$; Table 6b). Both of these sets of effect sizes are larger than those from the exposure base model. The exposure interaction was not significant for either sex on either outcome. In no cases where we previously observed a large and precisely estimated preschool effect with the actual LNS effective dates and age eligibility did shifting the effective dates back yield an effect that was both as large in magnitude and as precisely estimated as what we observed originally.

3.4b Sensitivity model 2 LNS open window shifted forward one year (1944-1947)

Figure 7 and the regression coefficients in Table 6 indicate no Lanham place effect for men on academic aptitude, but a positive Lanham place effect on income (larger effect size than found in EBM). The interaction effects were significantly positive for both outcomes. For women, there was a Lanham place effect for both outcomes, but no preschool effect for either. In no cases where we previously observed a large and precisely estimated preschool effect with the actual LNS effective dates and age eligibility did shifting the effective dates forward yield an effect that was both as large in magnitude and as precisely estimated as what we observed originally.

Figure 6. LNS open window shift to 1942-1945: Linear predictions of exposure effect by Lanham/non-Lanham place, all grades pooled

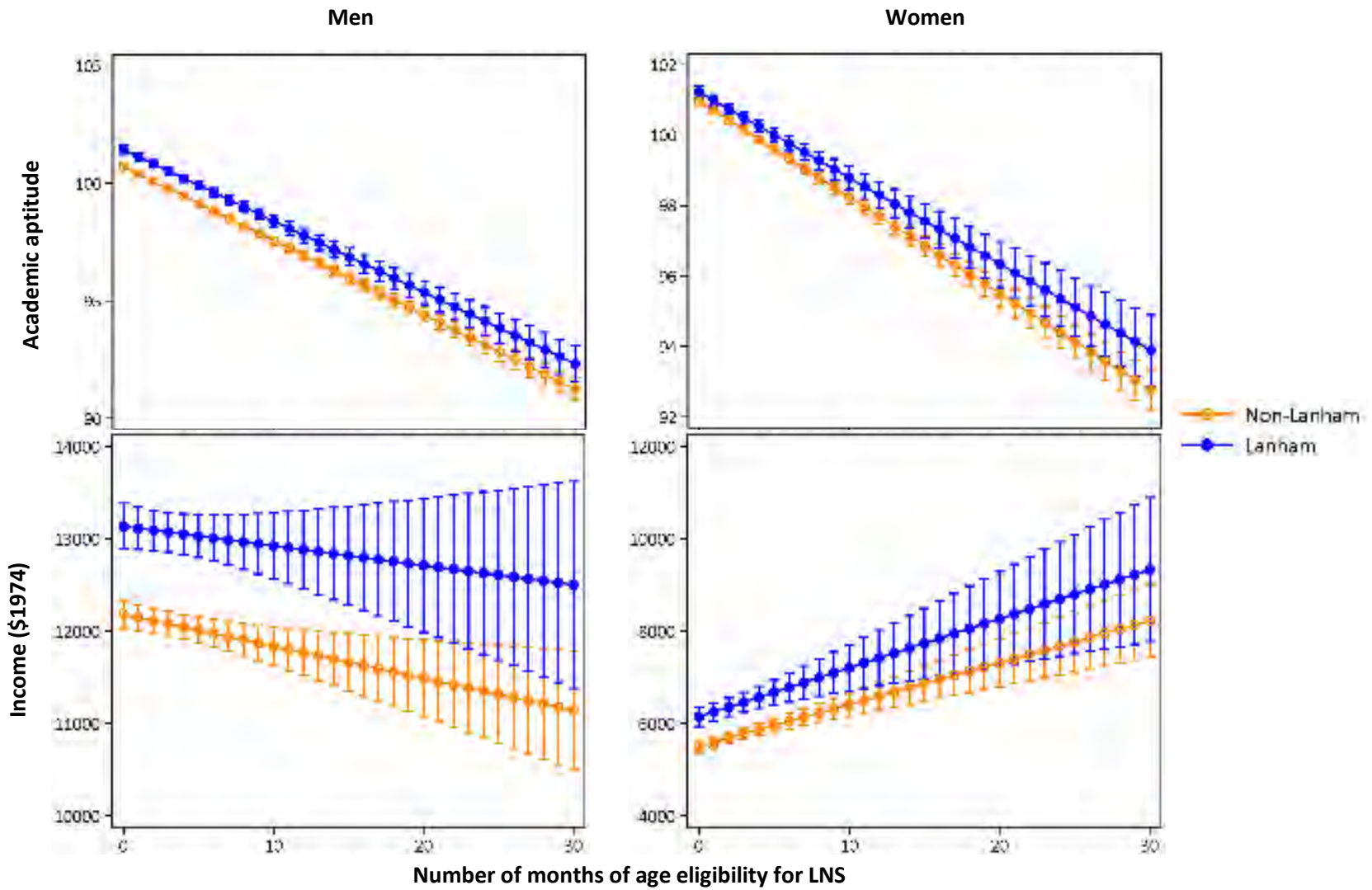
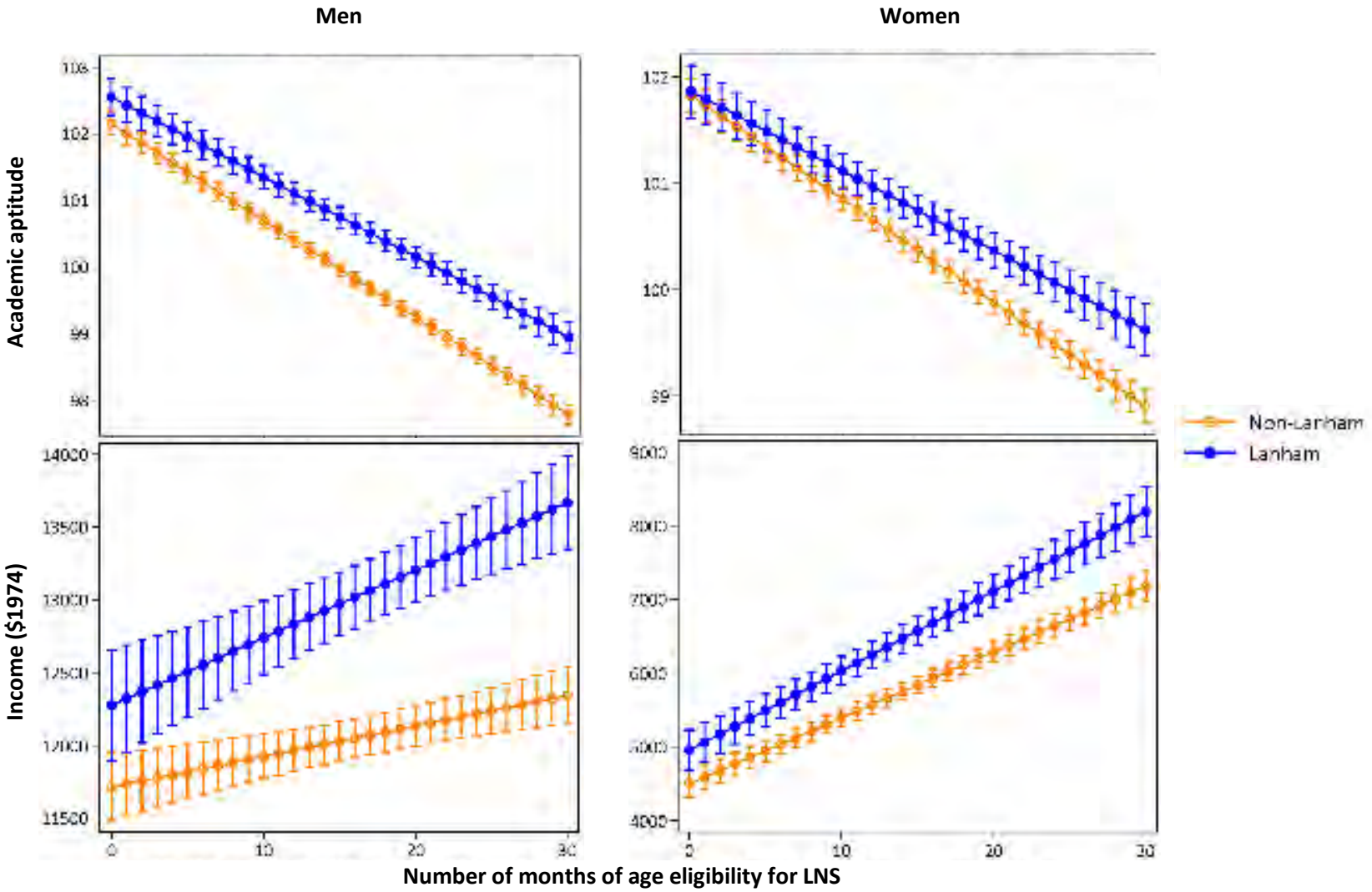


Figure 7. LNS open window shift to 1944-1947: Linear predictions of exposure effect by Lanham/non-Lanham place, all grades pooled

