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Analysis of Baseline by Treatment Interactions in a Drug Prevention and Health Promotion Program for High School Male Athletes

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Abstract

This paper investigates baseline by treatment interactions of a randomized anabolic steroid prevention program delivered to high school football players. Baseline by treatment interactions occur when a participant's score on an outcome variable is determined both by their pre-treatment standing on the outcome variable and the treatment itself. The program was delivered to 31 high school football teams (Control=16, Treatment=15) in Oregon and Washington over the course of three years (Total N=3207). Regression and multilevel analyses showed consistent baseline by treatment interactions for knowledge of the effects of steroid use and intentions to use steroids. Both of these interactions were beneficial in that they increased the effectiveness of the program for participants lower in knowledge and higher in intentions at baseline.

Analysis Baseline by Treatment Interactions in a Successful Drug Prevention and Health Promotion Program for High School Male Athletes

Drug prevention programs have been shown to delay or reduce drug use for a number of substances, including tobacco, alcohol, and marijuana (Lipsey & Wilson, 1993; Pentz et al., 1989). Despite these positive findings, the question has been raised whether prevention programs affect subgroups differently (Botvin, Malgady,Griffin, Scheier, & Epstein, 1998; MacKinnon, Weber, & Pentz, 1988). The purpose of this study is to investigate interactions between the intervention and an individual's pre-intervention standing (knowledge, attitudes, and intentions) in a large prevention program designed to reduce anabolic steroid use among adolescent male athletes.

Baseline by treatment interactions (BTI) occur when the magnitude or direction of the effect of a treatment upon an outcome variable depends on the individual's baseline standing on that variable. To use a prevention example, imagine a program designed to reduce smoking in teenagers, where the outcome variable is number of cigarettes smoked per day. If the group that received the intervention significantly reduced the number of cigarettes smoked compared to a control group, there would be a significant main effect of the treatment. However, if upon closer inspection of the treatment group it was found that heavier smokers reduced their smoking to a greater degree than lighter smokers, a baseline by treatment interaction would be present. That is, the effectiveness of the intervention on the number of cigarettes smoked would depend upon the number of cigarettes the individual smoked before being given the intervention.

Baseline by treatment interactions are used to assess the potential differential effects of an intervention, which can be beneficial or harmful in nature, or represent ceiling or floor effects

on outcomes. Using the smoking example, the greater reduction in smoking in the heavy smoking group compared to the light smoking group is a beneficial interaction because while both subgroups reduced their smoking, one group reduced it by a greater degree. In contrast, if one of the subgroups had increased the number of cigarettes smoked from baseline to post-test, a detrimental or iatrogenic interaction would be present. One possible reason why harmful interactions could occur in prevention studies is when low risk individuals become resentful about being made to participate in a prevention program or become labeled as atypical by peers who were not subjected to the program. This could cause the undesired behavior to arise through a self-fulfilling prophecy resulting in counter-productive program effects (Pillow, Sandler, Braver, Wolchik, & Gersten, 1991). Another explanation for iatrogenic effects is that when only high-risk individuals participate in an intervention program, deviant peer bonding can occur, counteracting the effect of the intervention and increasing the undesired behavior, such as smoking (Dishion & Andrews, 1995; Dishion, Andrews, & Crosby, 1995).

Baseline by treatment interactions have been found in a variety of prevention studies, many of which have found differential program effects for low risk individuals as compared to their high risk counterparts (Allen & Philliber, 2001; Flay et al., 1985; Holmbeck, 1997; Jensen et al., 2001; Pacifici, Stoolmiller, & Nelson, 2001; Stoolmiller, Eddy, & Reid, 2000; Wilson, Lipsey, & Derzon, 2003). Pacifici, Stoolmiller, and Nelson (2001) found that an intervention to reduce sexual coercion among high school students was effective for individuals who scored at or above the baseline mean for indicators of coercive attitudes. However, those scoring below the baseline mean did not significantly benefit from the program. Similarly, Stoolmiller, Eddy, and Reid (2000) found that the efficacy of a program designed to lower violent behavior in elementary school children depended upon the child's pre-intervention level of violent behavior.

In addition, Flay et al. (1985) found that a program to decrease smoking had a greater impact with individuals who already smoked or were exposed to smoking in the home, compared to those who where not analogously exposed.

Baseline by treatment interactions have also been reported in treatment research. Jensen et al. (2001) found that children with ADHD or ADHD comorbid with a conduct disorder performed better with medication therapy and worse with behavioral therapy, while children with ADHD comorbid with an anxiety disorder benefited equally well with either form of therapy. Children with ADHD, comorbid with both an anxiety disorder and a conduct disorder, were best served by a treatment regiment that combined medication and behavioral therapy.

Numerous authors have discussed iatrogenic effects and the need for the investigation of the presence of these effects in prevention programs (e.g., Dishion, McCord, & Poulin, 1999; Goodstadt, 1980; Lorion, 1983, 1987; Pillow et al., 1991; Werch & Owen, 2002). Besides identifying any iatrogenic effects, another reason to investigate baseline by treatment interactions in prevention programs is to discover how specific subgroups are affected by the program. With this knowledge, changes to the content or implementation of the intervention can be made to increase the efficacy of the program by tailoring the treatment to a particular subgroup's specific needs. Tailoring allows implementers to reduce time and costs by offering targeted interventions to groups that do not need the full version or even by identifying individuals who do not require the program at all, although selection of these individuals may create other problems (see Pillow et al., 1991 for a description of problems related to selection).

