Insights Into How Two Effective Human Capital Interventions Produced Their Impacts:
New York City’s Small High Schools of Choice and The National Job Corps Program

Symposium goal: Our goal is to learn about how two effective human capital interventions – one in the field of education policy and one in the field of employment and training policy – produced their impacts.

Interventions studied: Our first two papers will focus on how New York City’s Small High Schools of Choice (SSCs), produced their large impacts on student academic attainment. SSCs are nonselective and small in size, with a total of roughly 500 students in grades 9 – 12. They strive to provide a rigorous and personalized academic curriculum and focus on issues of real-world relevance. We will study 86 of the 120 SSCs created between 2004 and 2012. Our third paper will study the national Job Corps program, which is the nation’s largest job training program for disadvantaged youth. Job Corps, which operates out of roughly 100 program centers from across the U.S., is designed to increase human capital through education, vocational training and counseling.

Client populations involved: SSCs are located throughout New York City in predominantly disadvantaged communities. About 94 percent of SSC students are black or Hispanic, 84 percent qualify for free or reduced-price lunch and 75 percent entered high school performing below grade level in reading or mathematics. Jobs Corps serves youth between 16 and 24 years old who have dropped out of high school or are in need of additional education and training, and live in poverty or difficult environments.

Prior evidence of intervention effectiveness: Based on a series of naturally-occurring randomized lotteries, Bloom, Unterman and Levy (2010), Bloom and Unterman (2014) and Unterman (2014) documented large positive impacts of SSC enrollment on students’ academic progress, high school graduation and post-secondary enrollment. Based on a randomized study of the national Job Corps applicant pool, Lee (2009), Schochet et al. (2008) and Zhang et al. (2009) documented a program-induced increase in employment and earnings.

Research questions: Our first paper will explore the question: “What factors mediate the effects of SSCs on the probability that their ninth-graders are on track toward graduation?” Our second paper, will then focus on the question: “What role do SSC impacts on ninth-grade progress toward graduation have with respect to their impacts on high school graduation rates?” Our third paper will explore the question: “To what extent do the two key elements of Job Corps programs – basic education and vocational training – mediate the program’s impacts on future employment and earnings?

Contributions and connections: Our three papers will report important findings about the mechanisms by which two successful large-scale interventions in education and job-training produced their positive impacts. In addition, these papers will illustrate the use of evolving analytic methods for exploring the black box by which interventions produce impacts. The first paper will use an extension of instrumental variables analysis to leverage information about cross-site variation in SSC impacts on student outcomes and corresponding variation in SSC effects on hypothesized mediators of their student impacts. The second paper will use an
extension of principal stratification analysis to study the relationship between SSC impacts on students’ ninth-grade academic progress and their subsequent rates of high school graduation. The third paper will use an innovative weighting approach to study the extent to which basic education and job-training separately and jointly mediate the impact of Job Corps on future employment and earnings.

Paper #1

Title: Mediators of the Effects of New York City’s Small High Schools of Choice on Ninth-Grade Progress toward Graduation

Authors: H. Bloom, R. Unterman, P. Zhu, S. Reardon, F. Unlu

Background and Context: Since 2010, MDRC has released four reports on the New York City Department of Education’s (NYCDOE’s) multiyear initiative to create small public high schools that are open to any students who want to attend. Using naturally-occurring randomized lotteries within the City’s annual High School Application Processing System (HSAPS), MDRC has found that these small schools of choice, or SSCs, have large positive and sustained effects on students’ transition into high school, progress through high school, graduation from high school and enrollment in post-secondary education. These large SSC effects, which have occurred year after year, exist for students with different prior academic achievement levels and demographic characteristics and reflect a lower cost per high school graduate than that of their counterfactual counterparts.

Purpose and Research Question: The purpose of the present paper is to document the mechanisms through which SSCs produce their impressive effects. The paper thus addresses the question: “What factors mediate the effects of SSCs on the probability that their students are on track in ninth grade toward graduation in four years?” We focus on this short-run outcome (which is highly predictive of high-school graduation) to maximize the number of student cohorts in our analysis.