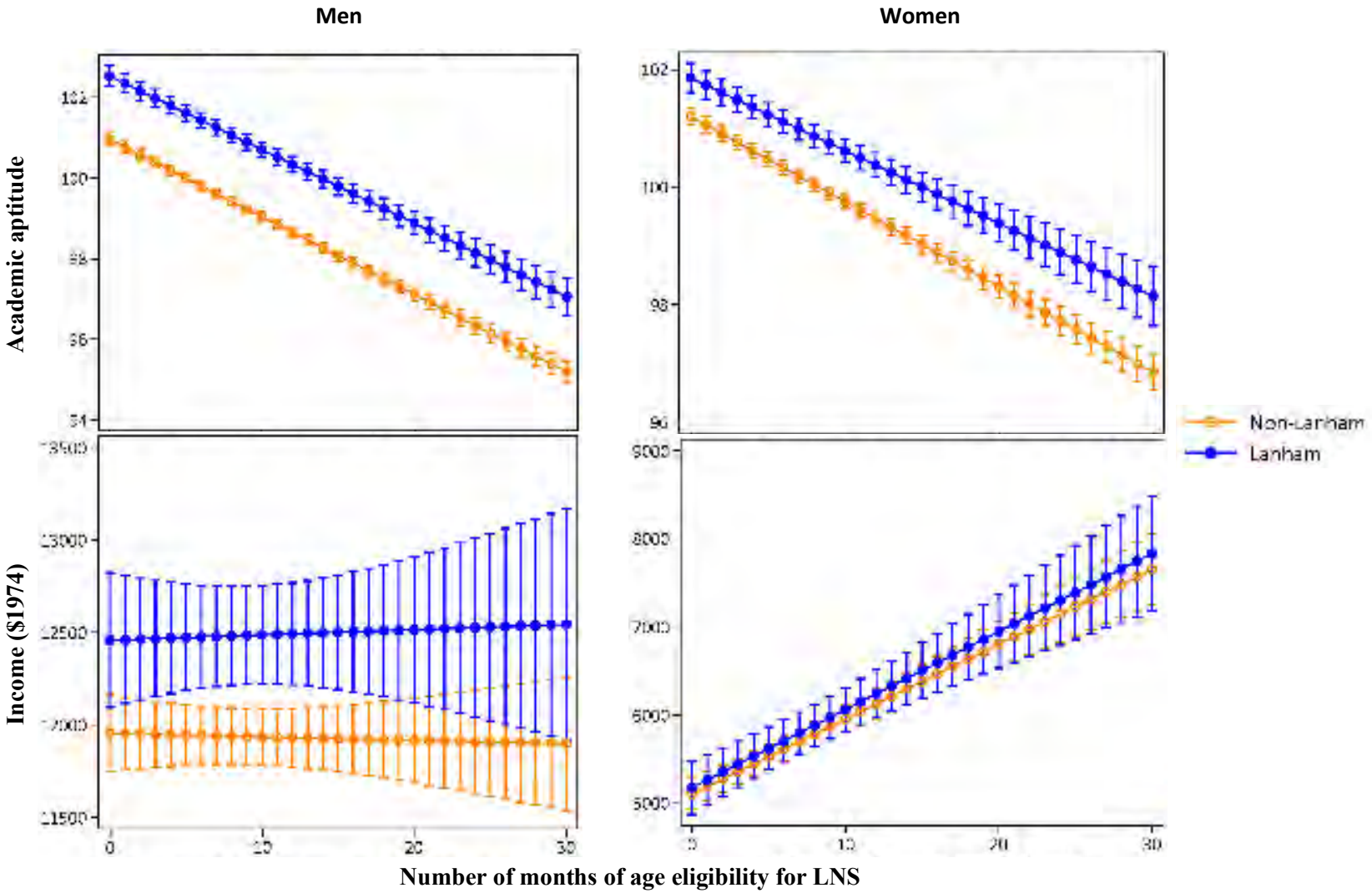


3.4c Sensitivity model 3: LNS-like non-Lanham places vs. other non-Lanham places

This final sensitivity test is similar to a regression discontinuity design and compares PT participants from two types of places: (1) those from non-Lanham places that were statistically similar to Lanham places; and (2) those from non-Lanham places that were not "Lanham-like" (section 2.3). If we observe a significant exposure interaction term when we know there was no preschool in those Lanham-like places, then we know that the preschool effect observed in the EBM reflects something other than preschool.

Figure 8 shows clear Lanham place effects for men's academic aptitude and income and women's academic aptitude, but not women's income. The slopes are statistically parallel for both sexes across both outcomes, indicating no exposure interaction effect. In Table 6, most of the preschool effects detected in the EBM (Col. 4) are eliminated in SM3 (Col. 7) when we compare non-Lanham places that were "like" Lanham places to non-Lanham places that were not "like" Lanham places. There is one striking exception to this generalization: an effect on women's IQ remains in Col. 7, from which we conclude that we cannot demonstrate a preschool effect on IQ for women, as "exposure" has a similar effect in non-Lanham places that are merely "like" Lanham places.

Figure 8. LNS-like non-Lanham places vs. the rest of the non-Lanham places



3.5 Results summary

Table 6 presents the regression results for all 23 outcomes for which we hypothesized a preschool effect (i.e., excluding height) from the base model (BM, section 3.1) and the EBM and three sensitivity models (sections 3.2 and 3.4). Because the three sensitivity tests examine whether there could be an explanation other than preschool for significant exposure interactions, a significant preschool effect in two out of the three sensitivity models negates a significant finding in the EBM. If two of the three grades show a Lanham place effect in the BM, we conclude the presence of a Lanham place effect for that model.

Here, we compare the findings across models to arrive at an interpretation of effects. We present the results for men, followed by the results for women.

Men's outcomes (Table 6a)

Both the BM and EBM supported positive Lanham place and preschool effects for IQ, academic aptitude, and verbal composite. Both models supported a positive Lanham place effect but no preschool effect for social sensitivity, impulsivity, tidiness, leadership, confidence, any college and graduating college by 5 and 11 years post high school, and having a blue-collar job 11 years post high school. We add calmness to this list of a positive Lanham place effect but no preschool effect because the sensitivity models suggest the EBM result should not be attributed to a preschool effect. And, both models indicate no Lanham place or preschool effects for culture or being satisfied with their job or experiencing any unemployment by 11 years post high school. The comparative results for the remaining outcomes are summarized below.

- Models conflicted on a Lanham place effect but agreed on a positive preschool effect for effective expression and no preschool effect for sociability and maturity (taking sensitivity model results into account for the latter).
- Models agreed on a Lanham place effect but conflicted on a preschool effect for math and income.
- There was disagreement on both effects for vigor.

The BM indicated a preschool effect for 11th and 12th grade vs. 9th grade (Figures 3a and 3b), while the EBM showed no preschool effect for both math and vigor (lower vigor for Lanham place 11th and 12th graders vs. 9th and 10th graders). Given the BM did not show a preschool effect for 10th vs. 9th graders and the EBM results, we conclude no preschool effect for men's math composite or vigor. For income, the results are inconclusive as the BM showed a "full" preschool effect (10th, 11th, and 12th graders in Lanham places made more than 9th graders) but the EBM showed no preschool effect.

Table 6. Regression results for Lanham place and preschool effect indicators, all models

a. Men

Outcome (LNS open)	Effect Estimate	BM [a] (1943-46)			EBM (1943-46)	SM1 (1942-45)	SM2 (1944-47)	SM3 [b] (1943-46)
		Grade 9	Grade 10	Grades 11 & 12	Grades pooled	Grades pooled	Grades pooled	Grades pooled
High school academic								
IQ	$\beta_{Lanham\ place}$	0.674***	0.802***	1.444***	0.763***	0.910***	0.645***	1.259***
		[0.205]	[0.179]	[0.137]	[0.127]	[0.107]	[0.165]	[0.153]
	$\beta_{preschool}$	--	--	--	0.0299**	0.0258	0.0244**	0.0214
		--	--	--	[0.00984]	[0.0168]	[0.00807]	[0.0116]
	95% CI	[0.27, 1.08]	[0.45, 1.15]	[1.18, 1.71]	--	--	--	--
Academic aptitude	$\beta_{Lanham\ place}$	0.237	0.579**	1.311***	0.565***	0.720***	0.400*	1.566***
		[0.204]	[0.179]	[0.138]	[0.127]	[0.107]	[0.165]	[0.152]
	$\beta_{preschool}$	--	--	--	0.0262**	0.0120	0.0255**	0.00995
		--	--	--	[0.00986]	[0.0169]	[0.00807]	[0.0115]
	95% CI	[-0.16, 0.64]	[0.23, 0.93]	[1.04, 1.58]	--	--	--	--
Verbal composite	$\beta_{Lanham\ place}$	0.436*	0.720***	1.472***	0.758***	0.896***	0.640***	1.808***
		[0.196]	[0.175]	[0.137]	[0.125]	[0.105]	[0.162]	[0.149]
	$\beta_{preschool}$	--	--	--	0.0230*	0.00820	0.0210**	0.0178
		--	--	--	[0.00966]	[0.0165]	[0.00791]	[0.0112]
	95% CI	[0.05, 0.82]	[0.38, 1.06]	[1.20, 1.74]	--	--	--	--
Effective expression	$\beta_{Lanham\ place}$	-0.00454	0.0869	0.209***	0.121***	0.154***	0.0786	0.267***
		[0.0542]	[0.0463]	[0.0324]	[0.0329]	[0.0278]	[0.0424]	[0.0401]
	$\beta_{preschool}$	--	--	--	0.00599*	0.00566	0.00532*	-0.000205
		--	--	--	[0.00255]	[0.00436]	[0.00208]	[0.00303]
	95% CI	[-0.11, 0.10]	[-0.004, 0.18]	[0.15, 0.27]	--	--	--	--
Math composite	$\beta_{Lanham\ place}$	0.0225	0.734***	1.401***	0.684***	0.818***	0.513**	1.467***
		[0.209]	[0.183]	[0.139]	[0.130]	[0.109]	[0.168]	[0.153]
	$\beta_{preschool}$	--	--	--	0.0174	-0.00562	0.0212**	-0.00356
		--	--	--	[0.0100]	[0.0171]	[0.00821]	[0.0116]
	95% CI	[-0.39, 0.43]	[0.38, 1.09]	[1.13, 1.67]	--	--	--	--
Height	$\beta_{Lanham\ place}$	-0.0528	-0.340	-0.408**	-0.266*	-0.302**	-0.176	0.114
		[0.213]	[0.186]	[0.142]	[0.134]	[0.113]	[0.173]	[0.165]
	$\beta_{preschool}$	--	--	--	-0.00467	-0.00300	-0.00785	-0.00794
		--	--	--	[0.0104]	[0.0178]	[0.00846]	[0.0124]
	95% CI	[-0.47, 0.36]	[-0.80, 0.02]	[-0.69, -0.13]	--	--	--	--