Despite the likelihood that interventions are affecting individuals differently, an alternative explanation for the presence of beneficial and adverse BTI effects is sampling variability. Given that most researchers fix their alpha error to 0.05 for all statistical tests,

chance alone would dictate that a prevention program containing twenty variables, for example, would likely have at least one statistically significant baseline by treatment interaction, even if the program had the same effect on all participants. A spurious interaction may be reported when in fact, no interaction existed. This underscores the need to replicate findings to determine the true nature of these interactions.

The purpose of this paper is to investigate the ATLAS (Adolescents Training and Learning to Avoid Steroids) prevention program for the presence of baseline by treatment interactions in the twelve potential program mediators identified by MacKinnon et al. (2001) and the three program outcome variables: intention to use steroids, nutrition behaviors, and strength training self-efficacy.

The ATLAS Program

ATLAS is a prevention program aimed at limiting alcohol and select substance use ('athletic enhancing' supplements and anabolic androgenic steroids (AAS)) among high school football players (Goldberg et al., 1996; Goldberg et al., 2000). ATLAS focused on reducing anabolic steroid use by targeting intentions to use AAS, as previous studies have shown that intentions are strong predictors of future behaviors (Fishbein & Ajzen, 1975; Kim & Hunter, 1993). Intentions to use AAS were decreased by presenting state-of-the-art nutrition and strength training programs as alternatives to AAS use. ATLAS is unlike other drug prevention programs in that by promoting nutrition and strength training, ATLAS was able to offer direct alternatives to AAS use and other athletic enhancing substances (For a more information on the ATLAS program see Goldberg et al., 1996).

The effects of the intervention on intentions to use anabolic steroids, nutrition behaviors, and strength training self-efficacy were reported in an earlier study (Goldberg et al., 2000).

Students in the treatment group reported an increased knowledge of the effects of AAS, increased perceptions that their peers and teammates were a reliable source of information, more confidence in their ability to resist offers of steroids, an increase in negative attitudes toward AAS users, and an increase in the perceived severity of AAS effects and susceptibility to those effects. Program participants identified more reasons for using AAS, as well as reasons against using AAS. They also had greater perceived athletic competence, and self-esteem, while becoming less likely to believe that their coaches were tolerant of AAS use or to believe in media advertisements.

Although an investigation of the mediating mechanisms in ATLAS found that not all of the twelve hypothesized mediating mechanisms were significant (MacKinnon et al., 2001), Goldberg et al. (2000) found that all of the potential mediators did increase or decrease in the desired direction as hypothesized by the investigators at the post-test, except for reasons for using AAS, which was found to increase following exposure to the intervention. As a result, all students who received the intervention might be expected to improve on all the mediators except reasons for AAS use, regardless of their baseline measurement or any demographic variables. Similarly, any significant interactions between program participation and baseline measurement should enhance the positive effects of the intervention, rather than decrease it or cause negative effects.

Overall, the target variables fall into five categories: outcomes, belief mediators, knowledge mediators, social norm mediators, and resistance mediators. Significant baseline by treatment interactions are expected for the belief mediators because the program is meant to weaken positive beliefs about steroid use while reinforcing negative beliefs. Therefore, individuals with strong a priori positive beliefs and weak negative beliefs should be affected

differently than those with already weak positive beliefs and strong negative beliefs. Knowledge of the effects of AAS should also have a significant interaction, with players who know less about steroids learning much more than players who already know a great deal about steroids. The significant interactions should remain constant across measurements time (i.e. significant at both post-test and one-year follow-up) and replicate across cohorts.

In contrast, the target variables that focus on social norms should not have significant interactions, since any change in norms will affect everyone to the same degree, which should also hold true for ability to resist drugs. Significant baseline by treatment interactions are not expected for the three outcome variables either, because the outcome variables are expected to be mediated by all of the variables and not just those with significant interactions.

Methods

Participants

The participants in this study were male high school football players from Oregon and Washington. The mean age of the participants was 15.43 years of age, with 73.3% of the fathers and 67.9% of the mothers having had at least some college education, and the parental divorce rate was 33.54%. A majority of the sample was White, 77.9%, with the rest of the sample being composed of 5.8% African-Americans, 3.6% Hispanics, 3.5% Asians, 0.9% Native Americans, and 8.3% had a mixed ethnic background.

The sample was composed of three cohorts consisting of 3207 students, one new cohort per year, with the first cohort starting in 1994. None of the demographic variables varied significantly across cohorts (all p-values >0.05) except for age, which decreased from the Cohort 1 to the later cohorts by several months. The difference in age was expected, however, because players in later cohorts were new to the team and mostly freshmen and sophomores.

