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# Facilitating motivation in young adolescents: Effects of an after-school program☆

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**Abstract**

This study examined the effects of a motivationally facilitative after-school program on 7th grade students' autonomous motivation, learning goals, school engagement, and performance in science class. Pairs of students were individually matched on sex, race/ethnicity, free lunch status, and science grades and each member was randomly assigned to either a 15 week, after-school program or a control group. Students ($N = 90$) completed questionnaires regarding their motivation, and engagement before and after the program. Science, math, social studies, and English teachers rated students' levels of classroom engagement. Students participating in the Investigators' Club increased in learning goals, engagement in school and in science class, and science grades, and decreased in performance goals relative to the controls. Effects of the program as well as drop-out and completer information, are discussed in terms of the goal of facilitating motivation in disadvantaged middle school students.


*Keywords:* Motivation; After-school program; Adolescents; Intervention

## 1. Introduction

Facilitating motivation and success in adolescents, particularly those from disadvantaged circumstances, is a widespread goal of psychologists, educators, and policy makers. Not only is academic achievement a goal in and of itself, but interest and involvement in school is associated with a variety of psychosocial outcomes such as self-esteem, adjustment, responsibility and competence (Jessor & Jessor, 1977; Steinberg, 1996). Conversely, disengagement from school has been related to use and abuse of drugs and alcohol, depression, early experience with sex, and crime and delinquency (e.g., Hawkins, Catalano, & Miller, 1992). The search for programs that can affect students' motivation and performance is thus a high priority.

Concern with school achievement and engagement is particularly heightened for students in their middle school years. Middle school has been identified as a time of academic risk (Eccles & Midgley, 1989; Eccles et al., 1993).

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During this period, students' attitudes toward school become more negative and self-esteem and perceived competence in school decline (Anderman & Maehr, 1994), especially when children transition to large, bureaucratic middle schools (Marsh, 1989; Seidman, Allen, Aber, Mitchell, & Feinman, 1994) and particularly for students who live in the most difficult social and economic conditions (Cuban, 1989; Peng, Wang, & Walberg, 1992). Finally, children's attitudes and motivations toward school early in middle school are strongly predictive of adaptation in high school, including grades, behavior problems and plans to continue schooling (Eccles, Lord, Roeser, Barber, & Jozefowicz, 1997; Murdock, Anderman, & Hodge, 2000). Such data support the call of the Carnegie Corporation for intervention with youth prior to the high school years (Carnegie Council on Adolescent Development, 1989).

This study evaluated an after-school program called the Investigators' Club, designed to facilitate motivation in middle school students from an urban, predominantly low-income neighborhood. This theory-based intervention focused on science, but was designed to build skills and attitudes that would transfer to the larger school context. The questions we attempted to answer in this study were: How effective is the program in facilitating positive motivational orientations toward school and achievement in science? Are these effects apparent in students' reports of their own motivation and/or in teachers' reports of student behavior in the classroom? Do effects of the intervention occur in relation to science class only, other classes, or school in general? Finally, given that drop-out from programs for at-risk populations is a major concern in intervention research (Gross, Julion, & Fogg, 2001; Weisman & Gottfredson, 2001), what factors predict who drops-out of this after-school program? The answers to these questions can provide information useful to planning future programs and also address basic questions about interactions between contexts for learning and motivation.

The Investigators' Club intervention is rooted in an approach to motivation known as Self-Determination Theory (e.g., Deci & Ryan, 1985; Grolnick, Ryan, & Deci, 1991). The active components of the intervention as well as the outcomes expected to change as the result of the intervention are based on this theory (see Connell & Klem, 2000). Self-Determination Theory posits that individuals have three needs: the need to feel competent, or able to achieve desired outcomes; the need to feel autonomous, or the origin of one's actions; and the need to feel related to others. The theory posits that when these needs are fulfilled, motivation will be enhanced. The outcomes of need fulfillment, autonomous motivation, feelings of self-efficacy, and feelings of connectedness with others will then translate into engaged patterns of action. Engagement includes participation, attention, ongoing task behavior, and positive affect (Connell & Wellborn, 1991) and is the antithesis of alienation (Finn & Rock, 1997). Supporting the importance of autonomy and competence, Vallerand and Bissonette (1992) found that students who ultimately dropped out of a compulsory college level course had initially lower levels of autonomous motivation than completers; and high school students who dropped out of school had initially lower levels of autonomy and felt less competent than those who persisted (Vallerand, Fortier, & Guay, 1997).

An important component of the theory is to specify environments that facilitate experiences of autonomy, competence, and relatedness. Three dimensions of the environment have thus been described — autonomy support (vs. control), structure, and involvement. Autonomy supportive contexts allow choice and support active problem solving. By contrast, controlling environments pressure students and solve problems for them, characteristics that should undermine autonomy resulting in children's taking a more external stance toward their work and adopting performance rather than learning goals. Consistent with this theorizing, research shows that classrooms (e.g., Black & Deci, 2000; Deci, Schwartz, Sheinman, & Ryan, 1981; Ryan & Grolnick, 1986), schools (Vallerand et al., 1997), and homes (Grolnick & Ryan, 1989; Grolnick et al., 1991) that support autonomy facilitate greater perceived autonomy, perceptions of competence and intrinsic motivation. The second dimension, structure, involves providing information and guidelines that facilitate competence. Structure has been associated with children's performance in school as well as with their understanding of the sources of control of their successes and failures (e.g., Grolnick & Ryan, 1989). Finally, feelings of relatedness are facilitated by an environment including involved, supportive others (Ryan & Lynch, 1989).

