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Predicting Intentions for Long-Term Anabolic–Androgenic Steroid Use Among Men: A Covariance Structure Model

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Long-term use of anabolic-androgenic steroids (AASs) is associated with both positive and negative effects. The authors examined possible mechanisms by which these effects contribute to AAS satisfaction and predict intentions for future AAS use. Five hundred male AAS users completed an interactive Web-based instrument assessing the psychological and physical effects of AAS use. Covariance structure modeling was used to evaluate both direct and indirect effects of AAS consequences on satisfaction with AASs and intentions for future AAS use. Results suggest that gain in muscle mass and psychological benefits from AAS use uniquely contributed to both AAS satisfaction and intentions for future use. Side effects from AAS use also uniquely contributed to AAS satisfaction, but ancillary drug use was found to partially mediate this relationship, suggesting that the satisfaction of experienced AAS users is enhanced by their mastery of side effects through the use of ancillary drugs. The final model explained 29% of the variance in intentions for future AAS use. Mechanisms for sustained AAS use and implications for intervention and prevention strategies are discussed.

Keywords: steroids, men, weight lifting, mediator, path analysis

Anabolic–androgenic steroid (AAS) use is a poorly understood phenomenon. A majority of studies evaluating and investigating AAS use and its side effects have relied on small samples of competitive bodybuilders or weight lifters, presented data mainly for descriptive purposes, and concentrated on the extent of physical and psychological side effects (Evans, 1997; Monaghan, 2002; Peters, Copeland, & Dillon, 1999; Strauss, Wright, Finerman, & Catlin, 1983; Tricker, O'Neill, & Cook, 1989; Yesalis et al., 1988) or the motivations for obtaining a lean and muscular physique or improving athletic performance (Copeland, Peters, & Dillon, 2000; Kutscher, Lund, & Perry, 2002). The existing literature, which consists of a limited number of studies, suggests that AASs induce both positive and negative effects. Both types of effects have implications for designing interventions with at-risk or user groups, as well as for differentiating problematic long-term AAS use from less harmful use patterns. If effective prevention, intervention, and harm reduction strategies are to be developed, understanding the relationships between positive and negative effects and sustained AAS use is essential.

Positive effects are observed during AAS use (AASs are typically used in intermittent cycles, between which most users dis-

continue use in order to permit re-regulation of the hypothalamic–pituitary–testicular axis) but may also have an additive effect, which persists beyond the presence of exogenous AASs in the blood (Alén, Hakkinen, & Komi, 1984; Forbes, Porta, Herr, & Griggs, 1992). AAS users commonly expect and experience psychological effects including enhanced focus on goals, improved self-esteem, better job performance, and ability to attract partners (Peters et al., 1999), and a well-controlled study supports the induction of elevated mood from AAS use (Pope, Kouri, & Hudson, 2000). Furthermore, AAS users achieve physical benefits by gains in lean mass and strength from AAS use (Bhasin et al., 1996; Woodhouse et al., 2003). These additive positive effects of AASs (e.g., increased self-esteem, muscle mass, and strength) and the absence of an identified intoxication syndrome make AASs unique among illicit drugs. Thus, long-term use is likely better understood as an operant behavior pattern, rather than as impulse-driven behavior as with common drugs of abuse, aimed at progressive improvement in appearance or athletic performance through changes in body composition, which ultimately may increase feelings of self-esteem through a sense of goal achievement.

Despite the presence of desirable effects from AAS use, approximately 9 of 10 AAS users report negative side effects (Bolding, Sherr, & Elford, 2002; Evans, 1997; Freidl, 2000), which users expect and often treat through ancillary drug use (Evans, 1997). Severity of side effects ranges from mild and treatable (e.g., water retention) to severe and difficult to treat (e.g., gynecomastia, bone growth). Within the subculture of AAS users, side effects are often devalued and do not effectively deter use. In fact, many AAS users claim knowledge equal to or greater than the medical community regarding pharmacologic prevention and management of side effects (Monaghan, 2002; Pope, Kanayama, Ionescu-Pioggia, & Hudson, 2004). Thus, the benefits of AAS use and side effect management may be mechanisms that help maintain regular AAS use. In this study we aimed to investigate the link between positive

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and negative effects of AAS use by analyzing their relationship to satisfaction and intentions for future AAS use.