Design

A total of 34 schools participated in the ATLAS program. The schools were randomly assigned to the treatment condition after being matched for socioeconomic status and the football team's win/loss record from the previous year. Three schools dropped out of the study prior to the initiation of the ATLAS program, causing one school to be reassigned from the control condition to the treatment condition. All schools were given $3,000 worth of weight lifting equipment for their participation in the study.

The athletes in Cohort 1 were measured for the first time (baseline) during August 1994 at the beginning of the football season. The ATLAS program given to the treatment schools consisted of fourteen sessions, seven strength training sessions and seven classroom sessions, over the course of seven weeks for the first cohort, while later cohorts received a modified program (Goldberg et al., 2000). Athletes at the control schools received a pamphlet outlining the dangers of steroid use, the need for a balanced diet, and information on strength training. A post-test was administered in November after completion of the program at the end of the football season. A one-year follow-up was given in August/September at the beginning of the 1995 football season. Graduating seniors were tested in the spring before graduation and this data was then combined with the August data.

Measures

The variables investigated in this analysis are a subset of the total number of variables in the ATLAS study and were picked to correspond to the potential program mediators studied by MacKinnon et al. (2001). The twelve potential mediators selected for mediation analysis were measured at all three waves, had at least three items forming the scale, and had a coefficient alpha of at least .6 at each measurement. The measures of belief were perceived severity of AAS

use, perceived susceptibility to AAS effects, belief in media advertisements, reasons for using AAS, and reasons for not using AAS. The measure of knowledge was knowledge of AAS effects. The measures of norms were perceived coach tolerance of AAS use, perceived peer tolerance of AAS use, team as an information source, peers as an information source, and normative beliefs about AAS use. Finally, the resistance skills measure was ability to turn down offers of drugs. For a complete list of the individual items that made up the scales and the reliabilities of the scales, see MacKinnon et al. (2001).

Statistical Analysis

Regression Analysis. For each hypothesized mediator and the three outcome variables, multiple ordinary least squares (OLS) regression equations were estimated using either the immediate post-test or the one-year follow-up measurements as the dependent variable and the baseline measurement and group membership (i.e. control versus treatment group) as the predictors for the within cohorts analysis. For all the models, X was centered at the mean to ease interpretation of the regression coefficients. Group membership was coded (0=control, 1=treatment) using the dummy code method suggested by Aiken and West (1991). Two regression equations, one for the post-test and one for the one-year follow-up were computed. The regression equations were of the form:

$$\hat{Y} = b_0 + b_1 X + b_2 Z + b_3 XZ \,, \qquad (1)$$

where $\hat{Y}$ is the predicted value of the follow-up measurement, X is the baseline measurement, Z is group membership, XZ is the interaction between baseline measurement and group membership, b_0 is the average follow-up score for an individual in the control group and at the mean score at baseline, b_1 is the effect of baseline score on the follow-up score for the control group, b_2 is the effect of treatment on the follow-up score when the baseline score is held

constant, and b_3 is the effect of the interaction on the follow-up score. All parameters and standard errors were estimated using SAS v.8.02 (SAS Institute, 2003).

A second across cohorts OLS regression analysis investigated whether the interaction between baseline standing and group varied across cohort by probing the cohort by baseline by group three-way interaction, using the model:

$$\hat{Y} = b_0 + b_1X + b_2Z + b_3C + b_4XZ + b_5XC + b_6ZC + b_7XZC, \quad (2)$$

where $\hat{Y}$ is the predicted value of the follow-up measurement, X is the baseline measurement, Z is group membership, C is the cohort membership, XZ, XC, ZC, and XZC are the interactions between baseline measurement, group membership, and cohort membership, b_0 is the average follow-up score for an individual in the control group, Cohort 1, and at the mean score at baseline, b_1 is the effect of baseline score on the follow-up score for an individual in the control group and Cohort 1, b_2 is the effect of treatment on the follow-up score for an individual in the control group and Cohort 1, b_3 is the effect of cohort on the follow-up score for an individual in the control group and at the mean baseline score, b_4 is the effect of the interaction between baseline score and treatment group, b_5 is the effect of the interaction between baseline score and cohort, b_6 is the effect of the interaction between treatment group and cohort, and b_7 is the effect of the interaction between baseline score, treatment group, and cohort. Cohort membership was dichotomized into two groups, Cohort 1 and then a second group made up of Cohorts 2 and 3 combined. This dichotomization was done both to ease interpretation of the results and because Cohorts 2 and 3 were fundamentally different than Cohort 1 in that they only included players new to the team, whereas Cohort 1 included all players on the team.

Multilevel Modeling. Due to the dependence that exists among students at the same school, it is important to model variation that is accounted for by the clustering within the

schools. To accomplish this, SAS PROC MIXED (SAS Institute, 2003) was used as described by Singer (1998). The model was:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + e_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01} Z_j + U_{0j}$

$\beta_{1j} = \gamma_{10} + \gamma_{11} Z_j + U_{1j}$,

where Y_{ij} is the value of the follow-up measurement for the i^{th} student at the j^{th} school, X_{ij} is the baseline measurement for the i^{th} student at the j^{th} school, Z_j is group membership for the j^{th} school, β_{0j}, and β_{1j} are the level 1 regression coefficients for the j^{th} school, γ_{00}, γ_{01}, γ_{10} and γ_{11} are the level 2 regression coefficients, e_{ij} is the level 1 residual for the i^{th} student at the j^{th} school, and U_{0j}, and U_{1j} are the level 2 residuals for the j^{th} school.

