Why did a randomized program of housing mobility cause changes in the mental health of adolescents? The mediating role of substance use, social networks, and family mental health in the Moving to Opportunity Study.

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Abbreviations: MTO=Moving to Opportunity; RCT=Randomized Controlled Trial; HUD=US Department of Housing and Urban Development

ABSTRACT

This study uses the Moving to Opportunity (MTO) housing voucher experiment to test mediation of MTO effects on youth mental health (n=2829). MTO had a harmful main effect for boys' behavior problems and psychological distress, and a beneficial main effect for girls' psychological distress. Using Inverse Odds Ratio Weighting mediation we tested youth substance use comorbidity, social networks, and family mental health as potential mediators of the MTO-mental health relationship. Gender-stratified models identified comorbid substance use as a significant mediating domain for boys' behavior problems, indicating that the same boys who exhibit increased behavior problems also exhibit increased substance use. Social networks did not significantly mediate effects on boys' behavior problems or psychological distress, although the results suggest this is a promising avenue for further exploration. Family mental health did not mediate effects on boys' mental health. No proposed mediators significantly accounted for MTO effects on girls' psychological distress.

INTRODUCTION

A growing body of evidence is documenting that adverse dimensions of neighborhood

context, such as neighborhood poverty, disorder, safety, crime, and violence, have important

associations with poor substance use and mental health outcomes (Kim 2008; Leventhal and

Brooks-Gunn 2000; Leventhal, Dupéré and Gunn 2009; Mair, Roux and Galea 2008; Truong and

Ma 2006). However the bulk of this literature is comprised of observational, cross-sectional

studies, and therefore limits causal inference due to potential threats to validity such as

unmeasured confounding and reverse causation. In fact, residential-related selection may be

the most serious issue plaguing neighborhood effect studies (Sampson, Morenoff and Gannon-

Rowley 2002). In addition, the body of neighborhood and health research typically takes a

"black box" approach, analyzing vaguely defined concepts measuring context and/or

composition (e.g., area-level vs. individual-level poverty), rather than on the specific

mechanisms that may influence health (Macintyre, Ellaway and Cummins 2002). To address this

gap in the literature, we leverage a unique experimental design of housing mobility. Such a

randomized design strengthens causal inference of how moving to different locations may

influence the health of low-income populations. We then test potential multilevel mechanisms

of the effects of an experiment on youth mental health, including individual-, peer-, and family-

level mediators.

The Moving to Opportunity (MTO) demonstration project provides a rare opportunity to

examine housing- and neighborhood-related causes and mediators of adolescent mental health

within an experimental design, among a low-income, predominantly minority, urban

population. The MTO study randomly assigned 4608 low-income families to one of three

treatments: (1) receiving a section 8 voucher allowing them to move out of public housing into a subsidized private rental apartment with no restrictions on where to move (Section 8 group); (2) receiving a section 8 voucher subsidizing rent but only in a low-poverty neighborhood, along with housing counseling (MTO Treatment group); (3) remaining in-place in public housing (Control Group) (Goering and Feins 2003). The families randomized to the MTO treatment and Section 8 groups improved their neighborhood and housing environment, compared to controls (Orr et al. 2003). Two uniform evaluations have been conducted, one 4-7 years (interim evaluation), and another (final evaluation) 10-15 years, following random assignment.

Although the main goals of the MTO program focused on improving economic self-sufficiency of household heads, the program changed very few socioeconomic outcomes (Orr et al. 2003). The main domain affected by the program was, unexpectedly, physical and mental health (Orr et al. 2003). Notably, there were opposite effects of the MTO program on adolescent health and substance use, (beneficial for girls and harmful for boys among the treatment group compared to controls). Specifically, interim survey findings (4-7 years after random assignment) noted reductions in girls' psychological distress, lifetime marijuana use, lifetime smoking, and an index of risky behaviors (Kling, Liebman and Katz 2007; Orr et al. 2003; Osypuk et al. 2012a; Osypuk et al. 2012b). In contrast, findings noted increases in boys' psychological distress, behavior problems, smoking, and risky behaviors (Kling et al. 2007; Orr et al. 2003; Osypuk et al. 2012a; Osypuk et al. 2012b). The final survey (10-15 years after random assignment) displayed some similar findings, with reductions (among a younger adolescent cohort) in girls' psychological distress, serious behavioral/emotional problems, and alcohol use, and increases in lifetime smoking for the total sample and for boys (Ludwig et al. 2011;

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Sanbonmatsu et al. 2011). These opposite findings have been quite puzzling for both researchers and housing advocates.

There are several theories as to why these opposite gender effects emerged, but no prior research has formally tested any mechanisms through which MTO caused these perplexing changes in mental health. For example, it is likely that the social environment operates differently for boys and girls. Women consistently report feeling less safe in their neighborhoods than men (Perkins and Taylor 1996; Silver, Mulvey and Swanson 2002), and qualitative work with the MTO families revealed that escaping from the very-high poverty baseline neighborhoods in public housing developments also translated to relief from experiencing sexual harassment and risk of sexual victimization for the teenaged girls (Popkin, Leventhal and Weismann 2008). Boys on the other hand may be more sensitive to disruptions to their social networks, for example, if their new neighborhoods lacked other minority males for establishing friendships or adult male role models, which are essential for preventing risky and other problem behaviors (Caldwell et al. 2010).

In this manuscript, we test whether three types of constructs mediate the MTO housing mobility program effects on adolescent mental health: youth's own substance use, youth's non-family social networks, and the mental health of other members of the youth's family. These hypotheses are grounded in several literatures. Substance use may be influenced by neighborhood norms (Ahern et al. 2008; Curry et al. 1993; Leventhal and Brooks-Gunn 2000), and may also affect mental health (Merikangas, Nakamura and Kessler 2009), so this may be an important intermediary between neighborhoods and mental health. Many common characteristics of disadvantaged neighborhoods, such as the presence of violence, residential

instability, and neighborhood disorder, affect the formation and connectedness of social networks (Harding 2008; Lenzi et al. 2013; Sampson and Groves 1989). In turn, these neighborhood social characteristics influence mental health and problem behaviors (Ary et al. 1999; Browning, Leventhal and Brooks-Gunn 2004; Leventhal and Brooks-Gunn 2000; Leventhal et al. 2009). There is growing evidence that these measures may be important mediators of neighborhood effects on health (Haines, Beggs and Hurlbert 2011; Ross and Mirowsky 2001). Neighborhood or family deprivation may also act as a stressor on family processes, which leads to parental stress and/or poor mental health (Klebanov, Brooks-Gunn and Duncan 1994). Parental mental health is one of the most well-documented risk factors for children's mental health (Goodman and Tully 1999; Kessler, Avenevoli and Ries Merikangas 2001; Merikangas et al. 2009). Since MTO improved the mental health of mothers, this provides another plausible pathway for explaining the beneficial effects of MTO on girls' mental health. In summary, we will test whether the MTO treatment-mental health effects are partially mediated by changes in the comorbidity of adolescent's substance use, in peer/social networks, or in the mental health of the parent or sibling.

Prior research suggests that gender may modify the mediators of interest, in addition to the outcomes (Orr et al. 2003; Osypuk et al. 2012a; Osypuk et al. 2012b), so we test gender-specific pathways of mediation. Specifically, we hypothesize that the harmful effect of MTO on boys' substance use and peer networks may partially account for some of the harmful effects of MTO on boys' mental health. In contrast, we hypothesize the beneficial effect of MTO on girls' substance use and family mental health may partially account for the beneficial effect of MTO on girls' mental health. Consistent with a broader eco-epidemiologic approach (Susser and

Susser 1996), we examine mediators at multiple levels, and include a range of factors from behavioral to social. Focusing on different levels of organization allows us to think beyond the black box (Susser and Susser 1996).

To formally test these mediation hypotheses, we employ Inverse Odds Ratio Weighting (IORW), an innovative weight-based causal mediation method, to estimate direct and indirect effects (effect decomposition). The IORW method is an advancement on the traditional parametric mediation methods (Baron and Kenny 1986), in that it does not require linear outcomes, it can accommodate complex interactions between the treatment and mediators, and it can model multiple mediators simultaneously (Nguyen et al. 2015; Tchetgen Tchetgen 2013).

METHODS

Data

This study uses data from the Moving to Opportunity for Fair Housing Demonstration Project (MTO), a randomized controlled trial (RCT). The US Department of Housing and Urban Development implemented the trial in 5 large cities, Baltimore, Boston, Chicago, Los Angeles, and New York, as a means of helping low-income families living in concentrated poverty to voluntarily move to more affluent neighborhoods (US Department of Housing & Urban Development 1996). Volunteer families were eligible to participate in MTO if they had children under age 18, qualified for rental assistance, and lived in public housing or housing projects (Feins and McInnis 2001). Public housing authorities drew applicants from waiting lists and evaluated families for eligibility, and applicants signed enrollment agreements, gave informed

consent, and completed the Baseline Survey (Goering et al. 1999). Of the families who

volunteered, 4608 were eligible and included in the MTO Tier 1 Restricted Access Data.

Treatment Assignment. Eligible families were randomly assigned, by special software,

to one of three treatment groups: the "low-poverty" treatment group received a Section 8

voucher that was only redeemable in a neighborhood with less than 10% census tract poverty,

as well as housing counseling to aid relocation; the "Section 8" treatment group received a

traditional Section 8 voucher that could be used in any neighborhood; the control group could

remain in public housing, but received no additional assistance (Goering et al. 1999). Families

had 90 days to use the offered voucher in order to subsidize the rent of a private market

apartment, after which point the offered voucher expired. In this study, we combined the low-

poverty and Section 8 experimental voucher groups to improve statistical power and

parsimony. Both groups experienced similar improvements in neighborhood poverty by 2002

(although immediately after treatment randomization these effects were larger for the low-

poverty group). Notably, the treatment effects on adolescent mental health were similar for

both groups, and formal tests of treatment effect homogeneity were not statistically significant

at p<.05.