To facilitate these experiences we developed the Investigators' Club, a 15-week after-school science program. Seventh grade students attend three days per week for 1 1/2 hours daily. Participants were referred to as "Investigators" whose job it is to "discover, practice, and acquire the skills of scientific investigation." The design is a hands-on approach utilizing group discussion, small group experimentation, and community building activities. Although the program shares a hands-on component with inquiry-oriented approaches (e.g., Katz, 1986; Kyle, Bonnstetter, McCloskey, & Fults, 1985; Woods, 1994), it is a structured program whereby a leader presents problems which children actively solve (rather than a purely exploratory program).

Our after-school program facilitated experiences of autonomy support, competence, and relatedness by utilizing activities and teacher discourse that included challenging material, support for student initiations, taking a nonevaluative stance (in contrast to the traditional Initiation, Response, Evaluation or IRE model that characterizes typical classroom lessons (e.g., Edwards & Westgate, 1987; Lemke, 1990), focusing on understanding, and transferring responsibility to the students for generating their own ideas (see Turner et al., 1998 for further discussion of teacher discourse structures). This stance, referred to as teacher scaffolding (Meyer, 1993; Turner et al., 1998, 2002) allows students to practice evidence based reasoning, a skill valued in school activities, and ownership of ideas in the context of a caring, involved learning environment. Such skills and approaches to material are expected to transfer to other learning contexts. In addition to the autonomous aspect of the discourse structure, the Investigators are given a great deal of personal autonomy, e.g., they are not required to sit in any particular place, or ask permission to get a calculator or use the bathroom. They also get to know the instructor personally.

The design of our program fits well with research on after-school programs, suggesting that programs that have active, child-initiated components (Heath, 1994; Villarruel & Lerner, 1994), increase knowledge, competence, and a sense of belonging (Carnegie Council on Adolescent Development, 1992) and those that are not too connected with schools (Villarruel & Lerner, 1994) were most beneficial. In accordance with the last point, our program occurred off school grounds at a University site.

To evaluate the Investigators' Club program we used a stratified selection procedure with randomization to after-school versus in-school control groups. We chose this strategy because we wished to oversample racial/ethnic groups and low achieving students. Thus, we identified such a diverse group from our set of interested students. Then, we matched each student with another student closest on variables of grades, ethnicity, sex, and free lunch status. Next, we randomly assigned one of the members to the after-school program and the other to our in-school control. Evaluation researchers consider randomization as key to evaluation designs (Cook, 2003). Our matching procedure also allowed us to deal with possible drop-out in that if an after-school member dropped out, his or her matched control could be excluded from analyses involving the control group. Also consistent with calls from evaluation researchers (Cook, 2003), we replicated our program a second time with a new teacher.

We assessed motivational resources directly connected to Self-Determination Theory pre- and post-intervention in the Investigators' Club children and the control group,. Measures included students' levels of autonomous versus controlled motivation, and students' perceptions of competence. We assessed as a further aspect of autonomy students' learning vs. performance goals in school (Dweck, 1975). Students with learning goals, who are oriented to increasing their knowledge are likely to feel more autonomous about their learning. By contrast, students with performance goals are oriented to more external outcomes of grades or looking smart. Although relatively little work has focused on the social context of achievement goals, Ames (1992) suggested that classroom factors such as the design of tasks, type of evaluation, and distribution of responsibility would be important factors. Deemphasizing social comparison (Ames, 1984), a shift of responsibility for learning to students, and democratic communication (Wentzel, 2002) should facilitate learning goals. As these characteristics are consistent with an autonomy supportive environment, we predicted increases in learning goals and decreases in performance goals in our intervention relative to our control group.

Achievement goals are connected with students' theories of intelligence in that students who have performance goals are more likely to have fixed theories of intelligence, whereas those who are more learning oriented are more likely to see intelligence as changeable, or to have an incremental theory (Farrell & Dweck, 1985). We thus predicted increases in endorsement of incremental and decreases in the endorsement of entity theories of intelligence in our intervention relative to our control group.

Further, while enhancing motivation is a primary goal of the Investigators' Club, we were also interested in examining the extent to which participants in the program changed in their patterns of behavior in the classroom and grades. We thus examined students' engagement in specific classes (English, Social Studies, Math, and Science) as well as in school in general.

Although there are many programs that have been created with similar goals to ours, there is a lack of controlled research on the outcomes of such after-school programs (Carnegie Council on Adolescent Development, 1992). The vast majority of programs have been evaluated anecdotally or qualitatively (Pressick-Kilborn & Walker, 2002). Further, even more quantitative approaches to evaluation have lacked experimental control (e.g., Frank et al., 2001; Pedraza & Ayala, 1996) or, if they did, they did not have a pre-test comparison to assure that the groups were appropriately matched (e.g., Pierce & Shields, 1998).

Supporting the potential for change in a theoretically informed intervention, Guthrie, Wigfield, and VonSecker (2000) evaluated the CORI (concept-oriented reading instruction) intervention which was designed to include autonomy support (provision of choice and self-direction), real world interaction (i.e., hands-on activities), competence enhancement (instruction in strategy use) and relatedness enhancement (collaboration among group members). Though they did not include a pre-program assessment, children in the CORI were higher in strategy use and curiosity relative to a group of children involved in traditional classroom activities.