Substituting the equations from level 2 into the equation in level 1 results in the mixed model:

$$Y_{ij} = \gamma_{00} + \gamma_{10} X_{ij} + \gamma_{01} Z_j + \gamma_{11} X_{ij} Z_j + U_{0j} + U_{1j} X_{ij} + e_{ij}, \quad (3)$$

where γ_{00} is the average follow-up score for an individual in the control group and at the mean baseline score, γ_{10} is the effect of baseline score for the control group, γ_{01} is the effect of treatment for individuals at the mean baseline score, and γ_{11} is the effect of the interaction between baseline score and group membership. U_{0j} and U_{1j} represent the random effects for the j^{th} school.

The three-way interaction between baseline, group, and cohort was also tested using multilevel modeling. The model for the three-way interaction was:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + \beta_{2j} C_{ij} + \beta_{3j} X_{ij} C_{ij} + e_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01} Z_j + U_{0j}$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} Z_j + U_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} Z_j$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31} Z_{ij} + U_{3j}$$

where Y_{ij} is the value of the follow-up measurement for the i^{th} student at the j^{th} school, X_{ij} is the baseline measurement for the i^{th} student at the j^{th} school, C_{ij} is cohort membership for the i^{th} student at the j^{th} school, $X_{ij}C_{ij}$ is the interaction between baseline measurement and cohort membership for the i^{th} student at the j^{th} school, Z_j is group membership at the j^{th} school, β_{0j}, β_{1j}, β_{2j}, and β_{3j} are the level 1 regression coefficients for the j^{th} school, γ_{00}, γ_{10}, γ_{20}, and γ_{30} are the level 2 regression coefficients, γ_{01}, γ_{11}, γ_{21}, and γ_{31} represent the effect of group membership, e_{ij} is the level 1 residual for the i^{th} student at the j^{th} school, and U_{0j}, U_{1j}, and U_{3j} are the level 2 residuals for the j^{th} school. U_{2j} was not included in the model because the cohorts were not directly nested within the schools so significant variation of the effect of cohort β_{2j} is not expected.

Substituting the equations from level 2 into the equation in level 1 results in the mixed model:

$$\begin{aligned} Y_{ij} &= \gamma_{00} + \gamma_{10} X_{ij} + \gamma_{20} C_{ij} + \gamma_{30} X_{ij} C_{ij} + \gamma_{01} Z_j + \gamma_{11} X_{ij} Z_j + \gamma_{21} C_{ij} Z_j + \gamma_{31} X_{ij} C_{ij} Z_j \\ &+ U_{0j} + U_{1j} X_{ij} + U_{3j} X_{ij} C_{ij} + e_{ij} \end{aligned} \quad (4)$$

where γ_{00} is the average follow-up score for individuals at the mean baseline score in the control group in Cohort 1, γ_{10} is the effect of baseline score for individuals in the control group in Cohort 1, γ_{20} is the effect on cohort for individuals at the mean baseline score in the control group, γ_{30} is the effect of the interaction between baseline score and cohort, γ_{01} is the effect of treatment group for individuals at the mean baseline score in Cohort 1, γ_{11} is the effect of the interaction between baseline score and treatment group, γ_{21} is the effect of the interaction between cohort and

treatment group, and γ_{31} is the effect of the interaction between baseline score, cohort, and treatment group. U_{0j}, U_{1j}, and U_{3j} represent the random effects for the j^{th} school.

Results

Demographics

Table 1 shows the individual demographic variables for the treatment and control groups for each of the three cohorts. The control and treatment groups are very similar for all of the cohorts, the only consistent difference being father's education level, which was higher in the control group for all three cohorts.

Insert Table 1 About Here

Regression Analysis

Within Cohort. There were several significant interactions between baseline status and group membership in each cohort, as shown in Table 2. Significant interactions were found for Cohort 1 at the post-test for seven of the potential mediating variables: knowledge of the results of AAS use, ability to turn down drugs, reasons to use AAS, team as an information source, peers as an information source, belief in media advertisements, and perceived severity of AAS use. A significant interaction was also found for one of the outcome variables for Cohort 1 at the post-test, strength training self-efficacy. Of these eight interactions, only knowledge of AAS use had a significant interaction at the one-year follow-up.

In Cohort 2, no outcome variables had significant interactions at the post-test, but intent to use AAS was significant at the one-year follow-up. Four mediators were found to have

significant interactions terms at the post-test, with only reasons to use steroids having a significant interaction at the one-year follow-up. Cohort 3 had three significant mediator variable interaction terms at the post-test, but none were significant at the one-year follow-up. There were no significant interactions for the outcome variables in Cohort 3 at the post-test, but intent to use AAS was significant at the one-year follow-up.