Assessment. The baseline survey was conducted in 1994 to 1998 and the interim

evaluation survey was conducted in 2001 to 2002, using in-person interviews with household

heads and sample children (Goering et al. 1999; Orr et al. 2003). We focus on youth randomized

through 12/31/1997 who were aged 12-19 by 5/31/2001. Of the 3537 eligible youth, 2829 were

interviewed at the interim survey, for a response rate of 89.3% (Orr et al. 2003). Household

heads provided written consent for themselves and their children (Feins and McInnis 2001; Goering et al. 1999; Orr et al. 2003).

Measures

Table 1 provides the coding, sources of data, and descriptive statistics for our mental health outcomes and mediators, overall and by treatment group. For descriptive statistics by gender and treatment group, see Supplemental Table 1.

<<TABLE 1>>

Outcomes. We focus on two youth self-reported dimensional mental health outcomes measured at the interim survey (2002), one of which captures internalizing behaviors (psychological distress), and one of which captures externalizing behaviors (behavior problems). The K6 scale (Kessler et al. 2002) measured past-month psychological distress with the following 6 items: depressed, nervous, restless or fidgety, hopeless, everything was an effort, and worthless. Responses were 5-item Likert responses ranging from "none of the time" to "all of the time." The Behavior Problems Index (BPI) measured past 6-month behavior problems with the following 11 items: have trouble concentrating, lie/cheat, tease others, disobey parents, have trouble sitting still, have a hot temper, prefer being alone, hang around with kids who get in trouble, disobey at school, don't get along with kids, don't get along with teachers. Responses were 3-item Likert responses ranging from "not true" to "often true." For both outcome measures, we used 2-parameter binary item response theory (IRT) modeling to obtain a factor score that approximates a standard normal distribution (Kessler et al. 2002). IRT scoring gives heavier weight to items with a stronger relationship to the underlying construct, thereby

increasing reliability and precision over simpler summed scores to improve measurement (Hambleton and Swaminathan 1985; Kessler et al. 2002) .

Mediators. We tested mediators collected at the interim survey (2001-2002) in three domains: youth substance use comorbidity, non-family social networks, and family mental health (see Table 1 for coding and descriptive statistics by treatment group; see Supplemental Table 1 for descriptive statistics by gender and treatment group). To aid interpretability, all potential mediators were coded such that higher values equal worse responses, and measures that needed to be reverse-coded to fit this rubric are noted. In addition to the mediators detailed below, we tested additional family social support variables including contact with and support from fathers, and maternal support and supervision, but findings were non-significant so we do not present these results here.

Youth self-reported substance use comorbidity includes several measures of alcohol, cigarette, and marijuana use. Alcohol use includes lifetime alcohol use, past 30-day alcohol use, past 30-day number of days youth drank, past 30-day binge drinking (5+ drinks), and past 30-day alcohol use before or during work or school. Cigarette use includes lifetime cigarette use, past 30-day cigarette use, and past 30-day number of cigarettes youth smoked per day. Marijuana use includes lifetime marijuana use, past 30-day marijuana use, past 30-day number of days youth smoked marijuana, and past 30-day marijuana use before or during work or school. Finally, we created a measure of past 30-day number of substances used by the youth, which includes alcohol, cigarettes, and marijuana, as well as other non-prescription drugs.

Non-family social networks include measures of the youth's relationships with adults and friends, as well as peer deviance and involvement in prosocial activities. Youth relationships

with adults were measured with two variables (both reverse coded so that lower numbers equal more adults): number of adults youth can confide in; and number of adults who youth can rely on for help. Youth friendships were measured with several variables, including the youth has no friends (self-reported and parent-reported), has less than 3 friends, has less than 5 friends, and has friends from the baseline neighborhood. Peer deviance includes binary measures indicating the youth has friends who use drugs, are gang members, and carry weapons. We also measured whether the youth had friends involved in school activities and sports (separately), both of which were reverse coded so 0=involvement and 1=no involvement.

Family mental health includes a variety of measures of the mental health of other family members in the index adolescent's household, including mother's/primary caregiver's mental health, as well as sibling mental health. We refer to the mother/primary caregiver measures as "maternal" mental health, because nearly 90% of youth lived with their mothers. These measures include maternal past-month psychological distress, lifetime major depressive disorder (MDD), past-year generalized anxiety disorder, and past 30 days calm/peaceful (reverse coded so 0=calm peaceful, 1=not calm/peaceful). Most sibling self-reported mental health measures were only available for youth in the analytic sample who also had a youth sibling (aged 12-19) in the analytic sample (N=1250). These measures include sibling past-month psychological distress, past 6-month behavior problems, past-year major depressive disorder (MDD), lifetime MDD, and past-year generalized anxiety disorder. We also tested parent-reported sibling behavior problems, which was measured among a wider age range of siblings (aged 5-19; N=2212).

Covariates. We adjusted all regression models for any baseline covariates that are significantly related (at p<.10) to each mental health outcome in order to adjust for potential confounding of the mediator-outcome relationship. As expected in a RCT, baseline covariates were balanced across treatment groups and therefore not associated with the outcomes. Baseline covariates include: youth gender, age, race; site; household head never married, was employed, was in school, education, moved more than three times in last five years; household member was disabled; school called to discuss youth's school work/behavior problems, youth received help for a learning problem, youth had problem requiring special medicine or equipment, youth was suspended or expelled.

Analytic Plan

Intention-to-treat (ITT) estimates of the total effects were derived, for each outcome, using covariate-adjusted linear regression. An ITT approach aligns with proper analytic methods for analyzing the main effect of a randomly-assigned treatment on outcomes. We then estimated first-leg ITT models to examine the effects of MTO treatment on each of the mediators (individually) using covariate-adjusted linear, logistic, poisson, or multinomial regression, depending on the scaling of the mediator. Mediation of the MTO treatment effects on psychological distress and BPI was tested using an innovative, weight-based mediation method, which has different strengths, limitations, and assumptions than traditional methods, as outlined below.

All models were stratified by gender because of the documented opposite-gender effects of MTO on our outcomes (i.e., beneficial for girls, and harmful for boys) (Kling et al.

2007; Orr et al. 2003; Osypuk et al. 2012a; Osypuk et al. 2012b), and were adjusted for survey

weights and family-level clustering using Stata 11.0.

We employ several common terms from the mediation literature when describing the

mediation of the MTO program on adolescent mental health. The effect of MTO on the

outcome of interest (here, adolescent mental health) is the total effect. We use the natural

direct and indirect effect approach (Pearl 2001) to decompose this effect, to identify variables

that significantly mediate the total effect, called the indirect effect. The effect of the MTO

program on adolescent mental health that does not operate through the modeled mediators is

deemed the direct effect. The magnitude of mediation was calculated with a percent change

((direct effect-total effect)/total effect), such that a positive percent change indicates a

countervailing effect (i.e., an increase in the effect of MTO after accounting for the mediator),

and a negative percent change indicates mediation in the expected direction (i.e., a decrease in

the effect of MTO). We conduct a lot of tests in this paper, and therefore, these analyses may

be considered exploratory. This is merited, however, given that an expensive program such as

MTO is not likely to be replicated soon, so we must learn all we can from the program and why

it influenced mental health in such puzzling ways.

Site heterogeneity has been documented for boys' BPI (Osypuk et al. 2012b), where

MTO had a beneficial effect on behavior problems in Los Angeles (LA), while MTO had a null or

harmful effect in the four other sites. In preliminary models, it appeared that this site

heterogeneity was producing unstable estimates for BPI. Therefore, we stratified the results,

separating LA from the other sites, before estimating the mediation models. Mediation results

for MTO on boys' BPI, omitting LA, are presented here; we also tested mediation for LA on its

own, however, models were severely underpowered given the small sample size, with no significant mediation findings, so we do not present these findings here. No site heterogeneity was documented for psychological distress, therefore, we employ the full sample.

Inverse Odds Ratio Weighting (IORW). The Inverse Odds Ratio Weighting mediation method is a semiparametric alternative to the traditional parametric formula approach (Baron and Kenny 1986). IORW condenses information on the relationship between treatment and the mediator into a weight, adjusting for covariates (Tchetgen Tchetgen 2013). The weight deactivates all indirect pathways through the mediator, which isolates the direct effect of treatment. The indirect effect is calculated by differencing the total effect and direct effect. We applied this method in several steps, and more detail on this application (including statistical code) is offered in a forthcoming methodological paper (Nguyen et al. 2015). First, we obtained the predicted odds from a logistic regression model predicting treatment from the mediator and baseline covariates. Second, we took the inverse of this predicted odds to create the IORW weight. Third, we estimated the total effect of MTO treatment on our outcomes in the ITT linear regression models described above. Fourth, we re-estimated this equation while applying the IORW weight to adjust for the mediator and recover the direct effect. Finally, we subtracted the direct effect coefficient from the total effect coefficient to obtain the indirect effect of MTO treatment through the mediator. Standard errors for the direct and indirect effect were obtained using bootstrapping with 1000 replications.

IORW mediation has several advantages, including that it can be used for outcomes of any scale, accommodates multiple mediators, whether binary, categorical, or continuous, and is robust to the presence of treatment-mediator interactions (Nguyen et al. 2015). IORW also

assumes no unmeasured confounding, an assumption that can be tested using a sensitivity analysis (Nguyen et al. 2015; Tchetgen Tchetgen and Shpitser 2012). Although this method overcomes some of the limitations of traditional mediation, estimates may be less precise and variances may be larger, making indirect effects more difficult to detect than traditional methods (when the assumptions are upheld) (Nguyen et al. 2015). Therefore, we also estimated indirect effects applying the traditional parametric mediation formula (Baron and Kenny 1986). Our aim was to take a complementary approach, applying two methods with different sets of assumptions, to evaluate mediation of the MTO treatment effects on mental health. We empirically tested the difference in the indirect effect obtained from the two different methods, and used bootstrapping (1000 replications) to recover standard errors. We saw congruence between the two sets of results (i.e., no significant differences in the indirect effect coefficients between methods) and consistent substantive findings, so we present findings from IORW models below.