## 2. Method

### *2.1. Overview of design*

The design of our study involved identifying matched pairs of seventh grade children and then randomly assigning one member to either the Investigators' Club after-school program or a control group. To determine whether the effect of participation in the Investigators' Club was due to the after-school program itself or simply participation in a project, the control group participants were treated as part of the Investigators' project. Three times during the 15-week period members of the control group met with research staff who demonstrated a science experiment. However, there were no active ingredients of the Investigators' Club included (i.e., competence or autonomy enhancing elements). Students from both groups completed questionnaires at their schools at the start and end of the 15-week program. The Investigators' Club was run twice, once in the spring of the first year and again in the fall of the second year with a new group of students from the same school. Students were provided with a bus to take them to the Club, which was located in a space just off campus from the University. The space included large areas in which groups could conduct experiments and hold group discussion.

### *2.2. Intervention description*

The Investigators' Club was developed as a manual-based set of curricular units — each with a particular content focused on science (e.g., air pressure, sinking and floating, mass and motion) that did not overlap with that of the science class curriculum, and with a set of common activities. Each unit involved a discrepant event, e.g., "what will happen when I drop this can full of water with a small hole punched in its side from the very top of this ladder?" Then, during "Circle Up Time" students in the full group predict what will happen when the experiment is run and provide an argument for their position. In these "position driven" discussions the teacher helps students clarify and explicate their positions. The leader does not evaluate children's thinking *per se*, but rather encourages them to build on each other's ideas and theories. In these discussions, students become facile at evidence based reasoning and in taking responsibility for their own positions with support from the group leader. "Circle Up Time" is followed by small group collaboration, in which students work with materials to address some issue pertaining to the topic at hand. The students then meet back in a circle to present results and explanations to the larger group. At the end of the session, students carry through and then discuss the experiment.

The first enactment of the Club was run by the lead teacher who was also one of the developers of the program, along with two apprentices. Following each session, the lead teacher watched videotapes of the session along with the apprentices and discussed what happened, including the amount of time spent in different structures (whole group, small group etc.). The second enactment was conducted by one of the apprentices. After each session, videotapes were reviewed with the lead teacher to be sure comparable standards and time frames were followed.

### *2.3. Participants*

Participants were 90 seventh grade children (47 boys, 43 girls) from an urban, largely disadvantaged school. Fifty-five (61%) lived with two-parents and 35 (39%) with a single parent. Fifty-six (62%) received free lunch. For race/ethnicity, 31 (34%) participants were of European descent, 28 (31%) were Hispanic/Latino, 19 (21%) were African American, 10 (11%) were Asian, and 2 (2%) were Native American.

### *2.4. Participant recruitment*

To recruit participants, two members of the research team visited the school — for the first Investigators' Club in January and for the second, in September of the following year. Team members demonstrated a physics phenomenon,

described the Club, and handed out consent forms for students to bring home. These forms requested parental permission for students to complete questionnaires and to hear more about the club and for the research team to obtain data from school records including grades, absences, and demographic information. Students were instructed to have their parents sign the forms if they were interested in participating. For the first club, 60 students returned completed forms and for the second, 128. The greater number in the fall was most likely due to greater familiarity of the teachers and students with the club.

### 2.5. Procedure

All students who brought in signed forms participated in a session held during school hours. During this session, students filled out questionnaires assessing motivation, science understanding, and demographics. They were informed that a subset of the group would be randomly assigned to the after-school program and the others would participate in the project through meetings in school. The pre-intervention assessment occurred before assignment to one of the two groups, thus preventing students' anticipation of group status from biasing the results.

Following the questionnaire session, the research team reviewed records of each potential participant. No names were included — only an assigned participant number, race/ethnicity, free lunch status, and science grades and conduct scores. One by one individual participants were selected, taking into account our goal of including a diverse group of individuals on race/ethnicity, science performance, and free lunch status. Each participant was then matched with another potential participant who was closest on variables of sex, race/ethnicity, free lunch status, science grades and conduct scores. After the matches were made, a coin was flipped to determine which of the pair would participate in the after-school program and which in the control group. Students who were not placed in the I-Club or control group also participated in all of the same sessions as the control group students. As they were not randomly assigned to a group, their data are not included in the present study.

### 2.6. Demographic variables

Children provided demographic information, including sex and household composition. Race/ethnicity, free lunch status, science grades, conduct scores, and absenteeism were obtained from students' records.

### 2.7. Measures

Measures were completed by students prior to the start of the Investigators' Club and approximately two weeks after the end of the Investigators' Club.

#### 2.7.1. Student report

*2.7.1.1. Self-regulation questionnaire (Ryan & Connell, 1989).* This 26-item scale assesses students' styles of regulating their school behavior on a continuum from external to autonomous. The questionnaire presents reasons why students might engage in behaviors such as doing homework and classwork, which children endorse on Likert scales from 1 (not at all true) to 4 (very true). Reasons represent subscales of external (to avoid negative consequences or obtain rewards), introjected (to avoid self-related negative affects such as guilt and shame), identified (for self-directed goals), and intrinsic (for fun or enjoyment). In this study, alphas were external = .75, introjected = .83, identified = .76 and intrinsic = .86. Consistent with other studies (e.g., Grolnick & Ryan, 1987; Vallerand et al., 1997) we also weighted and combined the four subscales to compute the Relative Autonomy Index (RAI), which represents the degree of autonomy in students' academic motivation. To compute the index the intrinsic scale is weighted by 2, identified by 1, introjected by −1, and external by −2. The reliability and validity of the index has been demonstrated in previous studies (e.g., Grolnick & Ryan, 1987; Vallerand et al., 1997).