Outcome (LNS open)	Effect Estimate	BM [a] (1943-46)			EBM (1943-46)	SM1 (1942-45)	SM2 (1944-47)	SM3 [b] (1943-46)
		Grade 9	Grade 10	Grades 11 & 12	Grades pooled	Grades pooled	Grades pooled	Grades pooled
High school social emotional								
Sociability	$\beta_{Lanham\ place}$	0.624**	0.261	0.213	0.428**	0.383***	0.556**	0.560***
		[0.214]	[0.192]	[0.143]	[0.136]	[0.114]	[0.176]	[0.165]
	$\beta_{preschool}$	--	--	--	-0.0139	-0.0286	-0.0144	0.00640
		--	--	--	[0.0105]	[0.0178]	[0.00858]	[0.0125]
	95% CI	[0.20, 1.04]	[-0.12, 0.64]	[-0.7, 0.49]	--	--	--	--
Social sensitivity	$\beta_{Lanham\ place}$	0.610**	0.733***	1.064***	0.751***	0.838***	0.708***	0.866***
		[0.218]	[0.195]	[0.144]	[0.138]	[0.116]	[0.178]	[0.168]
	$\beta_{preschool}$	--	--	--	0.0122	0.00461	0.00921	0.00324
		--	--	--	[0.0106]	[0.0180]	[0.00868]	[0.0127]
	95% CI	[0.18, 1.04]	[0.35, 1.12]	[0.78, 1.35]	--	--	--	--
Impulsivity	$\beta_{Lanham\ place}$	0.460	0.474*	0.549***	0.495***	0.486***	0.570**	0.0209
		[0.240]	[0.210]	[0.155]	[0.149]	[0.125]	[0.194]	[0.180]
	$\beta_{preschool}$	--	--	--	0.00159	0.00661	-0.00354	-0.00455
		--	--	--	[0.0115]	[0.0195]	[0.00944]	[0.0135]
	95% CI	[-0.01, 0.93]	[0.06, 0.89]	[0.25, 0.85]	--	--	--	--
Vigor	$\beta_{Lanham\ place}$	0.984***	0.0380	0.0299	0.328*	0.254*	0.587**	0.734***
		[0.223]	[0.196]	[0.147]	[0.140]	[0.117]	[0.181]	[0.170]
	$\beta_{preschool}$	--	--	--	-0.0119	-0.0129	-0.0210*	-0.0252*
		--	--	--	[0.0108]	[0.0184]	[0.00882]	[0.0128]
	95% CI	[0.55, 1.42]	[-0.35, 0.42]	[-0.26, 0.32]	--	--	--	--
Calmness	$\beta_{Lanham\ place}$	0.465*	0.407*	0.150	0.479***	0.379**	0.637***	0.533**
		[0.223]	[0.195]	[0.146]	[0.139]	[0.117]	[0.180]	[0.171]
	$\beta_{preschool}$	--	--	--	-0.0236*	-0.0373*	-0.0212*	-0.0145
		--	--	--	[0.0107]	[0.0183]	[0.00880]	[0.0129]
	95% CI	[0.03, 0.90]	[0.02, 0.79]	[-0.14, 0.44]	--	--	--	--
Tidiness	$\beta_{Lanham\ place}$	0.677**	0.740***	0.716***	0.760***	0.729***	0.853***	1.099***
		[0.218]	[0.194]	[0.144]	[0.137]	[0.115]	[0.177]	[0.167]
	$\beta_{preschool}$	--	--	--	-0.00732	-0.0128	-0.00884	0.00649
		--	--	--	[0.0106]	[0.0180]	[0.00866]	[0.0126]
	95% CI	[0.25, 1.10]	[0.36, 1.12]	[0.43, 1.00]	--	--	--	--
Culture	$\beta_{Lanham\ place}$	0.227	-0.270	0.258	0.117	0.138	0.203	0.126
		[0.217]	[0.194]	[0.143]	[0.136]	[0.115]	[0.176]	[0.167]
	$\beta_{preschool}$	--	--	--	-0.00273	-0.0157	-0.00628	0.00809
		--	--	--	[0.0105]	[0.0179]	[0.00862]	[0.0126]
	95% CI	[-0.20, 0.65]	[-0.65, 0.11]	[-0.02, 0.54]	--	--	--	--

Outcome (LNS open)	Effect Estimate	BM [a] (1943-46)			EBM (1943-46)	SM1 (1942-45)	SM2 (1944-47)	SM3 [b] (1943-46)
		Grade 9	Grade 10	Grades 11 & 12	Grades pooled	Grades pooled	Grades pooled	Grades pooled
Leadership	$\beta_{Lanham\ place}$	0.875**	1.277***	0.707***	1.115***	0.995***	1.233***	0.418*
		[0.273]	[0.242]	[0.179]	[0.172]	[0.144]	[0.222]	[0.210]
	$\beta_{preschool}$	--	--	--	-0.0254	-0.0359	-0.0199	-0.0101
		--	--	--	[0.0131]	[0.0224]	[0.0107]	[0.0157]
	95% CI	[0.34, 1.41]	[0.80, 1.75]	[0.36, 1.06]	--	--	--	--
Confidence	$\beta_{Lanham\ place}$	0.683**	1.172***	0.788***	1.019***	0.945***	1.125***	0.447**
		[0.214]	[0.189]	[0.141]	[0.134]	[0.113]	[0.174]	[0.162]
	$\beta_{preschool}$	--	--	--	-0.0192	-0.0340	-0.0157	0.00628
		--	--	--	[0.0104]	[0.0177]	[0.00849]	[0.0123]
	95% CI	[0.26, 1.10]	[0.80, 1.75]	[0.36, 1.06]	--	--	--	--
Maturity	$\beta_{Lanham\ place}$	0.441*	0.190	0.236	0.495***	0.382***	0.670***	0.322*
		[0.215]	[0.190]	[0.142]	[0.135]	[0.113]	[0.174]	[0.164]
	$\beta_{preschool}$	--	--	--	-0.0274**	-0.0442*	-0.0241**	-0.00736
		--	--	--	[0.0104]	[0.0177]	[0.00852]	[0.0124]
	95% CI	[0.02, 0.86]	[0.80, 1.54]	[0.51, 1.06]	--	--	--	--
Year 5 post H.S.								
Attended any college	$\beta_{Lanham\ place}$	0.0995***	0.110***	0.101***	0.113***	0.110***	0.115***	0.0660***
		[0.0182]	[0.0152]	[0.0107]	[0.0107]	[0.00892]	[0.0137]	[0.0132]
	$\beta_{preschool}$	--	--	--	-0.00119	-0.00304*	-0.000636	0.000320
		--	--	--	[0.000838]	[0.00151]	[0.000668]	[0.00101]
	95% CI	[0.06, 0.14]	[0.08, 0.14]	[0.08, 0.12]	--	--	--	--
Graduated college	$\beta_{Lanham\ place}$	0.0749***	0.0401**	0.0613***	0.0690***	0.0640***	0.0749***	0.0409***
		[0.0169]	[0.0140]	[0.01000]	[0.00990]	[0.00829]	[0.0127]	[0.0120]
	$\beta_{preschool}$	--	--	--	-0.00141	-0.00303*	-0.00102	-9.60e-05
		--	--	--	[0.000778]	[0.00140]	[0.000620]	[0.000911]
	95% CI	[0.04, 0.11]	[0.01, 0.07]	[0.04, 0.08]	--	--	--	--
Year 11 post H.S.								
Income	$\beta_{Lanham\ place}$	-280.5	841.9***	1,302***	824.3***	952.0***	561.5*	505.1*
		[349.6]	[254.8]	[157.0]	[176.6]	[147.5]	[226.8]	[213.2]
	$\beta_{preschool}$	--	--	--	19.83	13.55	25.42*	4.670
		--	--	--	[13.57]	[23.90]	[10.91]	[16.01]
	95% CI	[-965.72, 404.72]	[342.49, 1,341.31]	[994.28, 1,609.72]	--	--	--	--
Attended any college	$\beta_{Lanham\ place}$	0.110***	0.110***	0.121***	0.106***	0.111***	0.0994***	0.126***
		[0.0225]	[0.0193]	[0.0126]	[0.0132]	[0.0109]	[0.0171]	[0.0162]
	$\beta_{preschool}$	--	--	--	0.000788	0.000103	0.000797	-0.00238*

Outcome (LNS open)	Effect Estimate	BM [a] (1943-46)			EBM (1943-46)	SM1 (1942-45)	SM2 (1944-47)	SM3 [b] (1943-46)
		Grade 9	Grade 10	Grades 11 & 12	Grades pooled	Grades pooled	Grades pooled	Grades pooled
		--	--	--	[0.00101]	[0.00176]	[0.000814]	[0.00120]
	95% CI	[0.07, 0.15	[0.07, 0.15	[0.10, 0.15]	--	--	--	--
Graduated college	$\beta_{Lanham\ place}$	0.0677**	0.0810***	0.0802***	0.0881***	0.0815***	0.0911***	0.0866***
		[0.0230]	[0.0196]	[0.0131]	[0.0133]	[0.0111]	[0.0171]	[0.0161]
	$\beta_{preschool}$	--	--	--	-0.00179	-0.00361*	-0.000984	-0.00278*
		--	--	--	[0.00104]	[0.00183]	[0.000830]	[0.00122]
	95% CI	[0.02, 0.11	[0.04, 0.12	[0.05, 0.11]	--	--	--	--
Blue collar job	$\beta_{Lanham\ place}$	-0.0471*	-0.0827***	-0.0874***	-0.0737***	-0.0762***	-0.0676***	-0.0564***
		[0.0224]	[0.0186]	[0.0126]	[0.0130]	[0.0108]	[0.0169]	[0.0163]
	$\beta_{preschool}$	--	--	--	-0.000209	0.000673	-0.000541	0.000742
		--	--	--	[0.000991]	[0.00174]	[0.000806]	[0.00119]
	95% CI	[-0.09, 0.00	[-0.12, -0.05)	[-0.11, -0.06]	--	--	--	--
Satisfied with job	$\beta_{Lanham\ place}$	-0.0316	-0.0214	0.00521	-0.0167	-0.0124	-0.0280*	-0.0142
		[0.0193]	[0.0149]	[0.0101]	[0.0106]	[0.00878]	[0.0139]	[0.0129]
	$\beta_{preschool}$	--	--	--	0.000994	0.00150	0.00116	-0.00155
		--	--	--	[0.000807]	[0.00141]	[0.000660]	[0.000951]
	95% CI	[-0.07, 0.01	[-0.05, 0.01	[-0.01, 0.03]	--	--	--	--
Any unemployment	$\beta_{Lanham\ place}$	-0.00961	0.00479	0.00262	-0.00123	-0.00132	-0.00368	-0.00645
		[0.0122]	[0.00942]	[0.00703]	[0.00701]	[0.00584]	[0.00909]	[0.00853]
	$\beta_{preschool}$	--	--	--	0.000283	0.000960	0.000276	0.00129*
		--	--	--	[0.000540]	[0.000950]	[0.000436]	[0.000635]
	95% CI	[-0.03, 0.01	[-0.01, 0.02	[-0.01, 0.02]	--	--	--	--

[a] We compare the 95% CI for each grade in the base model to determine if the preschool effect is significant, as indicated by no overlap between grades 11 and 12 with grade 9.