RESULTS

Total Effects

Consistent with prior evidence, the MTO treatment exerted a harmful effect on boys' behavior problems (b(SE) = .271(.065); without LA) and boys' psychological distress (b(SE) = .140(.060)), while it had a beneficial effect on girls' psychological distress (b(SE) = -.123(.060)). The treatment effect on girls' BPI was nonsignificant, therefore, we do not present mediation results for girls' behavior problems.

First-leg Mediation Analyses

For the gender-pooled (total) sample, MTO treatment did not significantly change many of the mediators (Table 2; significant (p<.10) change denoted by + or – sign to denote direction of change). There was one harmful effect of MTO on peer drug use, and there were some improvements in a few of the non-family social network variables. Once stratified by gender though, a very different pattern emerged (Table 2). For boys, MTO treatment changed many mediators for the worse, including increasing past 30 day alcohol use, past 30 day binge drinking, lifetime and past 30 day cigarette use, past 30 day number of cigarettes smoked per day, past 30 day number of substances used, peer drug use, and sibling BPI. There were a few exceptions where MTO generated positive effects for boys, including: MTO decreased the youth having no friends, having friends in the baseline neighborhood, and having friends in a gang. Across the board, the MTO treatment improved many mediators for girls, decreasing past 30 day alcohol use and the number of days drank alcohol, past 30 day binge drinking, past 30 day cigarette use and number of cigarettes smoked per day, past 30 day marijuana use and number of days smoked marijuana, past 30 day marijuana use before or during work or school, past 30 day number of substances used, the youth feeling disconnected from adults, the youth having friends in the baseline neighborhood, the youth having friends not involved in sports, maternal psychological distress, and maternal not calm/peaceful feelings. Full results for the first-leg models are presented in Supplemental Table 2.

<< TABLE 2 >>

Mediation Analyses

For boys' BPI, the IORW estimates testing mediation by youth self-reported substance use comorbidity measures demonstrated four significant substance use mediators of the MTO

treatment effect (Table 3). Specifically, past 30 day alcohol use, past 30 day cigarette use, past 30 day number of cigarettes smoked per day, and past 30 day number of substances used were significant mediators of MTO treatment. These mediators resulted in a percent change in the total effect ranging from -12.6% to -18.0%. The IORW results showed no significant mediators in the non-family social network arenas or family mental health domains. However, peer drug use had a close to marginally significant effect (p=.106). MTO treatment increased peer drug use, which in turn led to a 14.4% decrease in the total effect, signifying a suggestion of mediation in the expected direction.

<< TABLE 3 >>

For boys' psychological distress, IORW models did not identify any significant mediation of MTO treatment effects (Table 4). In the non-family social network domain, having friends in the baseline neighborhood had a close to marginally significant effect (p=.102), corresponding to a 22.3% decrease in the total effect, signifying possible mediation, but in the opposite direction. In other words, MTO treatment reduced the likelihood that youth would have friends in the baseline neighborhood (a peer group who may increase exposure to risky/deviant behaviors), which served to increase the overall harmful effect of treatment. Family mental health was not a relevant mediating domain for boys' psychological distress. For girls' psychological distress, none of the IORW models showed significant mediation (Table 5).

<< TABLE 4 >>

<< TABLE 5 >>

DISCUSSION

In this study, we examined mediation of the heretofore puzzling opposite-gender effects of the Moving to Opportunity housing mobility experiment on adolescent mental health. Applying IORW mediation, we tested whether variables related to youth self-reported substance use comorbidity, non-family social networks, and family mental health mediated the harmful effects of MTO on boys' behavior problems and psychological distress, and the beneficial effects of MTO on girls' psychological distress. With a few exceptions, MTO treatment worsened many of the mediators for boys, while it improved many of the mediators for girls. These changes were most evident for the substance use mediators.

MTO treatment increased boys' engagement in several forms of substance use, including alcohol use, cigarette use, and a summary measure of substance use. Substance use also emerged as the main mediators of the harmful effect of MTO on behavior problems. Notably, since substance use was measured contemporaneously with mental health at the interim evaluation, our results formally suggest covariation rather than causal mediation, given that we cannot establish the temporal order between the measures. However, this is an important finding because it suggests comorbidity, e.g. that the same boys in the MTO experiment who experience increases in mental health problems also experience increases in substance use problems. Although MTO significantly reduced the substance use of girls in the treatment group, this is not significantly associated with decreases in girls' psychological distress.

In the non-family social networks domain, results suggested that peer drug use may be relevant for boys. Treatment increased the number of friends youths had who used drugs, which in turn exhibited close to marginally significant mediation of the harmful effects of

treatment for behavior problems (-14.4% change). This suggests that boys who move using the MTO voucher are falling in with peer groups who engage in more deviant/risky behavior. This finding is consistent with prior qualitative work that suggests that boys who moved to better neighborhoods were less discerning about who they formed friendships with, partially because they had not learned strategies for avoiding risky peers in their neighborhoods (Clampet-Lundquist et al. 2011). Although MTO improved several non-family social network variables for girls, these improvements did not account for the beneficial effect of MTO on girls' mental health.

Interestingly, MTO did improve two social network measures for boys—it reduced the likelihood that youth would have friends from baseline neighborhoods and the likelihood that youth would have friends in gangs. Having friends in the baseline neighborhood had a suggested mediation effect (p=.102) for the harmful effect of treatment on boys' psychological distress, however, not in a beneficial direction. It appears that after accounting for this mediator, the harmful effect increased by 22.3%. Although not close to significance, the effect for boys having friends in gangs was a similar size and direction (20.2%). Clearly, simply cutting boys off from friends in poor neighborhoods, even if you are cutting them off from potentially risky peers, is not beneficial, and, in fact, may partially account for the harmful treatment effect.

In the family mental health arena, MTO increased sibling behavior problems for boys with teenage siblings also in the MTO study, but this factor did not mediate treatment effects on boys' mental health. On the other hand, MTO decreased maternal psychological distress and increased maternal calm/peaceful feelings, but, again, these factors did not account for the

beneficial effects of treatment on girls' mental health. Many of these potential mediators were improved for girls in the treatment group, however, none explained the beneficial effect of moving girls to lower poverty neighborhoods on their mental health.

Boys, however, experienced detriments in many potential mediators as a result of participating in the MTO program, especially in terms of substance use. Substance use, in turn, significantly covaries with mental health, indicating that boys in the treatment group experienced a multitude of harmful effects. This suggests an avenue that is important for future investigation, particularly in trying to tease out whether substance use or mental health acts as an intermediary between treatment effects on these important health risks.

Our study leverages a unique housing voucher experiment among low income minority families, which strengthens the causal inference on how neighborhood moves influence adolescent mental health. We apply a novel mediation method, IORW, to estimate indirect effects, which overcome some of the limitations of traditional mediation approaches (Nguyen et al. 2015). However, our study also exhibits several limitations. Notably, in order to test mediation, we had to break the experimental design. Mediation analysis explicitly models the relationship between mediators and outcomes, which is not randomized, meaning our estimates are subject to confounding. The validity of our mediation estimates rely on the assumption of no unmeasured confounding. One potential confounder is early substance use at baseline. Although such a variable would not account for the treatment effects, it could confound estimates of the mediator on the mental health outcome. We plan to conduct sensitivity analyses, recently developed in epidemiology, to test how unmeasured confounding may account for the results we obtain here (Nguyen et al. 2015; Tchetgen Tchetgen and

Shpitser 2012). We plan to include these in our final paper. Another limitation includes that we cannot establish the temporal order among our mental health outcome of interest, with respect to the mediators we modeled, given that they were simultaneously measured in the interim survey data.

Although the MTO study is an RCT, it is a bundled treatment. Therefore, separating out the specific effect of any one element of the treatment that was effective for changing mental health may be challenging. Moreover, MTO does not provide us with neighborhood effects, strictly speaking, but may indicate a combination of neighborhood effects, mobility effects, and/or housing effects. Nonetheless, MTO did substantially improve neighborhood context, and it remains a very policy relevant treatment since housing vouchers currently represent the primary form of federal affordable housing dollars (National Low Income Housing Coalition 2011).

In conclusion, our results suggest that the MTO program worsened boys' mental health and substance use. Future housing policies should consider building in components that could ease some of the potential negative repercussions of this widespread housing policy. For example, MTO was conceived and delivered as a housing program, and health was not considered an a priori outcome that would be affected by the program, nor was the adverse effects for boys anticipated. Housing voucher programs would benefit from integrating non-housing components, such as the resident supportive services required under the HOPE VI housing relocation program (e.g., case management, and linkage to health care access or educational services tailored to residents' needs) (Engdahl 2009; Popkin et al. 2002). Another promising, multi-pronged approach for preventing and treating mental health and housing-

related problems is incorporating medical care with unmet legal service needs, such as legal

counseling and housing support (Cohen et al. 2010). Finally, future housing policies may benefit

from measuring mental health and substance use, at baseline and follow-up, to provide

targeted services to health-vulnerable population.

REFERENCES

Ahern, J., S. Galea, A. Hubbard, L. Midanik, and S. Syme. 2008. ""Culture of drinking" and individual problems with alcohol use." *Am J Epidemiol.* 167(9):1041-1049.

Ary, D.V., T.E. Duncan, S.C. Duncan, and H. Hops. 1999. "Adolescent problem behavior: The influence of parents and peers." *Behaviour Research and Therapy* 37:217-230.

Baron, R.M.and D.A. Kenny. 1986. "The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations." *Journal of Personality and Social Psychology* 51:1173-1182.