*2.7.1.2. Perceived competence scale for children (Harter, 1982).* This scale measures students' perceptions of their competence in several areas. In this study, 6 items from the general self-worth and 6 from the cognitive (academic) area were included. Each item presents two types of students, one representing a high and the other a low level of

competence. Students decide which they are most like and then whether the item is really true (= 4) or sort of true (= 3) for them. Cronbach's alphas were .78 for the cognitive and .66 for the general scales.

*2.7.1.3. Performance vs. learning goals (Dweck & Leggett, 1988).* The 15 items, each rated on a 6-point scale from Strongly Disagree (= 1) to Strongly Agree (= 6), describe preferences for learning (to increase competence, acquire new skills, e.g., I get excited about learning something that really makes me think hard) or performance goals (to perform well, to look good, e.g., I get frustrated when the teacher or books explain things more than I need to know for the tests). Alphas for learning and performance goals, respectively, were .72 and .60.

*2.7.1.4. Theories of intelligence (Bandura & Dweck, 1985).* This 6-item measure assesses how closely students adhere to a view of intelligence as fixed (entity theory) or malleable (incremental theory). Students rate their level of agreement on a 6-point scale with 3 statements describing an entity view (e.g., You can learn new things but you can't really change your basic intelligence) and three describing an incremental theory (e.g., You can always greatly change how intelligent you are). Alphas were .79 for entity and .73 for incremental theories.

*2.7.1.5. Engagement (Connell & Wellborn, 1991).* For each of four school subjects (English, social studies, math and science) and school in general, students responded to 9 items, each rated on a scale from Not at all True (= 1) to Very True (= 4), which assessed their cognitive, emotional and behavioral engagement (e.g., I don't think about the things we do in school when I'm not in school, I pay attention in English class, I participate in science class). Alphas were English = .86, math = .88, social studies = .93, and science = .92.

*2.7.2. Teacher report*

*2.7.2.1. Engagement (Connell & Wellborn, 1991).* Four subject teachers (English, math, social studies, science) rated each students' engagement in the classroom on 9 items, each rated on a scale from Not at all True (= 1) to Very True (= 4). Items were parallel to those completed by students (e.g., In my class this student pays attention, In my class this student just tries to look busy). Alphas were English = .91, math = .92, social studies = .93, and science = .92.

## 3. Results

### *3.1. Equivalence of Investigators' Club and control groups*

Chi-squares (by cohort) to determine the effectiveness of random assignment indicated that for I-Club Spring, I-Club ($n$ = 20) and Control ($n$ = 20) students did not differ on the distributions of sex, $\chi^2$ (1, $n$ = 40) = .10, $p$ < .75, race/ethnicity, $\chi^2$ (5, $N$ = 40) = 4.61, $p$ < .47, or free lunch status, $\chi^2$ (1, $N$ = 40) = .11, $p$ < .74. This was the case for I-Club Fall ($n$ = 25 for I-Club, $n$ = 25 for Control) as well, $\chi^2$ (1, $N$ = 50) = .00, $p$ = 1, $\chi^2$ (5, $N$ = 50) = 3.42, $p$ < .63, and $\chi^2$ (1, $N$ = 50) = .76, $p$ < .38, respectively. Further, ANOVAs conducted for questionnaire variables indicated that for I-Club Spring, for the 20 variables, there were only two significant differences between the groups, a finding that is likely due to chance (see Table 1), whereas for I-Club Fall, there were no significant differences. These findings suggest that our groups were well-matched.

### *3.2. I-Club completers versus noncompleters*

During the course of the 15 weeks, several children left the Investigators' Club. For I-Club Spring, of the 20 original members, 1 never began the club, and 6 dropped out prior to completion, leaving 13 to complete. For the Fall club, 1 never began, 3 moved, and 7 dropped-out, leaving 14 to complete. This percentage is similar to drop-out rates in other programs with at-risk participants (Gross et al., 2001).

Chi-square analyses (across cohort) indicated that completers did not differ from noncompleters on sex, $\chi^2$ (1, $N$ = 45) = .07, $p$ < .30, race/ethnicity, $\chi^2$ (5, $N$ = 45) = 7.18, $p$ < .21, or free lunch status, $\chi^2$ (1, $N$ = 45) = .00, $p$ < 1. The results were the same when tested by cohort and whether including or not including students who left voluntarily.

ANOVAs for questionnaire variables indicated that completers ($M$ = 3.25, $SD$ = 1.39) were less likely than noncompleters ($M$ = 4.30, $SD$ = 1.29) to endorse an entity view of intelligence, $F$(1, 44) = 7.87, $p$ < .01, $d$ = − .78, rated