[b] Participants in non-Lanham places, divided into two groups of those most and least like Lanham places.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Abbreviations: 95% CI = 95% confidence interval around point estimate; EBM = exposure base model; LNS = Lanham schools; SM1/SM2/SM3 = sensitivity model 1/2/3.

b. Women

Outcome (LNS open)	Effect Estimate	BM (1943-46)			EBM (1943-46)	SM1 (1942-45)	SM2 (1944-47)	SM3 [b] (1943-46)
		Grade 9	Grade 10	Grades 11 & 12	Grades pooled	Grades pooled	Grades pooled	Grades pooled
High school academic								
IQ	$\beta_{Lanham\ place}$	0.880***	0.230	0.906***	0.431***	0.553***	0.372*	0.433**
		[0.192]	[0.176]	[0.129]	[0.118]	[0.101]	[0.150]	[0.148]
	$\beta_{preschool}$	--	--	--	0.0317**	0.0358	0.0206**	0.0349**
		--	--	--	[0.0105]	[0.0210]	[0.00781]	[0.0126]
	95% CI	[0.50, 1.26]	[-0.11, 0.57]	[0.65, 1.16]	--	--	--	--
Academic aptitude	$\beta_{Lanham\ place}$	0.402*	0.0404	0.635***	0.129	0.263**	0.0369	0.655***
		[0.192]	[0.177]	[0.130]	[0.119]	[0.101]	[0.150]	[0.148]
	$\beta_{preschool}$	--	--	--	0.0313**	0.0291	0.0226**	0.0214
		--	--	--	[0.0105]	[0.0210]	[0.00784]	[0.0126]
	95% CI	[0.03, 0.78]	[-0.31, 0.39]	[0.38, 0.89]	--	--	--	--
Verbal composite	$\beta_{Lanham\ place}$	0.566**	0.253	0.733***	0.322**	0.415***	0.252	1.075***
		[0.185]	[0.171]	[0.128]	[0.116]	[0.0989]	[0.147]	[0.143]
	$\beta_{preschool}$	--	--	--	0.0248*	0.0256	0.0180*	0.0213
		--	--	--	[0.0103]	[0.0205]	[0.00765]	[0.0122]
	95% CI	[0.20, 0.92]	[-0.08, 0.59]	[0.48, 0.98]	--	--	--	--
Effective expression	$\beta_{Lanham\ place}$	0.0775	0.0296	0.132***	0.0886***	0.111***	0.0675*	0.188***
		[0.0449]	[0.0402]	[0.0271]	[0.0268]	[0.0230]	[0.0337]	[0.0338]
	$\beta_{preschool}$	--	--	--	0.00681**	0.0114*	0.00430*	0.00533
		--	--	--	[0.00237]	[0.00478]	[0.00176]	[0.00287]
	95% CI	[-0.01, 0.17]	[-0.05, 0.11]	[0.08, 0.19]	--	--	--	--
Math composite	$\beta_{Lanham\ place}$	-0.0163	0.271	0.641***	0.164	0.279**	0.0369	0.209
		[0.202]	[0.185]	[0.133]	[0.124]	[0.105]	[0.156]	[0.152]
	$\beta_{preschool}$	--	--	--	0.0214	0.00739	0.0201*	0.0157
		--	--	--	[0.0109]	[0.0219]	[0.00813]	[0.0129]
	95% CI	[-0.41, 0.38]	[-0.09, 0.63]	[0.38, 0.90]	--	--	--	--
Height	$\beta_{Lanham\ place}$	-0.130	-0.244	-0.414**	-0.240*	-0.269**	-0.219	-0.319*
		[0.192]	[0.179]	[0.133]	[0.121]	[0.104]	[0.153]	[0.156]

Outcome (LNS open)	Effect Estimate	BM (1943-46)			EBM (1943-46)	SM1 (1942-45)	SM2 (1944-47)	SM3 [b] (1943-46)
		Grade 9	Grade 10	Grades 11 & 12	Grades pooled	Grades pooled	Grades pooled	Grades pooled
	$\beta_{preschool}$	--	--	--	-0.0113	-0.0300	-0.00630	0.0184
		--	--	--	[0.0107]	[0.0214]	[0.00799]	[0.0132]
	95% CI	[-0.51, 0.25]	[-0.59, 0.11]	[-0.67, -0.15]	--	--	--	--
High school social emotional								
Sociability	$\beta_{Lanham\ place}$	0.690***	0.746***	0.261	0.625***	0.530***	0.729***	0.464**
		[0.203]	[0.184]	[0.136]	[0.125]	[0.107]	[0.158]	[0.159]
	$\beta_{preschool}$	--	--	--	-0.0208	-0.0309	-0.0161	0.0162
		--	--	--	[0.0111]	[0.0222]	[0.00825]	[0.0135]
	95% CI	[0.29, 1.09]	[0.39, 1.11]	[-0.006, 0.53]	--	--	--	--
Social sensitivity	$\beta_{Lanham\ place}$	1.439***	1.202***	1.329***	1.315***	1.321***	1.366***	1.076***
		[0.204]	[0.187]	[0.138]	[0.127]	[0.108]	[0.160]	[0.162]
	$\beta_{preschool}$	--	--	--	-0.000842	-0.0102	-0.00324	0.000780
		--	--	--	[0.0112]	[0.0224]	[0.00835]	[0.0137]
	95% CI	[1.04, 1.84]	[0.84, 1.57]	[1.06, 1.60]	--	--	--	--
Impulsivity	$\beta_{Lanham\ place}$	0.0192	0.107	0.417**	0.139	0.204	0.0799	0.0366
		[0.223]	[0.202]	[0.146]	[0.136]	[0.116]	[0.173]	[0.172]
	$\beta_{preschool}$	--	--	--	0.0133	0.0135	0.0105	0.0104
		--	--	--	[0.0120]	[0.0239]	[0.00895]	[0.0145]
	95% CI	[-0.42, 0.46]	[-0.29, 0.50]	[0.13, 0.70]	--	--	--	--
Vigor	$\beta_{Lanham\ place}$	0.159	-0.405*	-0.484***	-0.319*	-0.364**	-0.229	0.355*
		[0.212]	[0.194]	[0.143]	[0.132]	[0.112]	[0.166]	[0.166]
	$\beta_{preschool}$	--	--	--	-0.00238	0.00768	-0.00636	0.00460
		--	--	--	[0.0117]	[0.0234]	[0.00867]	[0.0141]
	95% CI	[-0.26, 0.57]	[-0.79, -0.02]	[-0.76, -0.20]	--	--	--	--
Calmness	$\beta_{Lanham\ place}$	1.222***	1.144***	0.474***	0.990***	0.850***	1.183***	0.522**
		[0.208]	[0.193]	[0.141]	[0.130]	[0.111]	[0.165]	[0.165]
	$\beta_{preschool}$	--	--	--	-0.0241*	-0.0194	-0.0239**	0.0116
		--	--	--	[0.0115]	[0.0229]	[0.00855]	[0.0139]
	95% CI	[0.81, 1.63]	[0.77, 1.52]	[0.20, 0.75]	--	--	--	--
Tidiness	$\beta_{Lanham\ place}$	0.616**	0.923***	0.574***	0.709***	0.673***	0.750***	0.955***
		[0.204]	[0.189]	[0.137]	[0.127]	[0.108]	[0.160]	[0.161]
	$\beta_{preschool}$	--	--	--	-0.00481	-0.00321	-0.00466	-0.00862

Outcome (LNS open)	Effect Estimate	BM (1943-46)			EBM (1943-46)	SM1 (1942-45)	SM2 (1944-47)	SM3 [b] (1943-46)
		Grade 9	Grade 10	Grades 11 & 12	Grades pooled	Grades pooled	Grades pooled	Grades pooled
		--	--	--	[0.0112]	[0.0224]	[0.00834]	[0.0137]
	95% CI	[0.22, 1.02]	[0.55, 1.29]	[0.31, 0.84]	--	--	--	--
Culture	$\beta_{Lanham\ place}$	0.557**	0.835***	0.662***	0.668***	0.656***	0.689***	0.582***
		[0.201]	[0.187]	[0.137]	[0.126]	[0.107]	[0.159]	[0.159]
	$\beta_{preschool}$	--	--	--	-5.67e-05	0.00124	-0.000814	0.0119
		--	--	--	[0.0111]	[0.0222]	[0.00829]	[0.0135]
	95% CI	[0.16, 0.95]	[0.47, 1.20]	[0.39, 0.93]	--	--	--	--
Leadership	$\beta_{Lanham\ place}$	0.931***	0.638**	0.133	0.715***	0.536***	0.898***	0.200
		[0.254]	[0.232]	[0.168]	[0.157]	[0.134]	[0.198]	[0.201]
	$\beta_{preschool}$	--	--	--	-0.0371**	-0.0466	-0.0295**	-0.0153
		--	--	--	[0.0138]	[0.0278]	[0.0103]	[0.0170]
	95% CI	[0.43, 1.43]	[0.18, 1.08]	[-0.19, 0.46]	--	--	--	--
Confidence	$\beta_{Lanham\ place}$	0.662**	0.646***	0.594***	0.627***	0.604***	0.674***	0.292
		[0.204]	[0.187]	[0.136]	[0.126]	[0.108]	[0.159]	[0.158]
	$\beta_{preschool}$	--	--	--	-0.00266	-0.00206	-0.00392	-0.000244
		--	--	--	[0.0112]	[0.0222]	[0.00830]	[0.0134]
	95% CI	[0.26, 1.06]	[0.28, 1.01]	[0.38, 0.86]	--	--	--	--
Maturity	$\beta_{Lanham\ place}$	0.802***	0.468*	0.214	0.602***	0.490***	0.769***	0.177
		[0.202]	[0.187]	[0.138]	[0.127]	[0.108]	[0.160]	[0.160]
	$\beta_{preschool}$	--	--	--	-0.0254*	-0.0370	-0.0228**	-0.0110
		--	--	--	[0.0112]	[0.0223]	[0.00833]	[0.0136]
	95% CI	[0.41, 1.20]	[0.10, 0.83]	[-0.05, 0.48]	--	--	--	--
Year 5 post H.S.								
Attended any college	$\beta_{Lanham\ place}$	0.0619***	0.0490***	0.0747***	0.0567***	0.0594***	0.0565***	0.0228
		[0.0172]	[0.0146]	[0.0102]	[0.00998]	[0.00844]	[0.0127]	[0.0128]
	$\beta_{preschool}$	--	--	--	0.000817	0.00124	0.000447	0.000791
		--	--	--	[0.000883]	[0.00182]	[0.000652]	[0.00107]
	95% CI	[0.03, 0.10]	[0.02, 0.08]	[0.05, 0.09]	--	--	--	--
Graduated college	$\beta_{Lanham\ place}$	0.0176	0.0323*	0.0505***	0.0369***	0.0376***	0.0351**	0.00855
		[0.0156]	[0.0130]	[0.00900]	[0.00886]	[0.00749]	[0.0112]	[0.0112]
	$\beta_{preschool}$	--	--	--	-3.23e-06	-0.000658	0.000150	-0.000126
		--	--	--	[0.000784]	[0.00162]	[0.000578]	[0.000942]
	95% CI	[-0.01, 0.05]	[0.01, 0.06]	[0.03, 0.07]	--	--	--	--
Year 11 post H.S.								