Conceptual Framework: Figure 1 illustrates our conceptual model of SSC effects, the core of which focuses on mediators of these effects. Each mediator is specified in terms of a contrast between its value for students randomized to an SSC and its value for their control-group counterparts. The model posits first that randomization to an SSC produces a contrast in the quality of school leadership. This school leadership contrast produces a contrast in school teaching culture (teacher empowerment, support and training), which in turn, produces a contrast in teaching practices (data driven instruction and teacher/parent communication). The contrast in school resources (expenditures per student, teacher/student ratios and teacher classroom experience) also influences the teaching practice contrast. Together these hypothesized mediators represent the school input contrast produced by randomization to an SSC. This in turn produces a contrast between the school experiences of SSC lottery winners and losers (with respect to academic rigor, personal relationships, school safety and student peers), which produces a contrast in their academic outcomes (being on track toward graduation). This outcome contrast is the measure of SSC impacts for our present analysis.
Setting and Population: The NYCDOE created SSCs in partnership with a consortium of funders led by the Bill and Melinda Gates Foundation, as well as with the United Federation of Teachers, the Council of School Supervisors and Administrators, New Visions for Public Schools, and numerous other school intermediary organizations. About 94 percent of SSC students are black or Hispanic, 84 percent qualify for free or reduced-price lunch and 75 percent enter high school performing below grade level in reading or mathematics.

Intervention: SSCs are academically nonselective and small in size, with a total of roughly 500 students in grades 9 – 12. In addition, SSCs strive to be highly personalized by, among other things, providing common planning time for teachers and promoting strong, sustained relationships between teachers and students. SSCs also have three other key features. They are predominantly located in disadvantaged communities, whose large failing high schools were closed. They were established through a demanding and competitive proposal process that emphasized three design principles: academic rigor, educational personalization and community partnerships. They initially received an infusion of outside resources: new principals and teachers, partnerships with intermediary organizations that had expertise in starting new schools, and start-up funding from the district and its philanthropic partners.

Sample, Measures and Data: Our analysis sample includes seven annual cohorts of first-time ninth graders who entered high school in the falls of 2005 through 2011, for a total of 25,925 students who applied to 87 over-subscribed SSCs. Our student academic outcome measure, ONTRACK, is whether or not sample members were on track in ninth grade toward four-year graduation based on criteria developed by the University of Chicago Consortium on School Research. This measure draws on data from NYCDOE records for individual students. Our mediator measures are being constructed from data for annual NYCDOE surveys of teachers and students and data on school characteristics from New York State School Report Cards.

Research Design and Analysis: Our research design will use random assignment to an SSC as an instrumental variable (IV) for studying the relationship between ONTRACK and hypothesized mediators of SSC impacts. Our basic approach, which is described by Reardon et al. (2014), will estimate a site-level regression model of the relationship between the effect of randomization to an SSC on its student outcomes and the effect of this randomization on a given mediator. This analysis will be conducted for each of our hypothesized mediators separately, and for groups of hypothesized mediators that represent the same “causal location” in our conceptual model. For example, we would include our measure of school leadership with our several measures of school resources in the same IV regression. But we would not include our measure of school leadership and our several measures of teaching culture in the same IV regression. In addition, we will use an innovative method for partially relaxing the exclusion restriction – and thus accounting for some potential unobserved mediators – developed by Reardon et al. (in process).

Findings: Although our measure development and statistical analysis is well underway, we do not yet have findings to report. But will definitely have such findings in time for our proposed presentation.
Title: Ninth-grade On-track Status as a Precursor to High School Success in Small Schools of Choice

Authors: L. Page, A. Feller, L. Miratrix, M. Somers and R. Unterman

Background / Context: A robust body of descriptive evidence indicates successful completion of ninth grade as an important predictor of success in on-time high school completion. For example, even after controlling for prior achievement, Allensworth and Easton (2007) find in Chicago that students who completed ninth grade “on-track” were substantially more likely to complete high school on-time compared to their off-track peers. This finding is not limited to the Chicago context. Rather, a broad body of literature across several urban districts has found that as many as 40 percent of students fail to progress from ninth to tenth grade on time, and fewer than 20 percent of those students graduate from high school (Kemple et al., 2005; Allensworth and Easton, 2005; Balfanz, Neild & Herzog, 2007).

Purpose / Research Question: A key question that follows is whether rates of high school completion can be improved via interventions that improve the rates with which students complete ninth grade on-track. To shed light on this question, we analyze data from MDRC’s study of Small Schools of Choice (SSC) (e.g., Bloom & Unterman, 2014; Unterman, 2014). Research to date reveals that SSCs led to substantial improvements in a number of key educational outcomes, including ninth grade on-track status, high school graduation, and postsecondary enrollment. Our analytic goal is to investigate whether the subsequent improvements in high school graduation and college enrollment were realized primarily by those students who were induced to be on-track in ninth grade as a result of the SSC opportunity.