Table 1
Means (and Standard Deviations) for I-club and control students prior to group entry

| | Spring | | | Fall | | |
|---|---|---|---|---|---|---|
| | I-Club | Control | *t* | I-Club | Control | *t* |
| Student report–motivation | | | | | | |
| External | 3.01 (.52) | 3.11 (.57) | −0.58 | 3.17(.70) | 3.91 (.69) | 1.33 |
| Introjected | 3.05 (.70) | 2.80 (.70) | 1.13 | 3.00 (.73) | 3.06 (.69) | −0.32 |
| Identified | 3.65 (.37) | 3.40 (.53) | 1.74 | 3.59 (.42) | 3.63 (.45) | −0.33 |
| Intrinsic | 3.24 (.52) | 2.41 (.71) | 2.18* | 2.78 (.82) | 2.91 (.71) | −0.61 |
| RAI | .22 (2.12) | −.61 (1.94) | 1.05 | −.50 (3.23) | .92 (2.42) | 1.33 |
| Perceived Comp–cog | 2.92 (.70) | 2.96 (.64) | −0.20 | 2.75 (.69) | 2.91 (.68) | −0.80 |
| Self-worth | 3.08 (.55) | 3.05 (.60) | 0.14 | 3.20 (.59) | 3.20 (.57) | 0.02 |
| Performance goals | 3.79 (.67) | 3.64 (.76) | 0.64 | 3.62 (.72) | 3.66 (.54) | −0.22 |
| Learning goals | 4.38 (.39) | 3.91 (.71) | 2.55* | 4.44 (.75) | 4.34 (.66) | 0.49 |
| Incremental | 4.68 (.93) | 4.33 (1.29) | 1.07 | 4.87 (.97) | 4.53 (1.07) | 1.15 |
| Entity | 4.05 (1.29) | 3.55 (1.29) | 1.25 | 3.36 (1.50) | 3.04 (1.37) | 0.44 |
| Student report–engagement | | | | | | |
| School engage | 2.83 (.41) | 2.81 (.53) | 0.21 | 3.11 (.43) | 3.17 (.49) | −0.48 |
| English | 2.99 (.73) | 3.00 (.55) | −0.07 | 3.07 (.54) | 3.00 (.70) | 0.32 |
| Math | 3.00 (.60) | 3.25 (.72) | −1.08 | 3.46 (.52) | 3.54 (.36) | −0.56 |
| SocSt | 3.23 (.78) | 2.89 (.55) | 1.53 | 2.93 (.74) | 2.95 (.54) | −0.08 |
| Science | 3.35 (.61) | 3.26 (.54) | 0.64 | 3.01 (.61) | 3.12 (.59) | −0.57 |
| Teacher report–engagement | | | | | | |
| English | 3.08 (.75) | 3.02 (.89) | 0.22 | 2.97 (.71) | 3.15 (.83) | −0.64 |
| Math | 2.92 (.81) | 2.78 (.91) | 0.49 | 3.18 (.63) | 2.96 (.84) | 0.81 |
| SocSt | 3.05 (.77) | 3.16 (.75) | −0.45 | 3.25 (.79) | 3.23 (.78) | 0.12 |
| Science | 3.01 (.74) | 3.04 (1.01) | −0.09 | 2.98 (.90) | 3.05 (.77) | −.22 |
| Grades | | | | | | |
| Science average | 77.70 (13.60) | 77.40 (11.10) | 0.09 | 84.00 (7.07) | 84.00 (8.16) | 1.00 |

*$p<.05$.

themselves as more engaged in science, $F(1, 44) = 6.45$, $p < .05$, $M_{\text{completers}} = 3.30$, $SD = .61$, $M_{\text{noncompleters}} = 2.77$, $SD = .48$, $d = .96$, and received higher science grades, $F(1, 44) = 11.93$, $p < .01$, $M_{\text{completers}} = 84.33$, $SD = 9.13$, $M_{\text{noncompleters}} = 76.50$, $SD = 11.08$, $d = .77$, than noncompleters. Moreover, completers were rated by their teachers as more engaged than noncompleters in English, $F(1, 44) = 12.60$, $p < .01$, $M_{\text{completers}} = 3.34$, $SD = .57$, $M_{\text{noncompleters}} = 2.59$, $SD = .69$, $d = 1.18$, math, $F(1, 44) = 16.42$, $p < .001$, $M_{\text{completers}} = 3.36$, $SD = .68$, $M_{\text{noncompleters}} = 2.59$, $SD = .55$, $d = 1.24$, social studies, $F(1, 44) = 18.47$, $p < .001$, $M_{\text{completers}} = 3.50$, $SD = .55$, $M_{\text{noncompleters}} = 2.66$, $SD = .82$, $d = 1.20$, and science, $F(1, 44) = 16.49$, $p < .001$, $M_{\text{completers}} = 3.36$, $SD = .62$, $M_{\text{noncompleters}} = 2.43$, $SD = .75$, $d = 1.35$. There were also significant effects for cohort, in each case indicating that the spring cohort showed lower motivation and performance than the fall cohort.[1]

### 3.3. Primary analyses — effects of I-Club

Given the number of dependent variables, we first performed repeated measures multivariate analyses of variance for the motivational variables and the engagement variables. Because the student and teacher ratings of engagement were not highly correlated (*r*'s .09–.14 for pre-I-Club, *r*'s = .09–.31 for post-I-Club for the same school subjects)

[1] Individuals in cohort 1 (Spring) were more likely to have an entity theory than those in cohort 2 (Fall), $F(1, 44) = 4.10$, $p < .05$, and reported lower school engagement than those in cohort 2, $F(1, 44) = 5.86$, $p < .05$. Cohort 2 had higher science grades than those in cohort 1, $F(1, 44) = 13.53$, $p < .001$. These cohort differences are most likely due to the fact that cohort 1 pre-intervention questionnaires were administered in the spring of the first year of the study, while cohort 2 pre-intervention questionnaires were administered in the fall of the 2nd year. Since, motivation and context measures declined over the course of a school year, these effects are likely to be attributable to time of year. The difference between pre-I-Club science grades for cohorts 1 and 2 are likely to be due to the fact that for cohort 1 pre-club grades were fall of 7th grade marks while for cohort 2 they were spring of 6th grade marks. Middle school grades have been found to be lower than elementary grades (Kavrell & Petersen, 1984). There was one significant cohort × outcome interaction. For general self-worth, $F(1, 44) = 10.61$, $p < .01$, cohort 1 completers ($M = 3.28$) were higher in self-worth than noncompleters ($M = 2.69$). For cohort 2, noncompleters ($M = 3.45$) were somewhat higher than completers ($M = 2.99$).