Outcome (LNS open)	Effect Estimate	BM (1943-46)			EBM (1943-46)	SM1 (1942-45)	SM2 (1944-47)	SM3 [b] (1943-46)
		Grade 9	Grade 10	Grades 11 & 12	Grades pooled	Grades pooled	Grades pooled	Grades pooled
Income	$\beta_{\text{Lanham place}}$	47.40	733.7**	833.1***	617.3***	639.4***	456.1**	70.09
		[196.5]	[264.3]	[144.0]	[143.9]	[128.2]	[166.6]	[178.0]
	$\beta_{\text{preschool}}$	--	--	--	11.78	15.60	18.33	3.634
		--	--	--	[14.30]	[31.25]	[9.573]	[15.82]
	95% CI	[-337.74, 432.54]	[215.67, 1,251.73]	[550.86, 1,115.34]	--	--	--	--
Attended any college	$\beta_{\text{Lanham place}}$	0.0525*	0.0578**	0.0734***	0.0537***	0.0576***	0.0500**	0.0266
		[0.0212]	[0.0182]	[0.0117]	[0.0122]	[0.0101]	[0.0156]	[0.0154]
	$\beta_{\text{preschool}}$	--	--	--	0.00108	0.00165	0.000790	3.81e-05
		--	--	--	[0.00104]	[0.00209]	[0.000773]	[0.00122]
	95% CI	[0.01, 0.09]	[0.02, 0.09]	[0.05, 0.10]	--	--	--	--
Graduated college	$\beta_{\text{Lanham place}}$	0.00502	0.0437**	0.0521***	0.0351**	0.0359***	0.0298*	0.0251
		[0.0197]	[0.0170]	[0.0105]	[0.0110]	[0.00919]	[0.0140]	[0.0138]
	$\beta_{\text{preschool}}$	--	--	--	0.000207	-0.000116	0.000509	-2.10e-05
		--	--	--	[0.000952]	[0.00193]	[0.000703]	[0.00112]
	95% CI	[-0.03, 0.04]	[0.01, 0.08]	[0.09, 0.07]	--	--	--	--
Blue collar job	$\beta_{\text{Lanham place}}$	-0.0319*	-0.0317**	-0.0363***	-0.0345***	-0.0327***	-0.0365***	-0.0151
		[0.0132]	[0.0111]	[0.00657]	[0.00712]	[0.00591]	[0.00911]	[0.00958]
	$\beta_{\text{preschool}}$	--	--	--	-3.03e-05	-0.000627	9.63e-05	0.000208
		--	--	--	[0.000605]	[0.00122]	[0.000452]	[0.000759]
	95% CI	[-0.06, -0.01]	[-0.05, -0.01]	[-0.05, -0.02]	--	--	--	--
Satisfied with job	$\beta_{\text{Lanham place}}$	0.00666	-0.0801***	-0.00957	-0.0313*	-0.0266*	-0.0303	0.000407
		[0.0214]	[0.0198]	[0.0134]	[0.0129]	[0.0110]	[0.0162]	[0.0161]
	$\beta_{\text{preschool}}$	--	--	--	0.00106	0.00154	0.000403	-0.00102
		--	--	--	[0.00117]	[0.00243]	[0.000849]	[0.00131]
	95% CI	[-0.04, 0.05]	[-0.12, -0.04]	[-0.04, 0.02]	--	--	--	--
Any unemployment	$\beta_{\text{Lanham place}}$	-0.000383	-0.0115	0.00126	-0.00359	-0.00169	-0.00960	0.0136
		[0.0120]	[0.00962]	[0.00642]	[0.00662]	[0.00553]	[0.00840]	[0.00846]
	$\beta_{\text{preschool}}$	--	--	--	0.000137	-0.000295	0.000435	-0.000582
		--	--	--	[0.000567]	[0.00115]	[0.000421]	[0.000677]
	95% CI	[-0.02, 0.02]	[-0.03, 0.01]	[-0.01, 0.01]	--	--	--	--

[a] We compare the 95% CI for each grade in the base model to determine if the preschool effect is significant, as indicated by no overlap between grades 11 and 12 with grade 9.
[b] Participants in non-Lanham places, divided into two groups of those most and least like Lanham places.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
Abbreviations: 95% CI = 95% confidence interval around point estimate; EBM = exposure base model; LNS = Lanham schools; SM1/SM2/SM3 = sensitivity model 1/2/3.

Women's outcomes (Table 6b)

Both models indicated Lanham place and preschool effects for calmness (negative preschool effect). There was a significant Lanham place effect but no preschool effect according to both models for IQ (sensitivity models suggest the significant EBM interaction is picking up something other than a preschool effect), sociability, social sensitivity, vigor (negative effect), tidiness, culture, confidence, attending any college and graduating college by both 5 and 11 years following high school, and having a blue-collar job (lower percentage for Lanham place than non-Lanham place participants) 11 years following high school. No Lanham place or preschool effects were found for impulsivity and unemployment 11 years post high school for either model. Conflicting results were observed as follows for the rest of the outcomes.

- Models did not agree on a Lanham place effect but did agree on no preschool effect for effective expression and being satisfied with one's job 11 years post high school.
- There was agreement on a Lanham place effect but not on a preschool effect for verbal composite, leadership, maturity, and income.
- Models conflicted on both effects for academic aptitude and math composite.

The BM showed no preschool effect, while the EBM did for academic aptitude, verbal composite, leadership, and maturity. The results are therefore inconclusive. For math and income, the BM showed a preschool effect only for 11th and 12th graders but not 10th graders (in comparison to Lanham place 9th graders, Figures 3a and 3d). Taken together with the EBM results, we conclude no preschool effect.

In summary, we have evidence of positive LNS preschool effects for men's IQ, academic aptitude, verbal composite, and effective expression. For women, LNS preschool effects on high school academic outcomes were inconsistent across models, and there was a negative preschool effect on calmness.

4. Discussion

The foregoing analysis has revealed a number of differences between Project Talent participants who were and were not exposed to Lanham preschools. These effects were heterogeneous by sex and grade. The preschool effects were more pronounced for men; men who had access to LNS as preschoolers displayed improved high school academic outcomes. Women with access to LNS displayed reduced levels of calmness in high school. Effects were often stronger for 11th and 12th graders than for 10th graders, suggesting a possible preschool dose-response effect.

Other studies of the long-term impacts of preschool report a varied pattern of gender differences. Anderson's (2008) reanalysis of the Abecedarian, Perry, and Early Training Projects found an advantage for girls over boys. In another study of the Carolina Abecedarian Project and Carolina Approach to

Responsive Education (ABC/CARE), García, Heckman, and Ziff (2018) also found an advantage for girls, and attributed this to a greater opportunity for improvement for girls because they had poorer home environments and less paternal support. In the present study, a post hoc examination of father's educational level (a home environment proxy) by child sex indicated that a significantly higher percentage of boys (77.2%) had a father with at least a high school diploma compared with 76.5% for girls. This should create more opportunity and therefore better results for girls if we apply the conclusion of García and colleagues. LNS differed from the preschools in these other studies, which were privately funded, much smaller in scale, very intensive, and targeted to disadvantaged young children. In contrast, Gray-Lobe and colleagues (2021) reported an advantage for boys, but did not offer a potential explanation, in their study of the large-scale public preschools in Boston. Although Boston preschools (BPS) are publicly funded and universal, they still target disadvantaged families. And, although BPS gets high quality ratings (Gray-Lobe et al., 2021), it is likely to be less intensive than ABC/CARE, Perry, and Early Training Projects. As stated previously, we speculate that LNS was likely of lower quality than any of these later preschool programs. To explain the gender difference we observed, we may extend this speculation to propose that more advantaged children may gain more from lower quality preschools, thus underscoring the importance of today's focus on preschool quality to increase equity in educational attainment of today's youth.

We did observe an interesting phenomenon with the exposure models. Some outcomes decreased with each additional month the participant was between the ages of 2 and 6 years while LNS was open (June 1, 1943 to March 1, 1946; see academic aptitude, Figures 4-6; other graphs not shown[10] indicate similar patterns for other outcomes). While we might speculate on the reasons, such as the fact that WWII was ongoing and may have had a negative influence on young children's development, the pattern was observed in both Lanham and non-Lanham places. The positive effect of preschool was to slow the decline for Lanham place participants compared to non-Lanham place participants.

It is also important to note that while in the final analysis combining results across models, only calmness in women was negatively associated with access to Lanham preschool, some individual models showed negative associations between LNS and other outcomes in the social emotional domain for both men and women (e.g., vigor, leadership, and maturity). We do not presently know enough about the actual circumstances within Lanham preschool classrooms to understand how these negative outcomes came about. We may speculate, given that this was the first government-run nursery school and the lack of scientific awareness of or attention to young children's social emotional development during that period, that preschool quality was sufficient to support improved academic outcomes, but that may have

[10] Available from primary author.

been achieved at some cost to their social emotional development. It is also possible that having a mother in the labor force, which was not the cultural norm of the time, contributed to this effect. We might find very different results in a similar study conducted today, with the early childhood field's considerable focus on social emotional development and preschool quality.