Browning, C.R., T. Leventhal, and J. Brooks-Gunn. 2004. "Neighborhood context and racial differences in early adolescent sexual activity." *Demography* 41(4):697-720.

Caldwell, C.H., J. Rafferty, T.M. Reischl, E.H. De Loney, and C.L. Brooks. 2010. "Enhancing Parenting Skills Among Nonresident African American Fathers as a Strategy for Preventing Youth Risky Behaviors." *American Journal of Community Psychology* 45(1-2):17-35.

Clampet-Lundquist, S., K. Edin, J.R. Kling, and G.J. Duncan. 2011. "Moving teenagers out of high-risk neighorhoods: How girls fare better than boys." *American Journal of Sociology* 116(4):1154-1189.

Cohen, E., D.F. Fullerton, R. Retkin, D. Weintraub, P. Tames, J. Brandfield, and M.T. Sandel. 2010. "Medical-legal partnership: Collaborating with lawyers to identify and address health disparities." *Journal of General Internal Medicine* 25(suppl 2):S136-S139.

Curry, S., E. Wagner, A. Cheadle, and et al. 1993. "Assessment of community-level influences on individuals' attitudes about cigarette smoking, alcohol use, and consumption of dietary fat." *Am J Prev Med* 9:78–84.

Engdahl, L. 2009. "New Homes, New Neighborhoods, New Schools: A Progress Report on the Baltimore Housing Mobility Program." Baltimore, MD and Washington DC: Baltimore Regional Housing Campaign, and Poverty & Race Research Action Council.

Feins, J.D.and D. McInnis. 2001. "The Interim Impact Evaluation for the Moving to Opportunity Demonstration, C-OPC-21484." Cambridge, MA: Abt Associates Inc.

Goering, J.and J. Feins. 2003. *Choosing a Better Life? Evaluating the Moving to Opportunity Social Experiment*. Washington, DC: The Urban Institute Press.

Goering, J., J. Kraft, J. Feins, D. McInnis, M.J. Holin, and H. Elhassan. 1999. "Moving to Opportunity for Fair Housing Demonstration Program: Current Status and Initial Findings." Washington, DC: US Department of Housing & Urban Development, Office of Policy Development and Research.

Goodman, S.and E. Tully. 1999. "Risk for psychopathology in the children of depressed mothers: a developmental model for understanding mechanisms of transition." *Psychol Rev* 106:458-490.

Haines, V.A., J.J. Beggs, and J.S. Hurlbert. 2011. "Neighborhood disadvantage, network social capital, and depressive symptoms." *Journal of Health and Social Behavior* 52(1):58-73.

Hambleton, R.K.and H. Swaminathan. 1985. *Item Response Theory: Principles and Applications*. Boston, MA: Kluwer-Nijhoff Publishing.

Harding, D.J. 2008. "Neighborhood violence and adolescent friendships." *International Journal of Conflict and Violence* 2(1):28-55.

Kessler, R., G. Andrews, L. Colpe, E. Hiripi, D. Mroczek, S. Normand, E. Walters, and A. Zaslavsky. 2002. "Short screening scales to monitor population prevalences and trends in non-specific psychological distress." *Psychological Medicine* 32(06):959-976.

Kessler, R.C., S. Avenevoli, and K. Ries Merikangas. 2001. "Mood disorders in children and adolescents: an epidemiologic perspective." *Biological Psychiatry* 49(12):1002-1014.

Kim, D. 2008. "Blues from the neighborhood? Neighborhood characteristics and depression." *Epidemiologic Reviews* 30(1):101-117.

Klebanov, P.K., J. Brooks-Gunn, and G.J. Duncan. 1994. "Does neighborhood and family poverty affect mothers' parenting, mental health, and social support?" *Journal of Marriage and the Family* 56:441-455.

Kling, J.R., J.B. Liebman, and L.F. Katz. 2007. "Experimental analysis of neighborhood effects." *Econometrica* 75(1):83-119.

Lenzi, M., A. Vieno, M. Santinello, and D.D. Perkins. 2013. "How neighborhood structural and institutional features can shape neighborhood social connectedness: A multilevel study of adolescent perceptions." *American Journal of Community Psychology* 51:451-467.

Leventhal, T.and J. Brooks-Gunn. 2000. "The Neighborhoods They Live In: The Effects of Neighborhood Residence on Child and Adolescent Outcomes." *Psychological Bulletin* 126(2):309-337.

Leventhal, T., V. Dupéré, and J.B.-. Gunn. 2009. "Chapter 12: Neighborhood Influences on Adolescent Development." Pp. 411-443 in *Handbook of Adolescent Psychology, Volume 2, Contextual Influences on Adolescent Development, 3rd Edition*, edited by R.M. Lerner and L. Steinberg. Hoboken, NJ: Wiley.

Ludwig, J., L. Sanbonmatsu, L. Gennetian, E. Adam, G.J. Duncan, L.F. Katz, R.C. Kessler, J.R. Kling, S.T. Lindau, R.C. Whitaker, and T.W. McDade. 2011. "Neighborhoods, obesity, and diabetes - A randomized social experiment." *The New England Journal of Medicine* 365(16):1509-1519.

Macintyre, S., A. Ellaway, and S. Cummins. 2002. "Place effects on health: how can we conceptualise, operationalise, and measure them?" *Social Science & Medicine* 55:125-139.

Mair, C., A.V.D. Roux, and S. Galea. 2008. "Are neighbourhood characteristics associated with depressive symptoms? A review of evidence." *Journal of Epidemiology & Community Health* 62(11):940-946.

Merikangas, K.R., E.F. Nakamura, and R.C. Kessler. 2009. "Epidemiology of mental disorders in children and adolescents." *Dialogues in Clinical Neuroscience* 11(1):7-20.

National Low Income Housing Coalition. 2011. "Federal Budget & Approps, HUD Budget Charts, FY11 and FY12 Budget Chart for Selected HUD Programs, Updated April 27, 2011." Washington DC.

Nguyen, Q.C., T.L. Osypuk, N.M. Schmidt, M.M. Glymour, and E.J. Tchetgen Tchetgen. 2015. "Practical guidance for conducting mediation analysis with multiple mediators using inverse odds ratio weighting." *American Journal of Epidemiology* 181(5):349-356.

Orr, L., J.D. Feins, R. Jacob, E. Beecroft, L. Sanbonmatsu, L.F. Katz, J.B. Liebman, and J.R. Kling. 2003. "Moving to Opportunity for Fair Housing Demonstration Program: Interim Impacts Evaluation." Pp. 341. Washington, DC: U.S. Department of Housing and Urban Development, Office of Policy Development and Research.

Osypuk, T.L., N.M. Schmidt, L.M. Bates, E.J. Tchetgen-Tchetgen, F.J. Earls, and M.M. Glymour. 2012a. "Gender and crime victimization modify neighborhood effects on adolescent mental health." *Pediatrics* 130(3):472-481.

Osypuk, T.L., E.J. Tchetgen Tchetgen, D. Acevedo-Garcia, F.J. Earls, A. Lincoln, N.M. Schmidt, and M.M. Glymour. 2012b. "Differential mental health effects of neighborhood relocation among youth in vulnerable families." *Archives of General Psychiatry* 69(12):1284-1294.

Pearl, J. 2001. "Direct and indirect effects." Presented at Proceedings of the seventeenth conference on uncertainty in artificial intelligence, San Francisco, CA.

Perkins, D.and R. Taylor. 1996. "Ecological assessments of community disorder: Their relationship to fear of crime and theoretical implications." *American Journal of Community Psychology* 24(1):63-107.

Popkin, S.J., L.E. Harris, M.K. Cunningham, J. Bradley, A. Graham, and J. Comey. 2002. "Families in Transition: A Qualitative Analysis of the MTO Experience. Final Report." Pp. 191. Washington DC: Urban Institute.

Popkin, S.J., T. Leventhal, and G. Weismann. 2008. "Girls in the 'Hood: The Importance of Feeling Safe." in *Metropolitan Housing and Communities Center*. Washington, DC: The Urban Institute.

Ross, C.E.and J. Mirowsky. 2001. "Neighborhood disadvantage, disorder, and health." *Journal of Health and Social Behavior* 42(3):258-276.

Sampson, R.J.and W.B. Groves. 1989. "Community structure and crime: Testing social-disorganization theory." *American Journal of Sociology* 94(4):774-802.

Sampson, R.J., J.D. Morenoff, and T. Gannon-Rowley. 2002. "Assessing "neighborhood effects": Social processes and new directions in research." *Annual Review of Sociology* 28:443-478.

Sanbonmatsu, L., J. Ludwig, L.F. Katz, L.A. Gennetian, G.J. Duncan, R.C. Kessler, E. Adam, T.W. McDade, and S.T. Lindau. 2011. "Moving to Opportunity for Fair Housing Demonstration Program: Final Impacts Evaluation." Washington, D.C.: U.S. Department of Housing and Urban Development, Office of Policy Development and Research.

Silver, E., E.P. Mulvey, and J.W. Swanson. 2002. "Neighborhood structural characteristics and mental disorder: Faris and Dunham revisited." *Social Science & Medicine* 55(8):1457-1470.

Susser, M.and E. Susser. 1996. "Choosing a Future for Epidemiology: II. From Black Box to Chinese Boxes and Eco-Epidemiology." *American Journal of Public Health* 86(5):674-677.

Tchetgen Tchetgen, E.J. 2013. "Inverse odds ratio-weighted estimation for causal mediation analysis." *Statistics in Medicine* 32(26):4567-4580.

Tchetgen Tchetgen, E.J.and I. Shpitser. 2012. "Semiparametric theory for causal mediation analysis: Efficiency bounds, multiple robustness, and sensitivity analysis." *Annals of Statistics* 40(3):1816-1845.