Partial correlations were computed for the interaction terms to estimate the effects sizes for the interactions. The largest partial correlation was for knowledge of the effects of AAS use at the post-test in Cohort 3, where $r_{part}= 0.159$. Using 0.14 as a standard for small effect sizes (Cohen, 1988), all of the effect sizes for the interactions are considered small.

Insert Table 2 About Here

Across Cohort. The results of the within cohort analysis suggest that the BTI effect may differ across cohorts. A formal test of whether the interactions differ across cohorts was accomplished by testing the baseline by treatment by cohort three-way interaction term. The three-way interaction analyses show that the baseline by treatment interactions differed across cohorts for three of the twelve potential mediators and one of the outcome variables at the post-test, while one mediator, team as an information source, and one outcome variable, intent to use AAS, were significant only at the one-year follow-up (Table 3). Only one of the interactions was significant at both the post-test and the one-year follow-up, ability to turn down drugs.

Partial correlations were again computed for the interaction terms to estimate the effects sizes for the interactions. The largest partial correlation occurred for team as an information

source at the one-year follow-up where r_{part}= 0.100, indicating that all of the effect sizes for the interactions were small.

Insert Table 3 About Here

Multilevel Analyses

The following analyses are replications of the single level regression analyses described earlier, but differ in that clustering within schools was included in the analysis. For the most part, the multilevel analyses were very similar to the single level models. A measure of the dependency of observations within schools is the intraclass correlation. The intraclass correlation provides a gauge of whether multilevel modeling is necessary. Values of the ICC were very small to small (e.g., 0.003 to 0.035).

Within Cohort. The within cohorts analysis looked at whether the BTI's differed across different follow-up measures when school membership was used as a clustering variable. In the multilevel analysis of the Cohort 1 data there were seven significant baseline by treatment interactions at the post-test (Table 4), six potential mediators and one outcome variable, all of which had been significant in the single level analysis. As in the single level analysis, only knowledge of the effects of AAS use was significant at the one-year follow-up.

For Cohort 2, three significant mediator interactions were found at the post-test but no outcome interactions, with reasons to use AAS replicated at the one-year follow-up. However, both nutrition behaviors and intent to use AAS were significant at the one-year follow-up. Cohort 3 had two significant mediator interactions at the post-test, neither of which were

significant at the one-year follow-up, and two significant interactions at the one-year follow-up that were not significant at the post-test.

Insert Table 4 About Here

Across Cohort. The across cohort analysis investigated difference in BTI's across cohorts when school membership was used as a clustering variable. The across cohort analysis found significant interactions for three of the variables at the post-test, ability to turn down drugs, team as an information source, and peers as an information source, and one of the outcome variables, strength training self efficacy. Only team as an information source and intent to use AAS were significant at the one-year follow-up (Table 5).

Insert Table 5 About Here

Discussion

The purpose of the ATLAS program was in part to reduce the amount of anabolic steroid use among high school football players by reducing one outcome variable, intent to use AAS, and increasing two other outcome variables, nutrition behavior and strength training self-efficacy. This analysis examines the data from the ATLAS program for the presence of baseline by treatment interactions in the twelve potential mediating variables and in the three outcome variables. Only one of these outcome variables had a significant baseline by treatment interaction in the first cohort at the post-test, strength training self-efficacy, which was not

significant at the one-year follow-up and was not replicated in either of the other two cohorts. However, intent to use AAS had significant interactions at the one-year follow-up for both of the later cohorts. The multilevel analysis, which included the subject's school membership as a clustering variable, found very similar results even after the error terms were adjusted for clustering within school. Although the interaction for intent to use AAS was not significant for the post-test for Cohort 2 and 3, closer inspection shows that the estimates are in the same direction. The negative value of the interaction term means that at the post-test and one-year follow-up individuals in the treatment group with higher levels of baseline intent had decreased their intentions more than individuals with lower intent to use AAS. Also, the three-way interaction between intention, group, and cohort was significant, indicating that the interaction was not constant for the different cohorts. This would strengthen the assumption that an interaction is present.

Although several interactions were detected for the twelve mediating variables, knowledge of the effects of AAS use was the only variable that had a significant interaction at both the post-test and the one-year follow-up, and consistently replicated in later cohorts. Even though the interaction was not significant at the one-year follow-up for Cohorts 2 and 3, the estimates are in the same direction as the post-test estimate. The negative value of the interaction term means that as a student's baseline knowledge increases, if they are in the treatment group, their knowledge increases less than someone with lower baseline knowledge. A baseline by treatment interaction was expected for knowledge of the effects of AAS, since players who already knew a great deal about steroids were less likely to learn anything new from the program than players who were unfamiliar with steroids. The lack of interactions in the belief mediators was unexpected, however, especially for reasons to use AAS and reasons not to use AAS, as they

appear to be related to knowledge of steroids. It is important to consider, however, that the measures are beliefs about the pros and cons of steroid use, not necessarily the actual facts about steroid use.

The lack of baseline by treatment interactions for the normative mediators was expected. When norms are changed for a social group, in this case the football team, the change should affect everyone in that social group equally, regardless of their pre-treatment status. The absence of interactions in the normative mediators supports the argument that the ATLAS program is changing team norms. No interaction for ability to resist drug offers was expected either, since ATLAS focuses mainly on increasing knowledge about AAS and describing alternatives to AAS use.