The longitudinal study of participants in Boston preschools by Gray-Lobe and colleagues (2021) is the most comparable to in that it examined a public preschool setting and was open to all children. Our results did not match for high school achievement and behavior or for college measures. We found positive achievement and potentially negative social emotional effects in high school, while they found no achievement and positive behavioral effects (reduced high school suspension and incarceration). We found no college attendance or graduation effects at both 5 and 11 years post high school, while they found positive effects. A study using the Early Childhood Longitudinal Study Kindergarten Cohort of 1998 reported findings similar to ours: preschool attendees performed better on academic achievement tests but worse on behavioral tests from the beginning of kindergarten through the end of 8th grade compared with children who attended informal care at age 4 (Ansari, 2018). In addition, these negative behavioral effects were associated with 20 or more hours of preschool attendance per week.

In their study of Tulsa's universal pre-K program, Gormley and colleagues (2018) found more pronounced effects of males than for females, as we identified in this study. They also examined heterogeneity by family socioeconomic status, measured by free or reduced lunch, and found effect size magnitudes to be comparable, with the observed variation possibly due to small sample sizes and consequent imprecise estimates. Our examination of family socioeconomic status as measured by father's high school education indicated no heterogeneity along this dimension, meaning there was no change in the gaps between children of more vs. less-education fathers. While it is positive that the gaps did not widen due to access to preschool, we would prefer to see a reduction in the gaps. These findings add to the mixed results in existing research that sometimes show stronger effects for lower-income children (gap narrowing) and sometimes stronger effects for higher income children (gap widening).

While the contemporary American context of racial/ethnic inequality demands more data on the size, direction, and reason for disparities in educational and labor outcomes, we were unable to study that without compromising our difference in differences design. We chose to include only participants who attended schools with 80% or more white students due to shortcomings in the Project Talent racial self-identification data. Had we included students from more racially diverse schools, we would have included more participants categorized as potentially exposed to LNS but who would never have gone (because black mothers were already substantially more likely to work than white mothers before the war and would have already found child care arrangements). This would have attenuated our results.

These findings are striking for two reasons in particular. The first is that this was a program that never reached more than 13% of the eligible population, so our intent-to-treat effect size estimations underestimate the treatment-on-the-treated effects (TOTT) by at least a factor of 7. It is possible that if our design allowed direct estimation of TOTT, we would have found more effects, particularly at 5 and 11 years following graduation. The second reason why these findings are somewhat surprising is that this was not a narrowly targeted program. It was instead available to anyone residing in the communities that received funding for one of these preschools. It was therefore universally accessible to any child in the eligible age range, regardless of other child or family characteristics.

Significant caution should nonetheless be exercised in interpreting our results. One concern is that we are not observing a pure unidimensional treatment. Instead, places that received preschools were also places where mothers may have been more likely to enter the labor force, so any effect that we observe will be a combination of potential preschool attendance and disruption to circumstances at home. And at the end of this exercise, we are unable to assess exactly which dimensions of the Lanham nursery school experience were most responsible for the outcomes we have observed. For example, the schools provided more than just a classroom experience, as they also offered nutrition and medical care.

The results nonetheless provide some optimism as communities, states, and the federal government contemplate expanding funding for today's early learning environments. The Lanham experience demonstrates that even with the less advanced understanding of child development of the early 1940s, programs could be constructed that had demonstrable, positive impacts on children that were discernible in their high school careers.

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Appendix A: Regression results from models using weights and/or clustered standard errors

Table A1. Dichotomous Lanham place term model, grades stratified, entropy weights

	Men			Women		
	Grade 9	**Grade 10**	**Grades 11 & 12**	**Grade 9**	**Grade 10**	**Grades 11 & 12**
High school academic						
IQ	-1.036	0.180	-0.694	-0.0410	-0.966	0.0919
	[0.591]	[0.517]	[0.458]	[0.638]	[0.648]	[0.491]
Academic aptitude	-1.739**	-0.660	-1.174*	-0.977	-2.015**	-0.674
	[0.599]	[0.528]	[0.478]	[0.618]	[0.688]	[0.509]
Verbal composite	-1.674**	-0.910	-1.146*	-1.137	-1.677**	-0.808
	[0.590]	[0.534]	[0.454]	[0.590]	[0.623]	[0.486]
Effective expression	-0.323	-0.0328	-0.283**	-0.280*	-0.315*	-0.0672
	[0.174]	[0.159]	[0.104]	[0.121]	[0.132]	[0.0973]
Math composite	-2.562***	-0.217	-0.762	-1.925**	-2.339**	-0.800
	[0.636]	[0.557]	[0.504]	[0.623]	[0.764]	[0.512]
Height	0.270	0.0947	-0.278	0.0835	-1.046*	0.175
	[0.570]	[0.675]	[0.489]	[0.543]	[0.530]	[0.444]
High school social emotional						
Sociability	-1.259*	-0.958	-0.862	-0.856	-0.719	-0.587
	[0.615]	[0.722]	[0.504]	[0.628]	[0.647]	[0.486]
Social sensitivity	-2.335***	0.158	-0.614	-0.865	0.250	-0.232
	[0.683]	[0.652]	[0.529]	[0.702]	[0.658]	[0.533]
Impulsivity	-0.506	-0.0804	0.119	-0.373	-1.264	-0.0478
	[0.684]	[0.746]	[0.488]	[0.746]	[0.743]	[0.547]
Vigor	-1.607*	-1.188	-1.776***	-1.187	-1.720**	-1.079*
	[0.701]	[0.682]	[0.516]	[0.688]	[0.655]	[0.531]
Calmness	-1.774**	-0.247	-0.589	-0.227	-0.145	-0.522
	[0.655]	[0.687]	[0.536]	[0.632]	[0.695]	[0.580]
Tidiness	-3.152***	-0.897	-1.161*	-1.105	-0.631	-0.347
	[0.627]	[0.770]	[0.507]	[0.610]	[0.709]	[0.599]
Culture	-2.341***	-0.753	-1.014*	-2.233***	-0.847	-0.925
	[0.641]	[0.757]	[0.515]	[0.632]	[0.728]	[0.510]
Leadership	-1.103	0.642	0.278	0.818	-0.953	-0.353
	[0.843]	[0.915]	[0.608]	[0.676]	[0.970]	[0.633]
Confidence	-0.732	0.0478	-1.143*	-1.304*	0.00455	-0.326
	[0.695]	[0.656]	[0.535]	[0.606]	[0.720]	[0.520]
Maturity	-2.626***	0.652	-0.722	-0.820	-0.615	-1.388*
	[0.647]	[0.709]	[0.538]	[0.620]	[0.675]	[0.567]

	Men			Women		
	Grade 9	**Grade 10**	**Grades 11 & 12**	**Grade 9**	**Grade 10**	**Grades 11 & 12**
Year 5						
Attended any college	-0.221*	-0.160	0.0465	0.00211	-0.111	-0.245*
	[0.110]	[0.0978]	[0.108]	[0.0787]	[0.141]	[0.0971]
Graduated college	0.0288	-0.122	0.00960	-0.0275	0.0486	-0.181
	[0.0813]	[0.113]	[0.0642]	[0.0570]	[0.0530]	[0.107]
Year 11						
Income	833.1	1,682	-119.2	-2,226	386.9	197.3
	[1,501]	[1,207]	[985.6]	[1,683]	[762.7]	[628.0]
Attended any college	-0.0763	-0.0731	-0.0488	-0.160	-0.121	-0.111
	[0.135]	[0.153]	[0.0826]	[0.125]	[0.0961]	[0.101]
Graduated college	-0.200	0.0672	0.103	-0.177	0.0396	-0.137
	[0.134]	[0.117]	[0.0630]	[0.157]	[0.0623]	[0.123]
Blue-collar job	0.112	0.0641	0.0156	0.0725	0.0361	0.0180
	[0.0783]	[0.113]	[0.0851]	[0.0370]	[0.0397]	[0.0220]
Satisfied with job	0.0830	-0.113*	-0.0490	-0.117*	-0.00237	0.00372
	[0.151]	[0.0552]	[0.0544]	[0.0552]	[0.121]	[0.0398]
Any unemployment	0.0485*	-7.67e-05	0.00558	0.0491	-0.0155	-0.00373
	[0.0230]	[0.0222]	[0.0221]	[0.0370]	[0.0152]	[0.0349]

Table A2. Comparison of preschool effect estimates: dichotomous Lanham place term model (grades stratified, standard errors clustered at the school level) vs. exposure model (grades pooled, standard errors clustered at the school level)