Truong, K.and S. Ma. 2006. "A systematic review of relations between neighborhoods and mental health." *J Ment Health Policy Econ* 9(3):137-154.

US Department of Housing & Urban Development. 1996. "Expanding Housing Choices For HUD-Assisted Families: Moving to Opportunity. First Biennial Report to Congress, Moving to Opportunity for Fair Housing Demonstration Program.".

Table 1. Youth Outcome and Mediator Coding and Descriptive Statistics, Moving to Opportunity Data (2001-02).

Domain & Variable	Variable Description	Total Sample			Experimental Group			Control Group		
		N	Mean	SD	N	Mean	SD	N	Mean	SD
OUTCOMES										
Psychological Distress	K6 psychological distress scale; 2-parameter binary IRT model of 6-items, higher=more distress; YR	2829	-0.04	0.93	1950	-0.04	0.93	879	-0.04	0.92
Behavior Problems	Behavior problems index (BPI); 2-parameter binary IRT model of 11-items, higher=more distress; YR	2829	-0.03	0.90	1950	-0.01	0.89	879	-0.06	0.90
MEDIATORS										
Youth Self-Reported Substance Use Comorbidity										
Lifetime Alcohol Use	Youth ever drank alcohol; 0=no, 1=yes; YR	2810	0.30	0.46	1938	0.30	0.46	872	0.30	0.46
Past 30 Day Alcohol Use	Youth drank alcohol in the past 30 days; 0=no, 1=yes; YR	2802	0.13	0.33	1933	0.13	0.34	869	0.12	0.33
Past 30 Day Number of Days Drank Alcohol	Number of days youth drank alcohol in the past 30 days; 0=did not drink, 1=1-2 days, 3=3 or more days; YR	2802	0.17	0.48	1933	0.18	0.49	869	0.16	0.46
Past 30 Day Binge Drinking	Youth had 5 or more drinks in the past 30 days; 0=no, 1=yes; YR	2790	0.04	0.19	1925	0.04	0.19	865	0.03	0.18
Past 30 Day Alcohol Use Before/During Work/School	Youth drank alcohol before or during work or school in the past 30 days; 0=no, 1=yes; YR	2793	0.02	0.14	1928	0.02	0.14	865	0.02	0.13
Lifetime Cigarette Use	Youth ever smoked cigarettes; 0=no, 1=yes; YR	2812	0.22	0.41	1938	0.23	0.42	874	0.20	0.40
Past 30 Day Cigarette Use	Youth smoked cigarettes in the past 30 days; 0=no, 1=yes; YR	2798	0.13	0.34	1927	0.14	0.35	871	0.11	0.31
Past 30 Day Number of Cigarettes Smoked per Day	Number of cigarettes youth smoked per day in the past 30 days; 0=none, 1=less than daily, 2=1-19 per day, 3=a pack per day or more; YR	2798	0.20	0.57	1927	0.22	0.60	871	0.16	0.51
Lifetime Marijuana Use	Youth ever smoked marijuana; 0=no, 1=yes; YR	2802	0.22	0.42	1933	0.22	0.42	869	0.22	0.42
Past 30 Day Marijuana Use	Youth smoked marijuana in the past 30 days; 0=no, 1=yes; YR	2794	0.10	0.30	1927	0.10	0.29	867	0.10	0.30
Past 30 Day Number of Days Smoked Marijuana	Number of days youth smoked marijuana in the past 30 days; range 0 to 30; YR	2794	0.92	4.37	1927	0.95	4.47	867	0.85	4.15
Past 30 Day Marijuana Use Before/During Work/School	Youth smoked marijuana before or during work or school in the past 30 days; 0=no, 1=yes; YR	2790	0.03	0.17	1924	0.03	0.17	866	0.03	0.16
Past 30 Day Number of Substances Used	Number of substances used by youth in the past 30 days; 0=none, 1=1 substance, 2=2 substances, 3=3-4 substances; YR	2750	0.35	0.73	1893	0.36	0.74	857	0.33	0.70
Non-Family Social Networks										
Number of Adults Youth can Confide in	Number of adults youth talks to about personal problems; 0=5 or more adults, 4=0 adults; YR	2811	1.80	1.18	1938	1.77	1.18	873	1.88	1.17
Number of Adults to Help Youth	Number of adults youth can rely on for help; 0=7 or more adults, 5=0 adults; YR	2796	1.84	1.42	1925	1.81	1.41	871	1.91	1.44

Table 1. (Continued) Youth Outcome and Mediator Coding and Descriptive Statistics, Moving to Opportunity Data (2001-02).

Domain & Variable	Variable Description	Total Sample			Experimental Group			Control Group		
		N	Mean	SD	N	Mean	SD	N	Mean	SD
Youth Has No Friends	Youth has no friends; 0=no, 1=yes; YR	2805	0.05	0.21	1931	0.04	0.21	874	0.05	0.22
Youth Has No Friends (Parent-Report)	Youth has no friends; 0=no, 1=yes; PR	2276	0.07	0.25	1570	0.06	0.24	706	0.07	0.25
Youth Has Less Than 3 Friends	Youth has less than 3 friends; 0=no, 1=yes; YR	2805	0.27	0.44	1931	0.26	0.44	874	0.27	0.45
Youth Has Less Than 5 Friends	Youth has less than 5 friends; 0=no, 1=yes; YR	2805	0.49	0.50	1931	0.48	0.50	874	0.50	0.50
Youth Has Friends from Baseline Neighborhood	Youth sees friends from baseline neighborhood; 0=no, 1=yes; YR	2723	0.61	0.49	1869	0.57	0.49	854	0.68	0.47
Friends Use Drugs	Youth has friends who use drugs; 0=no, 1=yes; YR	2659	0.29	0.45	1826	0.30	0.46	833	0.25	0.43
Friends In a Gang	Youth has friends who are gang members; 0=no, 1=yes; YR	2696	0.14	0.35	1849	0.14	0.34	847	0.16	0.37
Friends Carry Weapons	Youth has friends who carry weapons; 0=no, 1=yes; YR	2711	0.12	0.32	1858	0.12	0.33	853	0.11	0.31
Friends Are Not Involved in School Activities	Youth's friends are not involved in activities at school; 0=no, 1=yes; YR	2717	0.28	0.45	1881	0.27	0.45	836	0.28	0.45
Friends Are Not Involved in Sports	Youth's friends are not involved in sports; 0=no, 1=yes; YR	2704	0.90	0.30	1862	0.89	0.31	842	0.91	0.28
Family Mental Health										
Maternal Psychological Distress	K6 psychological distress scale; mean score of 6-items, range 1 to 5; AR	2745	1.98	0.95	1897	1.97	0.94	848	2.01	0.95
Maternal Lifetime MDD	Lifetime depressive symptoms; 0=no syptoms, 1=symptoms; AR	2742	0.17	0.37	1894	0.16	0.37	848	0.19	0.39
Maternal Generalized Anxiety Disorder	Past year generalized anxiety disorder; 0=no, 1=yes; AR	2696	0.39	0.49	1863	0.38	0.49	833	0.41	0.49
Maternal Not Calm/Peaceful	Past 30 days did not feel calm and peaceful all or most of the time; 0=felt calm/peaceful, 1=did not feel calm/peaceful; AR	2743	0.52	0.50	1895	0.51	0.50	848	0.56	0.50
Sibling Psychological Distress IRT	K6 psychological distress scale; 2-parameter binary IRT model of 6-items, higher=more distress; SR	1250	-0.01	0.93	860	0.00	0.94	390	-0.03	0.91
Sibling Behavior Problems	Behavior problems index (BPI); 2-parameter binary IRT mode of 11-itemsl, higher=more distress; SR	1250	-0.01	0.92	860	0.00	0.93	390	-0.04	0.90
Sibling Generalized Anxiety Disorder	Past year generalized anxiety disorder; 0=no, 1=yes; SR	1165	0.06	0.23	797	0.06	0.23	368	0.06	0.24
Sibling Past Year MDD	Lifetime major depressive disorder; 0=no, 1=yes; SR	1250	0.03	0.17	860	0.03	0.17	390	0.03	0.17
Sibling Lifetime MDD	Past year major depressive disorder; 0=no, 1=yes; SR	1250	0.05	0.21	860	0.04	0.21	390	0.05	0.21
Parent-Reported Behavioral Problems IRT	Behavior problems index (BPI); 2-parameter binary IRT model of 11-items, higher=more distress; PR	2212	-0.03	0.90	1538	-0.02	0.90	674	-0.05	0.91

YR=Youth Self-Report; AR=Adult Self-Report; SR=Sibling Self-Report; PR=Parent-Report

Table 2. Direction of First-Stage Mediation Results, MTO Treatment Effect on Mediators Significant at p<.10; + = Beneficial Effect, − = Harmful Effect.

	Total Sample	Boys	Girls
Youth Self-Reported Substance Use Comorbidity			
Lifetime Alcohol Use			
Past 30 Day Alcohol Use Yes/No		−	+
Past 30 Day Number of Days Drank Alcohol			
1-2 Days vs. Never			+
3 or More Days vs. Never			+
Past 30 Day Binge Drinking Yes/No		−	+
Past 30 Day Alcohol Use Before/During Work/School			
Lifetime Cigarette Use		−	
Past 30 Day Cigarette Use Yes/No		−	+
Past 30 Day Number of Cigarettes Smoked per Day			
Less than Daily vs. Never		−	
Daily, 1-19 Cigarettes vs. Never		−	+
Pack/Day or More vs. Never			
Lifetime Marijuana Use			+
Past 30 Day Marijuana Yes/No			+
Past 30 Day Number of Days Smoked Marijuana [†]			+
Past 30 Day Marijuana Use Before/During Work/School			
Past 30 Day Number of Substances Used			
One Substance vs. None			
Two Substances vs. None		−	+
3-4 Substances vs. None		−	
Non-Family Social Networks			
Number of Adults Youth can Confide in			
3-4 vs. 5+ Adults			
2 vs. 5+ Adults			+
1 vs. 5+ Adults	+		+
0 vs. 5+ Adults			
Number of Adults to Help Youth			
5-6 vs. 7+ Adults			+
3-4 vs. 7+ Adults			
2 vs. 7+ Adults		−	+
1 vs. 7+ Adults	+		+
0 vs. 7+ Adults			
Youth Has No Friends		+	
Youth Has No Friends (Parent-Report)			
Youth Has Less Than 3 Friends			
Youth Has Less Than 5 Friends			
Youth Has Friends from Baseline Neighborhood	+	+	+
Friends Use Drugs	−	−	
Friends In a Gang		+	
Friends Carry Weapons			
Friends Are Not Involved in School Activities			
Friends Are Not Involved in Sports	+		+

Table 2. (Continued) Direction of First-Stage Mediation Results, MTO Treatment Effect on Mediators Significant at p<.10; + = Beneficial Effect, − = Harmful Effect.