Table 2
*F*-values for Repeated Measures ANOVA's with final group (I-Club vs. Control), cohort (Spring, Fall), and interactions

| | Time (1,50) | Final gp (1,50) | Cohort (1,50) | Time × cohort (1,50) | Time × final gp (1,50) | Time × cohort × final gp (1,50) |
|---|---|---|---|---|---|---|
| Student report–motivation | | | | | | |
| External | 3.21$^{+}$ | 1.15 | 1.43 | 1.15 | 5.96** | 0.05 |
| Introjected | 14.30*** | 0.06 | 0.91 | 0.69 | 0.09 | 0.28 |
| Identified | 20.73*** | 0.43 | 2.89$^{+}$ | 0.38 | 0.38 | 2.48 |
| Intrinsic | 18.81*** | 0.13 | 4.73* | 0.00 | 0.84 | 5.83* |
| RAI | 3.25$^{+}$ | 0.83 | 0.44 | 0.02 | 4.29* | 3.41$^{+}$ |
| Perceived Comp–cog | 0.20 | 0.12 | 0.35 | 1.81 | 0.35 | 2.84$^{+}$ |
| Self-worth | 8.52** | 0.06 | 0.96 | 1.37 | 1.67 | 2.33 |
| Performance | 0.05 | 0.72 | 1.70 | 0.02 | 4.89* | 0.65 |
| Learning | 10.69** | 5.36* | 8.53** | 1.41 | 4.84* | 7.48** |
| Incremental | 0.02 | 9.18** | 1.96 | 2.03 | 0.56 | 0.07 |
| Entity | 2.91$^{+}$ | 1.41 | 1.33 | 0.68 | 1.02 | 0.26 |
| Student report–engagement | | | | | | |
| School engage | 10.83** | 1.02 | 8.96** | 0.62 | 8.77** | 0.35 |
| English engage | 14.56*** | 0.00 | 0.03 | 0.15 | 0.16 | 0.00 |
| Math engage | 18.45*** | 7.46** | 4.81* | 0.08 | 5.44* | 0.04 |
| SocSt engage | 3.79$^{+}$ | 1.40 | 1.80 | 0.00 | 6.41** | 0.55 |
| Science engage | 6.78** | 3.27$^{+}$ | 1.30 | .70 | 7.59** | 1.39 |
| Science average | 1.88 | 6.73** | 0.01 | .17 | 7.18** | 3.23$^{+}$ |

$^{+}p<.10$. *$p<.05$. **$p<.01$. ***$p<.001$.

MANOVAs for these sets were computed separately. When the set was significant, MANOVAs were followed with repeated measures analyses of variance. Because each I-Club member was matched to one control, the analyses included completers and their matched controls (though these analyses did not pair students but rather compared the two groups). [2]

The MANOVA for the set of motivation variables indicated a significant time effect, *Wilks Lambda*, 8, 41, = 4.12, $p < .001$, and a significant time by group interaction, *Wilks Lambda*, 8, 41 = 2.09, $p < .05$. For the sets of student-reported engagement variables there were also significant time, *Wilks Lambda*, 5, 42 = 5.41, $p < .001$, and interaction effects, *Wilks Lambda*, 5, 43 = 3.14, $p < .02$. By contrast, for the set of teacher ratings there were no time or time × group effects. Consistent with our conservative strategy, we did not further analyze teacher ratings.

Repeated measures ANOVAs tested whether there were effects over time for the group regardless of whether they were in the Investigators' Club (time), whether change over time depended on group membership (time × group) and whether the effects of the Investigators' Club varied by cohort (time × cohort × group). Results of these analyses are presented in Table 2 and least squares means in Table 3.

Table 3 shows a number of time effects, representing decreases in student-reported motivation and engagement across time (introjected, identified, and intrinsic motivation, self-worth, learning goals, engagement in school in general, and in English, math, and science).

Our primary hypotheses center around the effectiveness of the after-school program, which would be indicated by time × group interactions. Specifically, the time × group interaction for external regulation, $F(1, 50) = 5.96$, $p < .05$, indicated that the I-Club group decreased in external regulation (3.11 to 2.71, $t = -2.96$, $p < .007$, $d = -.54$) while those in the control group increased, though not significantly (3.10 to 3.14, $t = .47$, *ns*) over the 15 weeks. The interaction for the RAI was also significant, $F(1, 50) = 4.29$, $p < .05$, with I-Club students remaining stable (−.14 to −.04) and control students becoming less autonomous (.15 to −1.30, $t = -2.75$, $p < .01$, $d = -.66$). There was also a significant interaction for performance goals, $F(1, 50) = 4.89$, $p < .05$, with I-Club participants decreasing in their endorsement of performance goals, though not significantly (3.68 to 3.44), and control students increasing slightly

[2] This strategy was used successfully in another study (Grolnick, Kurowski, Dunlap, & Hevey, 2000) examining change in outcomes related to changes in motivational variables.