Re-examining Table 2 shows that there were twenty significant two-way interactions out of ninety possible interactions and Table 3 shows that there were five significant three-way interaction out of thirty possible interactions. Except for knowledge of the effects of AAS use and intent to use steroids, all other significant interactions were consistent with sampling variability. The fact that the estimates for the interaction terms were not consistently positive or negative supports this interpretation. However, the difficulty in detecting interactions in field research should be mentioned. McClelland and Judd (1993) showed that nonoptimal distributions of the variables led to a lower residual variance of the product of the variables and reduced both the statistical power and the efficiency of the interaction parameter estimate in field experiments compared to laboratory studies. Aiken and West (1991) likewise discuss the loss of power when investigating interactions. One solution to decreased power is to increase the number of observations, especially for interactions with small effect sizes (i.e., .14 or less), such as the interactions in this paper. Another is to replicate the experiment. Because of this, the

replications in ATLAS made the determination of whether a significant interaction is spurious or real more readily identifiable. However, the replications still did not make the presence or absence of the interactions as clear as was planned.

The absence of harmful BTI effects is desirable for a program such as ATLAS because it shows the program is having a beneficial effect on all subjects, which is appropriate as a universal application for male athletes, irrespective of their baseline knowledge, beliefs, and intentions. By not needing to give different players special versions of the program, it allows the administrator of the program to reinforce the idea that the reduction of AAS use is a team goal, rather than breaking the team into smaller units with differential risk. This is helpful since team cohesion is a main ingredient of the ATLAS program.

Overall, it appears that ATLAS does have at least one baseline by treatment interaction, knowledge of the effects of AAS use, and possibly a second BTI, intent to use AAS, based upon a student's pre-intervention level of risk. The baseline by treatment interaction analysis did not discover any adverse, iatrogenic effects, however, as the direction of the interaction was beneficial for both of the BTI's. This study is then consistent with the idea that ATLAS, designed to be delivered in a team atmosphere, can be safely applied, regardless of the student athlete's risk.

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Table 1.
Demographic variables for treatment groups by cohort.

Demographics	Cohort 1		Cohort 2		Cohort 3	
	Control	Treatment	Control	Treatment	Control	Treatment
Sample Size	804	702	493	391	422	395
Age	15.79	15.89	15.20	15.11	14.93*	15.11
(St. Error)	(1.16)	(1.16)	(1.15)	(1.15)	(1.12)	(1.08)
GPA	3.07*	3.00	2.98	3.03	3.12	3.05
(St. Error)	(0.64)	(0.63)	(0.62)	(0.68)	(0.64)	(0.60)
Asian%	3.52	3.00	3.88	3.34	3.59	3.56
Native American%	0.38	1.29	1.63	0.77	0.96	0.51
Hispanic%	3.14	2.29	5.10	3.86	4.31	4.07
African American%	4.40	6.29	4.29	10.03	4.07	7.63
White%	79.40	76.97	80.00	75.32	76.79	77.61
Mixed Ethnicity%	9.17	10.16	5.10	6.68	10.29	6.62
Father some college%	77.60*	71.67	73.06*	64.87	77.38*	71.84
Mother some college%	70.75	67.77	67.01*	57.45	73.08	68.13
Parents divorced%	31.29	33.14	33.95	38.26	34.22	32.99

Note: All significance test are t-tests with 1 degree of freedom between the treatment and control group within the same cohort.

* $P<0.05$

Table 2.

OLS regression coefficient estimates, standard errors, and partial correlations for the Baseline x Group interaction term.

	Cohort 1		Cohort 2		Cohort 3	
Construct		Year		Year		Year
	Post-test	Follow-up	Post-test	Follow-up	Post-test	Follow-up
Nutrition behaviors	0.018	0.010	-0.028	0.177	0.012	-0.101
	(0.046)	(0.060)	(0.068)	(0.092)	(0.070)	(0.093)
	0.011	**0.006**	**0.016**	**0.094**	**0.007**	**0.053**
Intent to use AAS	-0.008	0.032	-0.153	-0.309**	-0.093	-0.328**
	(0.046)	(0.062)	(0.081)	(0.101)	(0.091)	(0.103)
	0.005	**0.018**	**0.074**	**0.149**	**0.041**	**0.156**
Strength training efficacy	-0.273**	-0.077	0.032	0.032	-0.100	-0.009
	(0.053)	(0.065)	(0.070)	(0.094)	(0.079)	(0.091)
	0.147	**0.040**	**0.018**	**0.017**	**0.051**	**0.005**
Knowledge of AAS use	-0.223**	-0.235**	-0.223**	-0.033	-0.339**	-0.074
	(0.053)	(0.070)	(0.078)	(0.100)	(0.084)	(0.102)
	0.109	**0.113**	**0.111**	**0.016**	**0.159**	**0.036**
Coach's tolerance of use	-0.063	-0.088	-0.190*	0.133	0.089	-0.148
	(0.059)	(0.076)	(0.083)	(0.117)	(0.088)	(0.106)
	0.003	**0.039**	**0.090**	**0.006**	**0.041**	**0.069**