		Men				Women			
	Statistic	**Grade 9**	**Grade 10**	**Grades 11 & 12**	**Lanham place * exposure**	**Grade 9**	**Grade 10**	**Grades 11 & 12**	**Lanham place * exposure**
High school academic									
IQ	Coefficient	0.674	0.802	1.444*	0.030	0.880	0.230	0.906	0.032
	SE	[0.591]	[0.644]	[0.632]	[0.016]	[0.543]	[0.694]	[0.663]	[0.018]
	95% CI	[-0.484, 1.832]	[-0.460, 2.064]	[0.205, 2.683]	--	[-0.184, 1.944]	[-1.130, 1.590]	[-0.393, 2.205]	--
Academic aptitude	Coefficient	0.237	0.579	1.311	0.026	0.402	0.040	0.635	0.031
	SE	[0.654]	[0.730]	[0.688]	[0.017]	[0.591]	[0.774]	[0.707]	[0.018]
	95% CI	[-1.045, 1.519]	[-0.852, 2.010]	[-0.037, 2.659]	--	[-0.756, 1.560]	[-1.477, 1.557]	[-0.751, 2.021]	--
Verbal composite	Coefficient	0.436	0.720	1.472*	0.023	0.566	0.253	0.733	0.025
	SE	[0.637]	[0.665]	[0.670]	[0.016]	[0.565]	[0.715]	[0.677]	[0.016]
	95% CI	[-0.813, 1.685]	[-0.583, 2.023]	[0.159, 2.785]	--	[-0.541, 1.673]	[-1.148, 1.654]	[-0.594, 2.060]	--
Effective expression	Coefficient	-0.005	0.087	0.209	0.006	0.078	0.030	0.132	0.007*
	SE	[0.112]	[0.113]	[0.110]	[0.004]	[0.100]	[0.108]	[0.102]	[0.003]
	95% CI	[-0.224, 0.215]	[-0.135, 0.308]	[-0.007, 0.425]	--	[-0.119, 0.274]	[-0.182, 0.241]	[-0.068, 0.332]	--
Math composite	Coefficient	0.023	0.734	1.401*	0.0174	-0.016	0.271	0.641	0.021
	SE	[0.660]	[0.780]	[0.689]	[0.021]	[0.671]	[0.851]	[0.689]	[0.022]
	95% CI	[-1.271, 1.316]	[-0.795, 2.263]	[0.051, 2.751]	--	[-1.331, 1.299]	-1.397, 1.939]	[-0.709, 1.991]	--
Height	Coefficient	-0.053	-0.340	-0.408	-0.005	-0.130	-0.244	-0.414	-0.011
	SE	[0.236]	[0.279]	[0.319]	[0.010]	[0.236]	[0.254]	[0.267]	[0.012]
	95% CI	[-0.515, 0.410]	[-0.887, 0.207]	[-1.033, 0.217]	--	[-0.593, 0.333]	[-0.742, 0.254]	[-0.937, 0.109]	--
High school social emotional									
Sociability	Coefficient	0.624	0.261	0.213	-0.014	0.690	0.746**	0.261	-0.021
	SE	[0.377]	[0.283]	[0.227]	[0.014]	[0.388]	[0.252]	[0.190]	[0.014]

		Men				Women			
	Statistic	**Grade 9**	**Grade 10**	**Grades 11 & 12**	**Lanham place * exposure**	**Grade 9**	**Grade 10**	**Grades 11 & 12**	**Lanham place * exposure**
	95% CI	[-0.115, 1.363]	[-0.294, 0.816]	[-0.232, 0.658]	--	[-0.070, 1.450]	[0.252, 1.240]	[-0.111, 0.633]	--
Social sensitivity	Coefficient	0.610	0.733*	1.064***	0.012	1.439**	1.202***	1.329***	-0.0008
	SE	[0.375]	[0.320]	[0.296]	[0.014]	[0.456]	[0.338]	[0.270]	[0.013]
	95% CI	[-0.125, 1.345]	[0.106, 1.360]	[0.484, 1.644]	--	[0.545, 2.333]	[0.540, 1.864]	[0.800, 1.858]	--
Impulsivity	Coefficient	0.460	0.474	0.549**	0.002	0.019	0.107	0.417	0.013
	SE	[0.279]	[0.289]	[0.191]	[0.013]	[0.318]	[0.255]	[0.270]	[0.012]
	95% CI	[-0.087, 1.007]	[-0.092, 1.040]	[0.175, 0.923]	--	[-0.604, 0.642]	[-0.393, 0.607]	[-0.112, 0.946]	--
Vigor	Coefficient	0.984*	0.038	0.030	-0.012	0.159	-0.405	-0.484	-0.002
	SE	[0.396]	[0.297]	[0.238]	[0.015]	[0.349]	[0.331]	[0.296]	[0.013]
	95% CI	[0.208, 1.760]	[-0.544, 0.620]	[-0.437, 0.496]	--	[-0.525, 0.843]	[-1.054, 0.244]	[-1.064, 0.096]	--
Calmness	Coefficient	0.465	0.407	0.150	-0.024	1.222**	1.144***	0.474*	-0.024
	SE	[0.439]	[0.299]	[0.278]	[0.013]	[0.389]	[0.287]	[0.240]	[0.014]
	95% CI	[-0.395, 1.325]	[-0.179, 0.993]	[-0.395, 0.695]	--	[0.460, 1.984]	[0.581, 1.707]	[0.004, 0.944]	--
Tidiness	Coefficient	0.677	0.740*	0.716**	-0.007	0.616	0.923***	0.574*	-0.005
	SE	[0.400]	[0.326]	[0.266]	[0.017]	[0.354]	[0.251]	[0.240]	[0.013]
	95% CI	[-0.107, 1.461]	[0.101, 1.379]	[0.195, 1.237]	--	[-0.078, 1.310]	[0.431, 1.415]	[0.104, 1.044]	--
Culture	Coefficient	0.227	-0.270	0.258	-0.003	0.557	0.835*	0.662*	-5.67e-05
	SE	[0.394]	[0.332]	[0.267]	[0.015]	[0.395]	[0.353]	[0.264]	[0.015]
	95% CI	[-0.545, 0.999]	[-0.921, 0.381]	[-0.265, 0.781]	--	[-0.217, 1.331]	[0.143, 1.527]	[0.145, 1.179]	--
Leadership	Coefficient	0.875**	1.277***	0.707*	-0.025	0.931*	0.638*	0.133	-0.037*
	SE	[0.330]	[0.265]	[0.302]	[0.014]	[0.402]	[0.311]	[0.269]	[0.016]
	95% CI	[0.228, 1.522]	[0.758, 1.796]	[0.115, 1.299]	--	[0.143, 1.719]	[0.028, 1.248]	[-0.394, 0.660]	--
Confidence	Coefficient	0.683*	1.172***	0.788***	-0.0192	0.662*	0.646**	0.594**	-0.003
	SE	[0.333]	[0.265]	[0.225]	[0.012]	[0.299]	[0.250]	[0.209]	[0.012]
	95% CI	[0.030, 1.336]	[0.653, 1.691]	[0.347, 1.229]	--	[0.076, 1.248]	[0.156, 1.136]	[0.184, 1.004]	--
Maturity	Coefficient	0.441	0.190	0.236	-0.027	0.802*	0.468	0.214	-0.025*

		Men				Women			
	Statistic	**Grade 9**	**Grade 10**	**Grades 11 & 12**	**Lanham place * exposure**	**Grade 9**	**Grade 10**	**Grades 11 & 12**	**Lanham place * exposure**
	SE	[0.363]	[0.307]	[0.230]	[0.014]	[0.355]	[0.257]	[0.209]	[0.013]
	95% CI	[-0.270, 1.152]	[-0.412, 0.792	[-0.215, 0.687]	--	[0.106, 1.498]	[-0.036, 0.972]	[-0.196, 0.624]	--
Year 5									
Attended any college	Coefficient	-0.086	-0.224*	0.051	-0.001	-0.113	-0.155*	-0.310***	0.0008
	SE	[0.091]	[0.089]	[0.045]	[0.0009]	[0.098]	[0.072]	[0.072]	[0.001]
	95% CI	[0.046, 0.153]	[0.055, 0.165]	[0.044, 0.158]	--	[0.001, 0.122]	[-0.029, 0.127]	[0.003, 0.146]	--
Graduated college	Coefficient	0.111	-0.116*	-0.026	-0.001	-0.086	0.012	-0.219**	-3.23e-06
	SE	[0.067]	[0.058]	[0.053]	[0.0009]	[0.058]	[0.033]	[0.068]	[0.001]
	95% CI	[0.019, 0.131]	[-0.012, 0.092]	[-0.001, 0.124]	--	[-0.035, 0.070]	[-0.033, 0.098]	[-0.004, 0.105]	--
Year 11									
Income	Coefficient	-280.50	841.90**	1,302.00***	19.83	47.40	733.70**	833.10***	11.78
	SE	[377.90]	[311.90]	[316.70]	[13.75]	[191.00]	[255.40]	[242.60]	[16.21]
	95% CI	[-1,021.18, 460.18]	[230.58, 1,453.22]	[681.27, 1,922.73]	--	[-326.96, 421.76]	[233.12, 1,234.28]	[357.60, 1,308.60]	--
Attended any college	Coefficient	0.110***	0.110***	0.121***	0.0008	0.053	0.058	0.073*	0.001
	SE	[0.023]	[0.033]	[0.028]	[0.001]	[0.030]	[0.038]	[0.034]	[0.001]
	95% CI	[0.065, 0.155]	[0.046, 0.174]	[0.067, 0.175]	--	[-0.007, 0.112]	[-0.017, 0.133]	[0.008, 0.139]	--
Graduated college	Coefficient	0.068*	0.081**	0.080**	-0.002	0.005	0.044	0.052*	0.0002
	SE	[0.028]	[0.030]	[0.029]	[0.001]	[0.024]	[0.034]	[0.026]	[0.001]
	95% CI	[0.013, 0.122]	[0.022, 0.140]	[0.023, 0.137]	--	[-0.042, 0.052]	[-0.023, 0.110]	[0.000, 0.104]	--
Blue-collar job	Coefficient	-0.047	-0.083**	-0.087***	-0.0002	-0.032**	-0.032*	-0.036***	-3.03e-05
	SE	[0.028]	[0.027]	[0.024]	[0.001]	[0.012]	[0.013]	[0.009]	[0.0006]
	95% CI	[-0.103, 0.009]	[-0.136, -0.029]	[-0.134, -0.041]	--	[-0.055, -0.009]	[-0.057, -0.007]	[-0.053, -0.019]	--
Satisfied with job	Coefficient	-0.032	-0.021	0.005	0.001	0.007	-0.080***	-0.010	0.001
	SE	[0.021]	[0.015]	[0.011]	[0.001]	[0.021]	[0.022]	[0.014]	[0.001]

		Men				Women			
	Statistic	**Grade 9**	**Grade 10**	**Grades 11 & 12**	**Lanham place * exposure**	**Grade 9**	**Grade 10**	**Grades 11 & 12**	**Lanham place * exposure**
Any unemployment	95% CI	[-0.073, 0.010]	[-0.050, 0.007]	[-0.016, 0.026]	--	[-0.035, 0.048]	[-0.124, -0.036]	[-0.036, 0.017]	--
	Coefficient	-0.010	0.005	0.003	0.0003	-0.0004	-0.012	0.001	0.0001
	SE	[0.012]	[0.011]	[0.008]	[0.0006]	[0.012]	[0.010]	[0.006]	[0.0005]
	95% CI	[-0.034, 0.014]	[-0.016, 0.026]	[-0.013, 0.018]	--	[-0.024, 0.023]	[-0.031, 0.008]	[-0.011, 0.014]	--