Table 3
Least squares means (and standard errors) by time and final group status (across cohort)

| | I-Club | | Control | |
|---|---|---|---|---|
| | Time 1 | Time 2 | Time 1 | Time 2 |
| Student report–motivation | | | | |
| External | 3.11 (.13) | 2.71 (.13) | 3.10 (.13) | 3.14 (.13) |
| Introjected | 3.13 (.15) | 2.72 (.15) | 3.03 (.15) | 2.65 (.15) |
| Identified | 3.61 (.10) | 3.27 (.10) | 3.58 (.10) | 3.14 (.10) |
| Intrinsic | 2.80 (.14) | 2.42 (.15) | 2.81 (.14) | 2.24 (.15) |
| RAI | −.13 (2.70) | −.04 (2.73) | .03 (2.29) | −1.30 (1.40) |
| Perceived Comp–cog | 3.00 (.11) | 3.12 (.11) | 3.04 (.11) | 3.04 (.12) |
| Self-worth | 3.14 (.11) | 3.05 (.12) | 3.24 (.11) | 2.93 (.12) |
| Performance goals | 3.68 (.12) | 3.44 (.12) | 3.59 (.12) | 3.78 (.12) |
| Learning goals | 4.34 (.13) | 4.24 (.13) | 4.13 (.13) | 3.65 (.13) |
| Incremental | 4.79 (.20) | 4.97 (.20) | 4.33 (.20) | 4.17 (.20) |
| Entity | 3.26 (.27) | 2.69 (.27) | 3.45 (.27) | 3.29 (.27) |
| Student report–engagement | | | | |
| School engage | 3.04 (.10) | 3.02 (.10) | 3.06 (.10) | 2.68 (.10) |
| English engage | 3.09 (.13) | 2.79 (.14) | 3.05 (.14) | 2.73 (.13) |
| Math engage | 3.43 (.11) | 3.29 (.11) | 3.22 (.11) | 2.76 (.11) |
| SocSt engage | 3.08 (.12) | 3.12 (.12) | 3.09 (.13) | 2.69 (.12) |
| Science engage | 3.32 (.12) | 3.33 (.12) | 3.28 (.12) | 2.83 (.12) |
| Grades | | | | |
| Science average | 84.87 (2.27) | 87.04 (2.27) | 83.74 (2.27) | 76.72 (2.31) |

(3.59 to 3.78, $t = 2.79$, $p < .07$, $d = .31$). For learning goals, the interaction, $F(1, 50) = 4.84$, $p < .05$, indicated that I-Club participants were relatively stable from time 1 to time 2 (4.34 to 4.24), while control students decreased (4.13 to 3.65, $t = -3.87$, $p < .001$, $d = -.63$).

Interactions were significant for general school engagement, $F(1, 50) = 8.77$, $p < .01$, and engagement in math, $F(1, 50) = 5.44$, $p < .05$, social studies, $F(1, 50) = 6.41$, $p < .01$, and science, $F(1, 50) = 7.59$, $p < .01$. In each case, I-Club students remained stable in their engagement from time 1 to time 2 ($t$'s from .23–1.87, ns) while control students decreased markedly over the 15 weeks ($t$'s: school = −4.30, $p < .001$, math = −3.98, $p < .001$, social studies = −3.21, $p < .004$, and science = −3.68, $p < .001$, $d$'s = −.59 to −.66).

Finally, there was a significant time × group interaction for science grades, $F(1, 50) = 7.18$, $p < .01$. I-Club students increased from pre (84.87) to post-I-Club (87.04), $t = 4.71$, $p < .01$, $d = .21$, while control students decreased over the same time period (83.74 to 76.72, $t = -22.57$, $p < .001$, $d = -.69$).

### *3.4. Time × group × cohort*

There were two time × group × cohort interactions. The first for intrinsic motivation, $F(1, 50) = 5.83$, $p < .05$, indicated that for I-Club spring there was a decrease in intrinsic motivation for both I-Club students (2.90 to 2.21, $t = -2.64$, $p < .02$, $d = -.86$) and control students (2.46 to 2.12, $t = -1.84$, $p < .09$, $d = -.55$). However, for I-Club Fall, I-Club students were stable (2.70 to 2.63, $t = -42$, *ns*) while control students decreased (3.16 to 2.36, $t = -4.54$, $p < .001$, $d = -1.13$), indicating an effect for the I-Club only for the second cohort. Learning goals, $F(1, 50) = 7.48$, $p < .01$, showed a similar effect. While for I-Club Spring both I-Club (4.38 to 3.92, $t = -3.07$, $p < .01$, $d = -1.01$) and control students (3.81 to 3.45, $t = -1.94$, $p < .06$, $d = -.56$) decreased in their endorsement of learning goals, I-Club students in the Fall actually increased in their endorsement of learning goals over the 15 weeks (4.29 to 4.56, $t = 2.13$, $p < .05$, $d = .34$) while control students declined dramatically (4.74 to 3.85, $t = -3.81$, $p < .003$, $d = -.73$).

## 4. Discussion

This study evaluated the effects of an after-school science program on seventh graders' academic motivation, self-efficacy and school performance. The results suggest an interesting pattern of results whereby some aspects of

students' motivation changed as a result of participation, as did science grades, but these effects differed according to who was reporting on motivation. Before discussing these findings, we provide information on both matching of I-Club and control group members and completion of the I-Club.