	Total Sample	Boys	Girls
Family Mental Health			
Maternal Psychological Distress			+
Maternal Lifetime MDD			
Maternal Generalized Anxiety Disorder			
Maternal Not Calm/Peaceful			+
Sibling Psychological Distress IRT			
Sibling Behavioral Problems IRT		−	
Sibling Generalized Anxiety Disorder			
Sibling Past Year MDD			
Sibling Lifetime MDD			
Parent-Reported Behavioral Problems IRT			

+ = Beneficial effect of treatment; **−** = Harmful effect of treatment

† Poisson Model

NOTE: Models adjusted for all covariates in second-stage models

Table 3. IORW Mediation Predicting Behavioral Problems among Boys, Without LA; Indirect Effects

	INDIRECT			%	
	b	SE	p	Change	N
Youth Self-Reported Substance Use Comorbidity					
Lifetime Alcohol Use	0.021	0.024	0.368	-7.7%	1110
Past 30 Day Alcohol Use	0.034	0.020	0.084	-12.6%	1106
Past 30 Day Number of Days Drank Alcohol	0.030	0.020	0.129	-10.8%	1106
Past 30 Day Binge Drinking	0.030	0.021	0.158	-10.7%	1100
Past 30 Day Alcohol Use Before or During Work or School	0.006	0.021	0.755	-2.3%	1101
Lifetime Cigarette Use	0.035	0.022	0.109	-12.8%	1110
Past 30 Day Cigarette Use	0.038	0.019	0.047	-14.2%	1104
Past 30 Day Number Cigarettes Smoked per Day	0.037	0.019	0.053	-13.8%	1104
Lifetime Marijuana Use	0.029	0.024	0.230	-10.9%	1106
Past 30 Day Marijuana Use	0.018	0.024	0.438	-6.9%	1102
Past 30 Day Number of Days Smoked Marijuana	0.018	0.018	0.310	-6.9%	1102
Past 30 Day Marijuana Use Before or During Work or School	0.015	0.018	0.382	-5.8%	1099
Past 30 Day Number of Substances Used	0.049	0.024	0.040	-18.0%	1082
Non-Family Social Networks					
Number of Adults Youth can Confide In	0.003	0.015	0.839	-1.1%	1111
Number of Adults to Help Youth	0.008	0.015	0.563	-3.1%	1104
Youth Has No Friends	0.011	0.015	0.462	-3.9%	1106
Youth Has No Friends Parent-Report	0.008	0.018	0.673	-2.7%	888
Youth Has Less than 3 Friends	0.013	0.014	0.374	-4.6%	1106
Youth Has Less than 5 Friends	0.027	0.018	0.122	-9.9%	1106
Youth Has Friends from Baseline Neighborhood	0.016	0.017	0.347	-5.5%	1085
Youth Has Friends Who Use Drugs	0.039	0.024	0.106	-14.4%	1026
Youth Has Friends Who Are Gang Members	-0.014	0.029	0.613	5.0%	1049
Youth Has Friends Who Carry Weapons	0.031	0.025	0.212	-11.1%	1050
Youth Has Friends Who Are Not Involved in School Activities	0.014	0.015	0.368	-4.8%	1064
Youth Has Friends Who Are Not Involved in Sports	0.009	0.015	0.536	-3.2%	1061
Family Mental Health					
Maternal Psychological Distress	0.018	0.019	0.334	-6.3%	1095
Maternal MDD	0.013	0.015	0.381	-4.6%	1094
Maternal GAD	0.005	0.019	0.782	-1.8%	1074
Maternal Not Calm/Peaceful	0.010	0.016	0.515	-3.6%	1093
Sibling Distress [a]	0.034	0.041	0.412	-11.3%	494
Sibling BPI [a]	0.044	0.048	0.358	-14.7%	494
Sibling GAD [b]	-0.007	0.034	0.845	2.4%	455
Sibling Past Year MDD [a]	-0.005	0.033	0.890	1.5%	494
Sibling Lifetime MDD [a]	-0.003	0.033	0.929	1.0%	494
Parent-Reported Sibling BPI	0.034	0.025	0.180	-10.8%	871

NOTE: Models estimated with 1000 bootstrap replications and adjusted for the following baseline covariates: youth age; site; household head never married, had a job, was in school, education, moved more than 3 times in 5 years; household size; youth had learning problems, needed special medicine/equipment, was expelled, youth's school called to discuss school work/behavior problems; Percent change was calculated by taking (direct effect-total effect)/total effect, total effect of treatment on BPI was Boys without LA b(SE): .271(.065).
[a] One or more parameters could not be estimated in 9 bootstrap replicates; standard error estimates include only complete replications.
[b] One or more parameters could not be estimated in 7 bootstrap replicates; standard error estimates include only complete replications.

Table 4. IORW Mediation Predicting Psychological Distress among Boys, With LA; Indirect Effects

	INDIRECT			% Change	N
	b	SE	p		
Youth Self-Reported Substance Use Comorbidity					
Lifetime Alcohol Use	-0.001	0.017	0.952	0.8%	1390
Past 30 Day Alcohol Use	0.003	0.016	0.878	-2.0%	1386
Past 30 Day Number of Days Drank Alcohol	0.001	0.016	0.974	-0.4%	1386
Past 30 Day Binge Drinking	-0.001	0.015	0.947	0.8%	1378
Past 30 Day Alcohol Use Before or During Work or School	-0.009	0.016	0.560	7.4%	1380
Lifetime Cigarette Use	0.007	0.018	0.682	-5.4%	1390
Past 30 Day Cigarette Use	0.000	0.016	0.995	0.1%	1384
Past 30 Day Number Cigarettes Smoked per Day	-0.002	0.016	0.880	1.8%	1384
Lifetime Marijuana Use	-0.006	0.015	0.697	4.3%	1385
Past 30 Day Marijuana Use	-0.007	0.017	0.654	5.3%	1379
Past 30 Day Number of Days Smoked Marijuana	-0.005	0.015	0.738	3.7%	1379
Past 30 Day Marijuana Use Before or During Work or School	-0.003	0.016	0.828	2.4%	1376
Past 30 Day Number of Substances Used	0.004	0.016	0.807	-3.2%	1356
Non-Family Social Networks					
Number of Adults Youth can Confide In	-0.009	0.014	0.496	6.9%	1391
Number of Adults to Help Youth	-0.008	0.014	0.558	5.8%	1382
Youth Has No Friends	-0.008	0.014	0.577	5.7%	1382
Youth Has No Friends Parent-Report	-0.017	0.017	0.319	11.3%	1120
Youth Has Less than 3 Friends	-0.011	0.015	0.468	7.8%	1382
Youth Has Less than 5 Friends	-0.008	0.015	0.569	5.9%	1382
Youth Has Friends from Baseline Neighborhood	-0.030	0.018	0.102	22.3%	1354
Youth Has Friends Who Use Drugs	0.010	0.019	0.600	-8.8%	1286
Youth Has Friends Who Are Gang Members	-0.029	0.019	0.134	20.2%	1325
Youth Has Friends Who Carry Weapons	-0.005	0.018	0.787	3.7%	1320
Youth Has Friends Who Are Not Involved in School Activities	-0.009	0.015	0.538	6.6%	1332
Youth Has Friends Who Are Not Involved in Sports	-0.012	0.015	0.427	7.8%	1332
Family Mental Health					
Maternal Psychological Distress	-0.007	0.016	0.676	4.6%	1368
Maternal MDD	-0.013	0.015	0.391	8.9%	1367
Maternal GAD	-0.014	0.015	0.374	9.4%	1346
Maternal Not Calm/Peaceful	-0.012	0.015	0.453	8.0%	1366
Sibling Distress	0.013	0.043	0.764	-6.2%	626
Sibling BPI	-0.007	0.035	0.830	3.6%	626
Sibling GAD	-0.009	0.032	0.771	5.4%	579
Sibling Past Year MDD	-0.016	0.033	0.629	7.5%	626
Sibling Lifetime MDD	-0.024	0.034	0.471	11.6%	626
Parent-Reported Sibling BPI	-0.010	0.018	0.586	6.0%	1099

NOTE: Models estimated with 1000 bootstrap replications and adjusted for the following baseline covariates: youth age, black race; site; household head never married, teen parent, had a job, had a family member with a disability, lived in baseline neighborhood for 5+ years, chatted with neighbors; household size; youth was in gifted/advanced class, was expelled, youth's school called to discuss school work/behavior problems; Percent change was calculated by taking (direct effect-total effect)/total effect, total effect of treatment on Distress was Boys with LA b(SE): .140(.060).