Table 2. continued

	Cohort 1		Cohort 2		Cohort 3	
Construct		Year		Year		Year
	Post-test	Follow-up	Post-test	Follow-up	Post-test	Follow-up
Ability to turn down drugs	-0.123*	0.037	-0.028	-0.059	0.212*	-0.092
	(0.051)	(0.064)	(0.077)	(0.105)	(0.083)	(0.108)
	0.069	**0.020**	**0.014**	**0.027**	**0.102**	**0.042**
Peer tolerance of use	-0.040	0.010	-0.159*	-0.113	0.133	0.031
	(0.055)	(0.069)	(0.075)	(0.092)	(0.074)	(0.093)
	0.022	**0.005**	**0.085**	**0.061**	**0.072**	**0.017**
Normative beliefs of AAS	-0.086	0.009	-0.013	-0.166	0.177*	-0.010
	(0.053)	(0.066)	(0.075)	(0.087)	(0.083)	(0.099)
	0.047	**0.005**	**0.008**	**0.094**	**0.086**	**0.005**
Susceptibility to AAS	-0.013	-0.001	0.096	0.015	-0.023	-0.094
	(0.054)	(0.064)	(0.076)	(0.095)	(0.075)	(0.099)
	0.007	**0.001**	**0.050**	**0.008**	**0.012**	**0.048**
Reasons to use AAS	0.107*	0.105	-0.220**	0.309*	0.095	0.058
	(0.047)	(0.054)	(0.068)	(0.124)	(0.070)	(0.098)
	0.065	**0.066**	**0.127**	**0.121**	**0.054**	**0.029**

Table 2. continued

	Cohort 1		Cohort 2		Cohort 3	
Construct		Year		Year		Year
	Post-test	Follow-up	Post-test	Follow-up	Post-test	Follow-up
Reasons not to use AAS	0.003	0.034	0.088	-0.017	-0.053	-0.058
	(0.061)	(0.076)	(0.082)	(0.106)	(0.089)	(0.111)
	0.001	**0.015**	**0.042**	**0.008**	**0.024**	**0.026**
Team as an info source	-0.177**	0.008	-0.092	-0.174	0.101	-0.224*
	(0.056)	(0.068)	(0.081)	(0.108)	(0.085)	(0.099)
	0.093	**0.004**	**0.045**	**0.079**	**0.047**	**0.111**
Peers as an info source	-0.136*	0.003	0.084	-0.105	0.064	-0.040
	(0.054)	(0.068)	(0.074)	(0.096)	(0.080)	(0.100)
	0.073	**0.002**	**0.045**	**0.054**	**0.032**	**0.020**
Belief in media	-0.158**	-0.030	-0.118	-0.066	0.098	0.159
	(0.055)	(0.068)	(0.072)	(0.092)	(0.081)	(0.095)
	0.083	**0.015**	**0.067**	**0.035**	**0.049**	**0.082**
Perceived severity of AAS	-0.150**	-0.063	0.054	-0.138	-0.030	0.122
	(0.053)	(0.067)	(0.078)	(0.096)	(0.079)	(0.092)
	0.082	**0.032**	**0.027**	**0.070**	**0.015**	**0.065**

Note: Standard errors are in parentheses. Partial correlations are in bold.

* P<0.05, ** P<0.01.

Table 3.

OLS regression coefficient estimates, standard errors, and partial correlations for the Baseline x Group x Cohort interaction term.

Construct	Year	
	Post-test	Follow-up
Nutrition behaviors	-0.006	-0.050
	(0.032)	(0.043)
	0.004	**0.028**
Intent to use AAS	-0.077	-0.187**
	(0.041)	(0.051)
	0.038	**0.089**
Strength training efficacy	0.095**	-0.008
	(0.033)	(0.039)
	0.058	**0.005**
Knowledge of AAS use	0.017	0.022
	(0.040)	(0.051)
	0.008	**0.010**
Coach's tolerance of use	-0.023	-0.050
	(0.044)	(0.056)
	0.010	**0.022**

Table 3. continued

Construct	Year	
	Post-test	Follow-up
Ability to turn down drugs	0.077*	-0.103*
	(0.035)	(0.045)
	0.044	**0.055**
Peer tolerance of use	0.016	-0.007
	(0.041)	(0.051)
	0.008	**0.003**
Normative beliefs of AAS	0.077	-0.042
	(0.043)	(0.051)
	0.036	**0.020**
Susceptibility to AAS	-0.026	-0.076
	(0.037)	(0.046)
	0.014	**0.040**
Reasons to use AAS	-0.073*	-0.026
	(0.037)	(0.052)
	0.039	**0.012**

Table 3. continued

Construct	Year	
	Post-test	Follow-up
Reasons not to use AAS	-0.090	-0.064
	(0.046)	(0.057)
	0.040	**0.027**
Team as an info source	0.023	-0.184**
	(0.037)	(0.044)
	0.013	**0.102**
Peers as an info source	0.076*	-0.049
	(0.038)	(0.05)
	0.040	**0.024**
Belief in media	0.066	0.022
	(0.040)	(0.049)
	0.033	**0.011**
Perceived severity of AAS	0.013	0.052
	(0.035)	(0.044)
	0.007	**0.029**

Note: Standard errors are in parentheses. Partial correlations are in bold.