First, we were successful in matching our groups. On both demographic and motivational measures, I-Club and Control students were quite similar. One advantage of our project design is that the pre-intervention assessment was conducted before group assignment. Further, the students were matched on a one-to-one basis and each member of the pair was randomly assigned to either the I-Club or control group.

As designed, the Investigators' Club required students to attend sessions 3 times per week. During the course of the Club, several students dropped-out. The rate of drop-out was similar to that described in other interventions with at-risk populations (Gross et al., 2001). The students who dropped out did not differ from those who completed the club on any of the demographic variables (i.e., sex, race/ethnicity, free lunch status), but did differ on several questionnaire measures. Given that noncompleters were rated as less engaged in class by their teachers and had science grades that were lower than those of completers, it seems clear that students who did not complete the Investigators' Club were less engaged in school than those who completed. Although all students in the sample were "at-risk" by virtue of their disadvantaged status, it seems that the Club was less successful at maintaining the participation of students who were at highest academic risk. Although there is little research on characteristics of students who drop-out of prevention programs, the literature on attrition in child psychotherapy also finds that more severely impaired students and those with more academic problems are most at-risk for drop-out (e.g., Kazdin & Mazurick, 1994). It may be that it is not possible to affect all students with such an academically oriented after-school program. Whereas the students who left the club did not rate themselves as less engaged in English, math and social studies than those who completed, they did rate themselves as less engaged in science relative to completers. Again, an after-school program such as this does require sustained interest in science.

Notably, although there were few differences between completers and noncompleters on student-report motivation measures, students who dropped out did tend to endorse an entity theory of intelligence more than did those who completed the program. One explanation is that students who ascribe more to an entity theory may have had difficulty with the format of the program, which required students to put their ideas on the table and thus risk being wrong. The more entity oriented students may have wanted to avoid failure, which may signify to them being "not smart" (Covington, 1992). Such an interpretation is only speculative and would require further evidence, particularly seeing such students in an after-school program with a different approach.

Our main hypotheses concerned the effects of the Investigators' Club on students' motivation, self-efficacy and performance. There were several predicted effects for motivation. Specifically, students who participated in the I-Club reported less external motivation and more autonomous motivation overall following the I-Club than those in the control group. Thus, having the experience of being part of this self-directed, inquiry-oriented experience seemed to help students feel less coerced in their school learning behaviors. A similar explanation can be offered for effects of the Investigators' Club on both students' performance and learning goals. I-Club members decreased in their endorsement of performance goals whereas control members increased. Interestingly, the effect for learning goals was best described as a buffering effect. Whereas the I-Club students decreased a small amount in learning goals, the control students decreased a much greater amount. Consistent with motivational trends found in previous research (Anderman & Maehr, 1994), what can be expected over time is a decrease in the desire to learn for its own sake. This is supported by decreases in intrinsic and identified motivation over the 15 weeks across the two experimental groups. That an after-school program can buffer these decreases is important. However, such findings point to the need to further understand the ways in which school environments affect students' motivation over time. Interestingly, there was less evidence that our intervention changed perceptions of competence or that changes in perceived competence accounted for changes in outcomes. Given that perceptions of competence tend to result from successful achievement (Harter & Connell, 1984), it is possible that such changes may not have occurred immediately following our intervention and would be evident in further follow-ups.

Effects of the I-Club also emerged for students' reports of their engagement in school, and in particular classes; math, social studies and science. As with learning goals, these effects can best be considered buffering rather than enhancement effects. Interestingly, however, there were no effects of Investigators' Club participation on teachers' ratings of classroom engagement. Why this discrepancy? It is possible that as a result of the participation in the I-Club students changed in their internal experience of motivation but that these changes did not translate into teacher-experienced behavior in the classroom. The fact that there were effects of the Club on students' science grades does suggest that the changes reported by the students do represent something real. Alternatively, it may be that teachers

develop perceptions of and expectations of students in their classrooms that are somewhat resistant to change even in the face of new information. It is possible also, that these changes may simply take a bit more time to register. Teachers' reports of engagement in the classroom as a result of I-Club participation may emerge when we follow participants into the next school year. They may also be more apparent with a new teacher who has not previously had the particular student.

Given the effects of the intervention on engagement and grades in addition to motivation variables, it would be important to identify factors that mediate change in these outcomes. We would expect that changes in motivation would be important but it is also likely that particular discourse skills would mediate change, particularly in grades. In future studies it would be important to measure these more academic skills to determine how much of the change is accounted for by changes in motivation and how much by changes in academic skills.

There were some notable limitations of our study. First, we compared the after-school program with a less intense in-school control group. The effects of the program might be due to the level of student involvement or the degree of contact with the teacher. The results would be more compelling if the program were compared to an equally intense program using a different theoretical framework. It is important to note that the students in the in-school program were quite involved in the group and didn't seem to see themselves as less a part of the program than those in the after-school group. Second, many of the results were buffering effects rather than enhancement effects. Thus, we cannot say that the program can produce changes in motivational orientations. However, the fact that science grades were enhanced for the I-Club students suggests that the changes were meaningful. Finally, several of the measures had somewhat low reliabilities. Replication with more reliable and updated measures, e.g., a new measure of performance and learning goals distinguishing performance approach and performance avoidance goals (e.g., Pintrich, 2000) will be important in future studies.

In sum, this study provides some encouraging results and identifies some challenges of using after-school programs to facilitate motivation in at-risk students. Future work should examine the long-term effects of after-school programs, as well as the generalization of such programs to subjects other than science and to diverse groups of students.

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