Setting: The roughly 120 SSCs created between 2004 and 2008 in NYC are available to students of all academic backgrounds and are located mainly in poor communities where large, low-performing neighborhood high schools had been closed as part of a broader reform agenda.

Data: Because of the process of lottery-based high school assignment for over-subscribed SSCs, MDRC recognized the opportunity to examine rigorously the impacts of SSCs via a naturally-occurring randomized trial. The resulting dataset for our proposed paper includes 14,608 students from four cohorts across 84 SSCs. These data allow us to examine a host of student outcomes throughout high school and into post-secondary enrollment. Critically, these records include indicators of ninth grade on-track status, four- and five-year graduation outcomes, and indicators of SSC participation.

Research Design: We utilize the principal stratification framework (Frangakis & Rubin, 2002) to organize our analytic challenge. We articulate the problem in two different, but complementary, ways that together allow us to gain more purchase on our question of interest than either in isolation. First, we define principal strata only considering ninth-grade on-track status (Figure 2). With this structure, we articulate partially latent subgroups according to whether students would be (1) never on-track; (2) always on-track; or (3) induced on-track as a...
result of the randomized offer of an SSC.\(^1\) Because treatment effects are not point-identified for these subgroups, we use a bounding approach to estimate plausible ranges of treatment effects for each (e.g., Lee, 2009; Long & Hudgens, 2013) and apply plausible substantive assumptions to further narrow bounds.

Next, we define principal strata by a combination of ninth grade on-track status and first-year SSC take-up (Figure 3). In Figure 3, all shaded cells are those that we “assume away” through a combination of monotonicity and exclusion restrictions further articulated and justified in the paper. Under this specification, we again use a bounding approach to estimate plausible ranges of treatment effects which we again narrow via substantive assumptions.

Finally, we recognize and exploit a key equivalence between the two principal stratification specifications, as follows: in Figure 3, the three strata associated with never on-track (NOT) status represent a finer-grained look at the single NOT stratum in Figure 2. The same is true for the always on-track strata in Figures 2 and 3. In contrast, because of the assumptions applied to eliminate certain strata, we observe that all students who are induced to be on-track as a result of the SSC offer are SSC compliers. This equivalence allows us to substantially tighten bounds within this stratum (and, in turn, in other strata), given the equivalence of this stratum between the two specifications.

**Findings / Results:** We are able to tighten many of our bounded estimates by moving back and forth between the two different principal stratification scenarios, capitalizing on estimands that are equivalent between the two. Under the assumptions outlined in the two different scenarios, we arrive at a set of bounded estimates that indicate that treatment effects are positive and largest for those students who were induced by the SSC offer to be on-track by the end of 9\(^{th}\) grade, whereas possible values for treatment effects are smaller for compliers who are always on-track and smaller and potentially negative for those who are never on-track. These patterns are consistent with the notion that the SSC experience shaped high school outcomes by influencing students’ experiences in and success with their ninth grade high school year.

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**Paper #3**

**Title:** Unpacking Complex Mediation Mechanisms in the Multisite Job Corps Evaluation

**Authors:** J. Deutsch, E. Bein, G. Hong, K. Porter, X. Qin, and A. Vigil

**Background:** This study investigates the complex mediation mechanisms of Job Corps, the nation's largest job training program serving disadvantaged youth who are disconnected from school and work. Job Corps was designed to increase human capital through education and vocational training plus extensive counseling services. Following the human capital theory (Becker, 1964; Card, 1999), we make a distinction between *generic human capital* and *job-specific human capital*. The former includes education credentials as a proxy for literacy skills and work ethics; while the latter refers to technical knowledge or skills applicable in a certain vocational trade that may not transfer easily to other trades. Individual Job Corps participants

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\(^1\) Here, we make an assumption analogous to the monotonicity or “no-defiers” assumption in instrumental variables that the offer of the SSC would not induce any student to be off-track.
differ in their completion of education and training. These natural variations allow us to examine education and training as two concurrent mediators, distinguish the relative contribution of each, and determine whether these two types of human capital investments produce a joint impact that is greater than the sum of their separate impacts.