* P<0.05, ** P<0.01.

Table 4.

Multilevel regression coefficient estimates and standard errors for the Baseline x Group interaction term.

	Cohort 1		Cohort 2		Cohort 3	
Construct		Year		Year		Year
	Post-test	Follow-up	Post-test	Follow-up	Post-test	Follow-up
Nutrition behaviors	0.021	0.004	-0.033	0.180*	0.005	-0.098
	(0.050)	(0.064)	(0.073)	(0.091)	(0.070)	(0.102)
Intent to use AAS	0.020	0.037	-0.164	-0.351*	-0.078	-0.326**
	(0.077)	(0.081)	(0.103)	(0.15)	(0.116)	(0.110)
Strength training efficacy	-0.258**	-0.069	0.001	0.015	-0.082	0.002
	(0.054)	(0.066)	(0.071)	(0.094)	(0.083)	(0.092)
Knowledge of AAS use	-0.224**	-0.230**	-0.224**	-0.049	-0.340**	-0.108
	(0.054)	(0.072)	(0.080)	(0.103)	(0.091)	(0.113)
Coach's tolerance of use	-0.022	-0.060	-0.188*	0.126	0.076	-0.152
	(0.067)	(0.084)	(0.091)	(0.122)	(0.100)	(0.110)
Ability to turn down drugs	-0.125*	0.038	-0.031	-0.055	0.213*	-0.093
	(0.052)	(0.064)	(0.077)	(0.112)	(0.083)	(0.109)
Peer tolerance of use	-0.038	0.010	-0.144	-0.103	0.124	0.038
	(0.068)	(0.069)	(0.080)	(0.101)	(0.076)	(0.095)
Normative beliefs of AAS	-0.120	0.020	-0.021	.	0.172	-0.040
	(0.078)	(0.081)	(0.092)	(.)	(0.102)	(0.115)

Table 4. continued

	Cohort 1		Cohort 2		Cohort 3	
Construct		Year		Year		Year
	Post-test	Follow-up	Post-test	Follow-up	Post-test	Follow-up
Susceptibility to AAS	-0.010	0.005	0.080	0.005	-0.025	-0.094
	(0.057)	(0.066)	(0.079)	(0.096)	(0.076)	(0.097)
Reasons to use AAS	0.079	0.105	-0.290*	0.289*	0.074	0.051
	(0.057)	(0.070)	(0.113)	(0.14)	(0.086)	(0.107)
Reasons not to use AAS	-0.004	0.045	.	-0.016	-0.047	-0.061
	(0.065)	(0.083)	(.)	(0.108)	(0.088)	(0.130)
Team as an info source	-0.157**	0.042	-0.086	-0.132	0.073	-0.213*
	(0.058)	(0.070)	(0.083)	(0.108)	(0.089)	(0.101)
Peers as an info source	-0.121*	0.008	0.085	-0.106	0.059	-0.049
	(0.056)	(0.069)	(0.075)	(0.096)	(0.083)	(0.102)
Belief in media	-0.151*	-0.026	-0.132	-0.086	0.116	.
	(0.061)	(0.073)	(0.075)	(0.097)	(0.091)	(.)
Perceived severity of AAS	-0.141**	-0.057	0.013	-0.151	-0.043	0.121
	(0.053)	(0.068)	(0.079)	(0.097)	(0.081)	(0.092)

Note: Standard errors are in parentheses. A period indicates the model did not converge.

* P<0.05, ** P<0.01.

Table 5.

Multilevel regression coefficient estimates and standard errors for the Baseline x Group x Cohort interaction term.

Construct	Year	
	Post-test	Follow-up
Nutrition behaviors	-0.034	0.026
	(0.069)	(0.090)
Intent to use AAS	-0.143	-0.343**
	(0.091)	(0.109)
Strength training efficacy	0.259**	0.096
	(0.077)	(0.093)
Knowledge of AAS use	-0.055	0.176
	(0.078)	(0.101)
Coach's tolerance of use	0.007	0.076
	(0.095)	(0.115)
Ability to turn down drugs	0.223**	-0.112
	(0.078)	(0.099)
Peer tolerance of use	0.026	-0.050
	(0.083)	(0.096)
Normative beliefs of AAS	0.164	-0.101
	(0.090)	(0.103)

Table 5. continued

Construct	Year	
	Post-test	Follow-up
Susceptibility to AAS	0.040	-0.045
	(0.078)	(0.096)
Reasons to use AAS	-0.100	0.000
	(0.079)	(0.098)
Reasons not to use AAS	0.004	-0.084
	(0.093)	(0.112)
Team as an info source	0.187*	-0.204*
	(0.084)	(0.102)
Peers as an info source	0.221**	-0.075
	(0.079)	(0.098)
Belief in media	0.133	0.056
	(0.079)	(0.099)
Perceived severity of AAS	0.148	0.058
	(0.078)	(0.096)

Note: Standard errors are in parentheses. A period indicates the model did not converge.

* P<0.05, ** P<0.01.