Table 5. IORW Mediation Predicting Psychological Distress among Girls, With LA; Indirect Effects

	INDIRECT			%	
	b	SE	p	Change	N
Youth Self-Reported Substance Use Comorbidity					
Lifetime Alcohol Use	-0.007	0.019	0.723	-5.2%	1420
Past 30 Day Alcohol Use	-0.004	0.017	0.811	-3.3%	1416
Past 30 Day Number of Days Drank Alcohol	-0.003	0.016	0.845	-2.6%	1416
Past 30 Day Binge Drinking	0.012	0.013	0.383	9.1%	1412
Past 30 Day Alcohol Use Before or During Work or School	0.019	0.013	0.150	15.5%	1413
Lifetime Cigarette Use	0.005	0.015	0.743	3.9%	1422
Past 30 Day Cigarette Use	0.008	0.014	0.564	6.2%	1414
Past 30 Day Number Cigarettes Smoked per Day	0.006	0.014	0.657	4.8%	1414
Lifetime Marijuana Use	0.000	0.015	0.977	0.3%	1417
Past 30 Day Marijuana Use	0.003	0.016	0.864	2.2%	1415
Past 30 Day Number of Days Smoked Marijuana	0.011	0.014	0.453	8.9%	1415
Past 30 Day Marijuana Use Before or During Work or School	0.012	0.014	0.385	10.0%	1414
Past 30 Day Number of Substances Used	-0.007	0.017	0.680	-5.5%	1394
Non-Family Social Networks					
Number of Adults Youth can Confide In	0.008	0.015	0.587	6.3%	1420
Number of Adults to Help Youth	0.016	0.014	0.246	12.5%	1414
Youth Has No Friends	0.015	0.013	0.233	12.5%	1423
Youth Has No Friends Parent-Report	0.003	0.015	0.845	4.2%	1156
Youth Has Less than 3 Friends	0.016	0.013	0.226	13.0%	1423
Youth Has Less than 5 Friends	0.018	0.014	0.190	14.6%	1423
Youth Has Friends from Baseline Neighborhood	-0.014	0.018	0.429	-12.5%	1369
Youth Has Friends Who Use Drugs	0.015	0.016	0.338	10.7%	1373
Youth Has Friends Who Are Gang Members	0.015	0.017	0.370	11.4%	1371
Youth Has Friends Who Carry Weapons	0.017	0.017	0.306	13.1%	1391
Youth Has Friends Who Are Not Involved in School Activities	0.017	0.015	0.249	13.3%	1385
Youth Has Friends Who Are Not Involved in Sports	0.016	0.015	0.302	14.8%	1372
Family Mental Health					
Maternal Psychological Distress	-0.016	0.021	0.465	-14.5%	1377
Maternal MDD	0.004	0.015	0.794	3.6%	1375
Maternal GAD	0.006	0.018	0.734	6.3%	1350
Maternal Not Calm/Peaceful	0.000	0.015	0.991	-0.2%	1377
Sibling Distress	0.034	0.042	0.420	24.9%	624
Sibling BPI	0.026	0.037	0.478	19.3%	624
Sibling GAD	0.017	0.033	0.605	10.9%	586
Sibling Past Year MDD	0.025	0.032	0.441	18.4%	624
Sibling Lifetime MDD	0.029	0.032	0.354	21.7%	624
Parent-Reported Sibling BPI	0.005	0.020	0.811	3.7%	1113

NOTE: Models estimated with 1000 bootstrap replications and adjusted for the following baseline covariates: youth age, black race; site; household head never married, teen parent, had a job, had a family member with a disability, lived in baseline neighborhood for 5+ years, chatted with neighbors; household size; youth was in gifted/advanced class, was expelled, youth's school called to discuss school work/behavior problems; Percent change was calculated by taking (direct effect-total)/total effect, total effect of treatment on Distress was Girls with LA b(SE): -.123(.060).

Supplemental Table 1. Youth Outcome and Mediator Descriptive Statistics by Gender, Moving to Opportunity Data (2001-02).

	BOYS									GIRLS								
	Total Sample			Experimental Group			Control Group			Total Sample			Experimental Group			Control Group		
Domain & Variable	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
OUTCOMES																		
Psychological Distress	1403	-0.13	0.91	967	-0.09	0.92	436	-0.22	0.89	1426	0.05	0.93	983	0.01	0.93	443	0.15	0.92
Behavior Problems	1403	0.03	0.90	967	0.08	0.90	436	-0.08	0.90	1426	-0.08	0.88	983	-0.10	0.88	443	-0.04	0.89
MEDIATORS																		
Youth Self-Reported Substance Use Comorbidity																		
Lifetime Alcohol Use	1390	0.31	0.46	959	0.33	0.47	431	0.28	0.45	1420	0.29	0.45	979	0.27	0.45	441	0.32	0.47
Past 30 Day Alcohol Use	1386	0.13	0.34	956	0.15	0.36	430	0.09	0.29	1416	0.12	0.33	977	0.11	0.31	439	0.16	0.37
Past 30 Day Number of Days Drank Alcohol	1386	0.19	0.52	956	0.22	0.56	430	0.13	0.43	1416	0.15	0.43	977	0.13	0.40	439	0.20	0.49
Past 30 Day Binge Drinking	1378	0.05	0.21	951	0.06	0.23	427	0.02	0.15	1412	0.03	0.16	974	0.02	0.14	438	0.04	0.20
Past 30 Day Alcohol Use Before/During Work/School	1380	0.02	0.15	953	0.03	0.16	427	0.02	0.13	1413	0.01	0.12	975	0.01	0.12	438	0.02	0.13
Lifetime Cigarette Use	1390	0.25	0.43	958	0.28	0.45	432	0.19	0.39	1422	0.19	0.39	980	0.18	0.39	442	0.21	0.41
Past 30 Day Cigarette Use	1384	0.15	0.36	953	0.18	0.38	431	0.09	0.28	1414	0.11	0.31	974	0.10	0.30	440	0.13	0.34
Past 30 Day Number of Cigarettes Smoked per Day	1384	0.24	0.62	953	0.29	0.67	431	0.12	0.45	1414	0.17	0.53	974	0.16	0.52	440	0.20	0.56
Lifetime Marijuana Use	1385	0.27	0.44	954	0.29	0.45	431	0.23	0.42	1417	0.17	0.38	979	0.16	0.37	438	0.21	0.41
Past 30 Day Marijuana Use	1379	0.12	0.33	949	0.13	0.34	430	0.10	0.30	1415	0.07	0.25	978	0.06	0.23	437	0.10	0.29
Past 30 Day Number of Days Smoked Marijuana	1379	1.24	5.07	949	1.42	5.39	430	0.85	4.26	1415	0.60	3.52	978	0.49	3.28	437	0.86	4.03
Past 30 Day Marijuana Use Before/During Work/School	1376	0.04	0.20	947	0.05	0.21	429	0.03	0.17	1414	0.01	0.12	977	0.01	0.11	437	0.02	0.15
Past 30 Day Number of Substances Used	1356	0.40	0.78	932	0.45	0.83	424	0.28	0.64	1394	0.30	0.67	961	0.27	0.63	433	0.38	0.75
Non-Family Social Networks																		
Number of Adults Youth can Confide in	1391	1.82	1.21	960	1.80	1.21	431	1.84	1.23	1420	1.79	1.15	978	1.73	1.16	442	1.92	1.11
Number of Adults to Help Youth	1382	1.83	1.44	952	1.84	1.42	430	1.80	1.48	1414	1.85	1.40	973	1.78	1.40	441	2.01	1.39
Youth Has No Friends	1382	0.05	0.22	951	0.04	0.21	431	0.06	0.24	1423	0.04	0.20	980	0.04	0.21	443	0.04	0.20
Youth Has No Friends (Parent-Report)	1120	0.06	0.24	761	0.06	0.24	359	0.06	0.24	1156	0.07	0.25	809	0.07	0.25	347	0.08	0.27
Youth Has Less Than 3 Friends	1382	0.23	0.42	951	0.23	0.42	431	0.25	0.43	1423	0.30	0.46	980	0.30	0.46	443	0.30	0.46
Youth Has Less Than 5 Friends	1382	0.43	0.50	951	0.43	0.49	431	0.44	0.50	1423	0.54	0.50	980	0.53	0.50	443	0.57	0.50
Youth Has Friends from Baseline Neighborhood	1354	0.62	0.49	928	0.59	0.49	426	0.67	0.47	1369	0.59	0.49	941	0.56	0.50	428	0.68	0.47

Supplemental Table 1. (Continued) Youth Outcome and Mediator Descriptive Statistics by Gender, Moving to Opportunity Data (2001-02).

| | BOYS | | | | | | | | | GIRLS | | | | | | | | |
| | Total Sample | | | Experimental Group | | | Control Group | | | Total Sample | | | Experimental Group | | | Control Group | | |
Domain & Variable	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Friends Use Drugs	1286	0.32	0.47	881	0.35	0.48	405	0.25	0.44	1373	0.26	0.44	945	0.26	0.44	428	0.25	0.43
Friends In a Gang	1325	0.15	0.35	912	0.13	0.34	413	0.18	0.39	1371	0.14	0.35	937	0.14	0.35	434	0.14	0.35
Friends Carry Weapons	1320	0.14	0.34	902	0.14	0.35	418	0.12	0.33	1391	0.10	0.30	956	0.10	0.30	435	0.09	0.29
Friends Are Not Involved in School Activities	1332	0.27	0.44	923	0.28	0.45	409	0.24	0.43	1385	0.28	0.45	958	0.27	0.44	427	0.31	0.46
Friends Are Not Involved in Sports	1332	0.86	0.34	917	0.86	0.34	415	0.86	0.35	1372	0.94	0.24	945	0.93	0.26	427	0.97	0.17
Family Mental Health																		
Maternal Psychological Distress	1368	1.99	0.94	946	2.02	0.97	422	1.93	0.87	1377	1.98	0.95	951	1.93	0.91	426	2.09	1.02
Maternal Lifetime MDD	1367	0.17	0.37	945	0.16	0.37	422	0.17	0.38	1375	0.17	0.38	949	0.16	0.37	426	0.20	0.40
Maternal Generalized Anxiety Disorder	1346	0.40	0.49	929	0.39	0.49	417	0.42	0.49	1350	0.38	0.49	934	0.38	0.48	416	0.40	0.49
Maternal Not Calm/Peaceful	1366	0.52	0.50	944	0.52	0.50	422	0.53	0.50	1377	0.52	0.50	951	0.50	0.50	426	0.58	0.49
Sibling Psychological Distress IRT	626	0.08	0.94	431	0.11	0.95	195	0.02	0.91	624	-0.11	0.91	429	-0.12	0.92	195	-0.08	0.90
Sibling Behavior Problems	626	0.01	0.91	431	0.06	0.91	195	-0.11	0.90	624	-0.03	0.93	429	-0.06	0.94	195	0.03	0.90
Sibling Generalized Anxiety Disorder	579	0.06	0.25	395	0.06	0.24	184	0.07	0.26	586	0.05	0.22	402	0.05	0.22	184	0.05	0.22
Sibling Past Year MDD	626	0.04	0.18	431	0.04	0.19	195	0.03	0.18	624	0.02	0.15	429	0.02	0.15	195	0.03	0.17
Sibling Lifetime MDD	626	0.06	0.23	431	0.05	0.23	195	0.06	0.25	624	0.03	0.18	429	0.04	0.19	195	0.03	0.17
Parent-Reported Behavioral Problems IRT	1099	-0.02	0.89	757	-0.01	0.88	342	-0.06	0.92	1113	-0.04	0.92	781	-0.04	0.92	332	-0.04	0.90