**Research Questions.** Findings from the original evaluation of the Job Corps program indicate that individuals randomly assigned to Job Corps had a statistically significant increase in employment and earnings relative to their control group counterparts (Lee, 2009; Schochet et al, 2008; Zhang et al, 2009). We re-analyze data from the National Job Corps Study to address the following four questions:

- How much of the Job Corps impact on employment and earnings is mediated by educational attainment and how much is produced by other factors (i.e. the program’s direct effect)?
- To what extent did the program-induced increase in education credentials (i.e. GEDs or high school diplomas) mediate Job Corps’ impact on employment and earnings?
- To what extent did the program-induced increase in vocational certificates mediate Job Corps’ impact on employment and earnings?
- To what extent, did the joint mediational effect of the two types of credential together exceed the sum of their two separate mediational effects?

**Setting:** All approximately 100 Job Corps centers from throughout the contiguous 48 states and the District of Columbia. Study intake occurred between November 1994 and February 1996.

**Population:** Eligible Job Corps applicants include all youth between 16 and 24 years old who were U.S. citizens or permanent residents, had dropped out of high school or were in need of additional education and training, and lived in poverty or an environment characterized by a disruptive home life, high crime rates, or limited job opportunities.

**Intervention:** Job Corps establishes a structured institutional environment with intensive academic education and vocational training. The program also provides a comprehensive array of support services, including residential living, personal supervision, behavioral counseling, social skills training, physical and mental health care services, drug and alcohol treatment plus regular evaluation of progress, incentive programs, and assistance with career placement.

**Research Design:** Sample members randomized to the program group were assigned to one of the approximately 100 Job Corps in the U.S. Sample members randomized to the control group were not permitted to enroll in Job Corps for the next three years, although they could enroll in other programs. For each sample member, the Job Corps center that he or she would be assigned to if randomized to the program was determined prior to random assignment. Thus in effect, the study is a randomized multisite trial.

**Data Collection:** Study participants were given a baseline interview soon after random assignment, and at 12-, 30-, and 48-month follow-ups. Additional surveys were conducted at Job Corps centers with outreach and admissions counselors in 1996.
Analysis: Under the potential outcomes causal framework, we conceptualize and identify a joint distribution of the site-specific direct and indirect effects of treatment assignment. The ratio-of-mediator-probability weighting (RMPW) methodology (Hong, 2010, 2015; Hong, Deutsch, & Hill, 2011, 2015; Hong & Nomi, 2012; Huber, 2014; Tchetgen, Tchetgen & Shpister, 2012), implemented under a method-of-moments framework, consistently estimates the population average and the variance and covariance of the site-specific effects (Qin & Hong, 2014, revise and resubmit). These causal parameters are identifiable when treatment assignment and mediator value assignment under each treatment are strongly ignorable within each site given observed pretreatment covariates. Our strategy conveniently relaxes the assumption of no treatment-by-mediator interaction while greatly simplifying the outcome model specification without invoking strong distributional assumptions. In addition, we derive asymptotic standard error estimators that reflect the sampling variability of the estimated weights (Bein et al, 2015). We extend the application of a single mediator to multiple concurrent mediators. We also develop and employ sensitivity analyses regarding the ignorability assumptions.

Findings: Applying the RMPW methodology to Job Corps data, our preliminary findings indicate that the indirect effect of Job Corps on earnings mediated by educational attainment accounted for nearly half of the average ITT effect and was fairly uniform across the sites. In contrast, the direct effect of Job Corps varied substantially from site to site, which tends to explain the cross-site variation of the Job Corps ITT effect. Results from our concurrent mediator analysis of employment outcomes are forthcoming.
References


Qin, X., & Hong, G. (revise and resubmit) “A weighting method for assessing between-site heterogeneity in causal mediation mechanism”.


Reardon, Unlu, Zhu and Bloom (in process) “Using the MSMM-IV Model to Estimate Mediator Effects When the Exclusion Restriction is Invalid”.


Figure 1

SSC Impact Model

SSC Characteristics

School input contrast

School leadership contrast → Teaching culture contrast → Teaching practices contrast → School experience contrast for students → Student outcome contrast

School resources contrast

HSAPS assignment → SSC enrollment contrast

Student Characteristics
### Figure 2. Principal strata defined by on-track status

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<th>On track</th>
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<tr>
<td>On track</td>
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<td>Always on-track (AOT)</td>
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### Figure 3. Principal strata defined by on-track status and first year SSC participation

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<th>SSC, on track</th>
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<td>SSC, on track</td>
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<td>SSC complier, Induced on-track</td>
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