Table A3. Dichotomous Lanham place term model, grades stratified, entropy weights, standard errors clustered at the school level, state fixed effects, and father's education

	Men			Women		
	Grade 9	Grade 10	Grades 11 & 12	Grade 9	Grade 10	Grades 11 & 12
High school academic						
IQ	-1.827*	-1.392*	-2.272***	-1.440	-2.657**	-1.886*
	[0.881]	[0.636]	[0.602]	[0.740]	[0.888]	[0.770]
Academic aptitude	-2.249*	-2.553**	-2.886***	-1.846*	-3.859***	-2.662**
	[1.018]	[0.798]	[0.693]	[0.816]	[1.027]	[0.829]
Verbal composite	-2.383*	-2.488***	-2.575***	-1.799	-3.369***	-2.457**
	[1.182]	[0.652]	[0.759]	[0.956]	[0.803]	[0.881]
Effective expression	-0.398*	-0.354***	-0.484***	-0.431***	-0.487***	-0.156
	[0.166]	[0.102]	[0.112]	[0.121]	[0.114]	[0.120]
Math composite	-2.805***	-1.893*	-2.169**	-2.829**	-4.172**	-2.499***
	[0.815]	[0.890]	[0.801]	[0.864]	[1.311]	[0.691]
Height	0.491	-0.445	-1.146***	-0.512	-1.537**	-0.459
	[0.466]	[0.453]	[0.335]	[0.412]	[0.503]	[0.485]
High school social emotional						
Sociability	-1.321	-1.458*	-0.662	-0.522	-1.022*	-0.525
	[0.741]	[0.690]	[0.423]	[0.356]	[0.479]	[0.461]
Social sensitivity	-2.123**	0.298	-0.866*	-1.905***	-0.0353	-0.366
	[0.700]	[0.436]	[0.430]	[0.471]	[0.562]	[0.375]
Impulsivity	0.411	-0.308	-0.172	-0.647	-1.458*	-0.451*
	[0.421]	[0.619]	[0.390]	[0.450]	[0.624]	[0.216]
Vigor	-1.316	-1.423*	-1.964***	-1.779**	-2.313***	-1.301*
	[0.676]	[0.617]	[0.512]	[0.681]	[0.638]	[0.571]
Calmness	-1.586	-0.302	-0.896*	-0.866	-0.704	-0.711
	[1.140]	[0.443]	[0.386]	[0.487]	[0.616]	[0.374]
Tidiness	-2.917***	-0.726	-1.267**	-1.014*	-0.784	-0.284
	[0.859]	[0.509]	[0.476]	[0.425]	[0.615]	[0.349]
Culture	-1.298*	-1.106*	-1.293***	-2.887***	-1.415	-1.296**
	[0.624]	[0.559]	[0.307]	[0.686]	[0.860]	[0.450]
Leadership	-0.308	-0.0670	-0.0102	1.947***	-1.294*	-0.785*
	[0.635]	[0.582]	[0.541]	[0.588]	[0.591]	[0.362]
Confidence	-0.0817	0.352	-1.008	-1.517**	-0.372	-0.801
	[0.398]	[0.416]	[0.680]	[0.461]	[0.562]	[0.541]
Maturity	-2.718*	0.744	-0.531	-1.602***	-0.926	-1.624**
	[1.128]	[0.489]	[0.369]	[0.473]	[0.676]	[0.618]
Year 5						

	Men			Women		
	Grade 9	**Grade 10**	**Grades 11 & 12**	**Grade 9**	**Grade 10**	**Grades 11 & 12**
Attended any college	-0.0862	-0.224*	0.0510	-0.113	-0.155*	-0.310***
	[0.0906]	[0.0888]	[0.0449]	[0.0977]	[0.0723]	[0.0717]
Graduated college	0.111	-0.116*	-0.0258	-0.0864	0.0123	-0.219**
	[0.0667]	[0.0578]	[0.0532]	[0.0575]	[0.0327]	[0.0684]
Year 11						
Income	1,148	620.9	1,417	-2,586**	1,340**	964.5
	[957.1]	[1,112]	[806.7]	[964.9]	[479.4]	[705.4]
Attended any college	-0.273*	-0.204**	-0.0940*	-0.120	-0.166***	-0.203**
	[0.121]	[0.0667]	[0.0406]	[0.0811]	[0.0469]	[0.0657]
Graduated college	-0.161*	-0.154*	-0.0368	-0.177**	-0.0610	-0.247***
	[0.0785]	[0.0760]	[0.0489]	[0.0590]	[0.0619]	[0.0663]
Blue-collar job	0.0665	0.186*	-0.0319	0.245**	-0.0154	0.00781
	[0.116]	[0.0797]	[0.0544]	[0.0805]	[0.0468]	[0.0299]
Satisfied with job	0.154	-0.105	-0.000719	-0.140	-0.0632	0.0497
	[0.132]	[0.0810]	[0.0452]	[0.115]	[0.0801]	[0.0281]
Any unemployment	0.0130	0.0214	0.00734	0.0790	-0.0173	-0.0213
	[0.0148]	[0.0443]	[0.0302]	[0.0830]	[0.00988]	[0.0308]

Table A4. Interaction terms for preschool effect from exposure model including father's education, grades stratified

	Men	Women
High school academic		
IQ		
Lanham place * exposure	0.000316	0.00240
	[0.0194]	[0.0210]
Lanham place * father more than high school * exposure	0.0369	0.0257
	[0.0224]	[0.0241]
Academic aptitude		
Lanham place * exposure	-0.00662	0.0127
	[0.0194]	[0.0211]
Lanham place * father more than high school * exposure	0.0411	0.00980
	[0.0224]	[0.0242]
Verbal composite		
Lanham place * exposure	-0.0113	0.00178
	[0.0191]	[0.0206]
Lanham place * father more than high school * exposure	0.0433*	0.0156
	[0.0220]	[0.0236]
Effective expression		
Lanham place * exposure	0.00363	0.0100*
	[0.00508]	[0.00481]
Lanham place * father more than high school * exposure	0.00278	-0.00640
	[0.00585]	[0.00551]
Math composite		
Lanham place * exposure	-0.0160	0.0288
	[0.0198]	[0.0220]
Lanham place * father more than high school * exposure	0.0413	-0.0234
	[0.0228]	[0.0252]
Height		
Lanham place * exposure	-0.0502*	-0.0490*
	[0.0219]	[0.0224]
Lanham place * father more than high school * exposure	0.0585*	0.0467
	[0.0249]	[0.0255]
High school social emotional		
Sociability		
Lanham place * exposure	-0.00676	-0.00252
	[0.0210]	[0.0227]
Lanham place * father more than high school * exposure	-0.0107	-0.0290
	[0.0242]	[0.0260]
Social sensitivity		

	Men	Women
Lanham place * exposure	-0.00691	0.0124
	[0.0213]	[0.0229]
Lanham place * father more than high school * exposure	0.0243	-0.0233
	[0.0245]	[0.0263]
Impulsivity		
Lanham place * exposure	0.0116	-0.000129
	[0.0237]	[0.0252]
Lanham place * father more than high school * exposure	-0.0136	0.0149
	[0.0271]	[0.0287]
Vigor		
Lanham place * exposure	-0.00825	0.0245
	[0.0218]	[0.0241]
Lanham place * father more than high school * exposure	-0.00675	-0.0398
	[0.0250]	[0.0275]
Calmness		
Lanham place * exposure	-0.0335	0.00632
	[0.0216]	[0.0235]
Lanham place * father more than high school * exposure	0.0121	-0.0451
	[0.0248]	[0.0269]
Tidiness		
Lanham place * exposure	-0.0123	0.0350
	[0.0212]	[0.0229]
Lanham place * father more than high school * exposure	0.00540	-0.0559*
	[0.0244]	[0.0263]
Culture		
Lanham place * exposure	-0.00375	0.0199
	[0.0211]	[0.0227]
Lanham place * father more than high school * exposure	6.84e-05	-0.0329
	[0.0243]	[0.0260]
Leadership		
Lanham place * exposure	-0.0259	-0.0343
	[0.0276]	[0.0293]
Lanham place * father more than high school * exposure	-0.00103	-0.00684
	[0.0314]	[0.0332]
Confidence		
Lanham place * exposure	-0.00868	-0.0249
	[0.0208]	[0.0228]
Lanham place * father more than high school * exposure	-0.0149	0.0249
	[0.0240]	[0.0262]

	Men	Women
Maturity		
Lanham place * exposure	-0.0269	0.0183
	[0.0208]	[0.0228]
Lanham place * father more than high school * exposure	-0.00209	-0.0639*
	[0.0240]	[0.0262]
Year 5		
Attended any college		
Lanham place * exposure	-0.00399*	0.00209
	[0.00184]	[0.00199]
Lanham place * father more than high school * exposure	0.00363	-0.00212
	[0.00206]	[0.00221]
Graduated college		
Lanham place * exposure	-0.00270	0.00145
	[0.00172]	[0.00177]
Lanham place * father more than high school * exposure	0.00169	-0.00215
	[0.00192]	[0.00197]
Year 11		
Income		
Lanham place * exposure	12.08	49.50
	[29.94]	[33.74]
Lanham place * father more than high school * exposure	11.08	-48.27
	[33.57]	[37.25]
Attended any college		
Lanham place * exposure	-0.00249	0.00166
	[0.00220]	[0.00240]
Lanham place * father more than high school * exposure	0.00435	-0.00131
	[0.00246]	[0.00265]
Graduated college		
Lanham place * exposure	-0.00488*	0.00191
	[0.00223]	[0.00219]
Lanham place * father more than high school * exposure	0.00399	-0.00244
	[0.00251]	[0.00243]
Blue-collar job		
Lanham place * exposure	0.00254	-0.00205
	[0.00218]	[0.00142]
Lanham place * father more than high school * exposure	-0.00363	0.00262
	[0.00245]	[0.00157]
Satisfied with job		
Lanham place * exposure	0.00152	0.00289

	Men	Women
	[0.00177]	[0.00275]
Lanham place * father more than high school * exposure	-0.000583	-0.00238
	[0.00199]	[0.00304]
Any unemployment		
Lanham place * exposure	0.00119	-0.000224
	[0.00120]	[0.00134]
Lanham place * father more than high school * exposure	-0.00118	0.000542
	[0.00134]	[0.00148]