YR=Youth Self-Report; AR=Adult Self-Report; SR=Sibling Self-Report; PR=Parent-Report

Supplemental Table 2. First-Stage Mediation Results, MTO Treatment Effect on Family and Individual Mediators.

	Total Sample					Boys					Girls			
	+/-	**b**	**SE**	**p**	**N**	+/-	**b**	**SE**	**p**	**N**	+/-	**b**	**SE**	**p**	**N**
Youth Self-Reported Substance Use Comorbidity															
Lifetime Alcohol Use		-0.060	0.125	0.630	2810		0.123	0.172	0.474	1390		-0.246	0.168	0.144	1420
Past 30 Day Alcohol Use Yes/No		-0.039	0.152	0.796	2802	-	0.459	0.227	0.043	1386	+	-0.481	0.205	0.019	1416
Past 30 Day Number of Days Used Alcohol					2802					1386					1416
1-2 Days vs. Never		-0.066	0.175	0.708			0.445	0.284	0.117		+	-0.411	0.224	0.066	
3 or More Days vs. Never		0.002	0.266	0.993			0.518	0.358	0.148		+	-0.654	0.397	0.100	
Past 30 Day Binge Drinking Yes/No		0.109	0.251	0.663	2790	-	0.805	0.419	0.055	1378	+	-0.766	0.320	0.017	1412
Past 30 Day Alcohol Use Before/During Work/School		0.111	0.344	0.747	2793		0.297	0.469	0.527	1302		-0.183	0.514	0.722	1413
Lifetime Cigarette Use		0.117	0.138	0.397	2812	-	0.415	0.204	0.042	1390		-0.199	0.177	0.260	1422
Past 30 Day Cigarette Use Yes/No		0.180	0.161	0.264	2798	-	0.764	0.234	0.001	1384	+	-0.397	0.219	0.070	1414
Past 30 Day Number of Cigarettes Smoked per Day					2798					1384					1414
Less than Daily vs. Never		0.078	0.197	0.693		-	0.481	0.281	0.088			-0.365	0.279	0.191	
Daily, 1-19 Cigarettes vs. Never		0.244	0.252	0.332		-	1.187	0.419	0.005		+	-0.571	0.321	0.075	
Pack/Day or More vs. Never		0.491	0.523	0.348			0.870	0.642	0.175			0.248	0.712	0.728	
Lifetime Marijuana Use		-0.064	0.139	0.642	2802		0.149	0.195	0.444	1385	+	-0.341	0.185	0.066	1417
Past 30 Day Marijuana Yes/No		-0.117	0.180	0.515	2794		0.170	0.253	0.502	1379	+	-0.597	0.249	0.017	1415
Past 30 Day Number of Days Smoked Marijuana [†]		-0.039	0.198	0.843	2794		0.287	0.259	0.266	1379	+	-0.607	0.271	0.025	1415
Past 30 Day Marijuana Use Before/During Work/School		0.067	0.256	0.794	2790		0.347	0.317	0.273	1376		-0.618	0.457	0.177	1339
Past 30 Day Number of Substances Used					2750					1356					1394
One Substance vs. None		0.050	0.166	0.764			0.228	0.253	0.368			-0.134	0.219	0.541	
Two Substances vs. None		-0.245	0.197	0.214		-	0.534	0.282	0.058		+	-1.026	0.276	0.000	
3-4 Substances vs. None		0.413	0.332	0.214		-	0.924	0.443	0.037			-0.027	0.430	0.951	
Non-Family Social Networks															
Number of Adults Youth can Confide in					2811					1391					1420
3-4 vs. 5+ Adults		-0.022	0.158	0.889			0.016	0.217	0.942			-0.122	0.223	0.585	
2 vs. 5+ Adults		-0.117	0.163	0.474			0.246	0.228	0.280		+	-0.486	0.227	0.032	
1 vs. 5+ Adults	+	-0.375	0.168	0.025			-0.239	0.245	0.329		+	-0.510	0.217	0.019	
0 vs. 5+ Adults		-0.068	0.256	0.789			0.096	0.310	0.756			-0.280	0.366	0.445	
Number of Adults to Help Youth					2796					1382					1414
5-6 vs. 7+ Adults		-0.183	0.153	0.231			0.030	0.216	0.888		+	-0.468	0.219	0.032	
3-4 vs. 7+ Adults		0.026	0.141	0.853			0.128	0.203	0.529			-0.123	0.194	0.525	
2 vs. 7+ Adults		-0.104	0.163	0.524		-	0.399	0.226	0.078		+	-0.651	0.220	0.003	
1 vs. 7+ Adults	+	-0.422	0.189	0.025			-0.335	0.259	0.196		+	-0.584	0.249	0.019	
0 vs. 7+ Adults		0.160	0.500	0.749			0.156	0.731	0.831			0.544	0.767	0.479	

Supplemental Table 2. (Continued) First-Stage Mediation Results, MTO Treatment Effect on Family and Individual Mediators.

	Total Sample					Boys					Girls				
	+/-	**b**	**SE**	**p**	**N**	+/-	**b**	**SE**	**p**	**N**	+/-	**b**	**SE**	**p**	**N**
Youth Has No Friends		-0.232	0.244	0.342	2805	+	-0.570	0.341	0.095	1256		0.208	0.389	0.592	1423
Youth Has No Friends (Parent-Report)		-0.155	0.214	0.468	2276		-0.077	0.310	0.805	1120		-0.172	0.274	0.531	1156
Youth Has Less Than 3 Friends		-0.134	0.123	0.278	2805		-0.271	0.178	0.129	1382		-0.026	0.160	0.873	1423
Youth Has Less Than 5 Friends		-0.176	0.107	0.101	2805		-0.162	0.151	0.283	1382		-0.192	0.150	0.202	1423
Youth Has Friends from Baseline Neighborhood	+	-0.507	0.118	0.000	2723	+	-0.455	0.162	0.005	1354	+	-0.611	0.159	0.000	1369
Friends Use Drugs	-	0.280	0.122	0.022	2659	-	0.461	0.182	0.011	1286		0.099	0.157	0.527	1373
Friends In a Gang		-0.201	0.146	0.169	2696	+	-0.445	0.212	0.036	1325		0.035	0.189	0.851	1371
Friends Carry Weapons		0.159	0.159	0.319	2711		0.221	0.221	0.318	1320		0.125	0.212	0.557	1391
Friends Are Not Involved in School Activities		-0.072	0.117	0.537	2717		0.155	0.171	0.365	1332		-0.253	0.166	0.129	1385
Friends Are Not Involved in Sports	+	-0.291	0.171	0.088	2704		-0.047	0.200	0.815	1332	+	-0.957	0.347	0.006	1372
Family Mental Health															
Maternal Psychological Distress		-0.029	0.058	0.614	2745		0.078	0.071	0.273	1368	+	-0.142	0.083	0.088	1377
Maternal Lifetime MDD		-0.167	0.159	0.294	2742		-0.068	0.212	0.749	1367		-0.262	0.214	0.221	1375
Maternal Generalized Anxiety Disorder		-0.098	0.124	0.427	2696		-0.099	0.158	0.531	1346		-0.090	0.163	0.580	1350
Maternal Not Calm/Peaceful		-0.174	0.119	0.145	2743		-0.052	0.156	0.738	1366	+	-0.323	0.158	0.042	1377
Sibling Psychological Distress IRT		0.056	0.074	0.449	1250		0.069	0.098	0.484	626		0.027	0.104	0.796	624
Sibling Behavioral Problems IRT		0.075	0.071	0.292	1250	-	0.159	0.087	0.069	626		0.022	0.098	0.820	624
Sibling Generalized Anxiety Disorder		-0.194	0.328	0.554	1165		-0.194	0.437	0.656	579		-0.043	0.417	0.918	586
Sibling Past Year MDD		-0.232	0.424	0.584	1250		-0.232	0.604	0.701	586		-0.210	0.501	0.676	593
Sibling Lifetime MDD		-0.137	0.337	0.683	1250		-0.455	0.425	0.284	586		0.066	0.457	0.886	593
Parent-Reported Behavioral Problems IRT		0.016	0.053	0.766	2212		0.020	0.075	0.788	1099		0.006	0.071	0.929	1113

+ = Beneficial effect of treatment; - = Harmful effect of treatment

† Poisson Model

NOTE: Models adjusted for all covariates in second-stage models