Method

Participants

Participants included men aged 18 and older who completed an interactive self-report instrument over the Internet. We recruited men by posting links on moderated discussion boards devoted to AASs, bodybuilding, and power lifting. These boards consisted of both unrestricted public message boards and selected membership boards. The link to the self-report instrument traveled to at least 15 known anabolic discussion boards; however, the total number of postings could not be traced because the Internet enables easy posting and sharing of URLs. To ensure data quality, we excluded data submitted from identical IP addresses, participants responding to bogus AASs or thermogenic drugs, and participants who did not complete a majority of questions. As stated, a majority of users cycle AASs or take prescribed doses and sequences of AASs for a predetermined duration. This cycling is intended to maximize positive effects while limiting side effects and allowing for re-regulation of endogenous sex hormone production. To ensure that participants were those who cycled AASs, we excluded users who reported cycles of 52 weeks (i.e., take AASs continually) because the nature of their use pattern invalidated other questions pertaining specifically to AAS cycles. The final sample consisted of 500 male AAS users. Demographics are reported in Table 1. The mean age of respondents was 29.3 ($SD = 8.5$) years, and they identified themselves as mainly bodybuilders (61.4%), recreational weight lifters (16.1%),

and power lifters (14.4%). Participants averaged 218.5 lb ($SD = 32.0$ lb; 99.1 kg [$SD = 14.5$ kg]) with a body mass index of 30.2 kg/m² ($SD = 4.2$ kg/m²) and fat free mass index (Kouri, Pope, Katz, & Oliva, 1995) of 26.2 kg/m² ($SD = 4.3$ kg/m²). They were experienced users, having cycled an average of 5.7 ($SD = 3.1$) times and having taken an average of 250–500 mg/week of oral AASs and 750–1,000 mg/week of injectible AASs for 5.7 ($SD = 2.8$) and 13.6 ($SD = 8.8$) weeks, respectively.

Measures

The instrument included questions pertaining to 10 areas associated with AAS use, including queries about exercise, thermogenic use, and prohormone use. The instrument included 445 items and took between 20 and 30 min to complete. Only data from the anabolic use section were used for the current study.

Positive AAS effects. Three items were used to assess positive effects associated with AASs. The first item (“What, if any, benefits [they] received from a cycle of steroidal or nonsteroidal anabolics?”) listed six possible benefits (better ability to concentrate, more energy, greater self-esteem, more calm, more power over others, and stronger sex drive), and these responses were summed to form a psychological benefits scale (Cronbach’s $\alpha = .86$). The two additional items used to measure positive effects were ratings of the percentage of strength increase during a usual cycle (from 0% to 50%) and muscle mass in pounds retained after a usual cycle of AASs (from 0 to 50 lb [from 0 to 22.68 kg]).

Negative AAS effects. Two items were used to assess negative consequences associated with AASs. The first item presented participants with a list of 22 side effects and asked participants to endorse those experienced “during or immediately after a cycle of steroidal or nonsteroidal anabolics.” Side effects were summed (Cronbach’s $\alpha = .76$) and included all known physical and psychological side effects reported in the literature on AAS use. The list included side effects related to feminization (e.g., water retention, gynecomastia), suppression of the hypothalamic–pituitary–testicular axis (e.g., reduced sex drive and testicular shrinkage), and effects related to method of administration (e.g., abscesses at injection site). Participants also rated “how uncomfortable” they were with the effects of a “post-cycle crash” on an 11-point Likert-type scale from *not at all uncomfortable* (0) to *extremely uncomfortable* (10).

Pharmacological treatment. Ancillary drugs are regularly taken by AAS users to combat side effects. These drugs include antiaromatases (Arimidex, Femara [anastrozole citrate, letrozole citrate]), Clomid (clomiphene citrate), human chorionic gonadotropin (HCG), Nolvadex (tamoxifen), and Proviron (mesterolone). Ancillaries treat AAS side effects. For example, at the end of a cycle, AAS users will take clomiphene citrate, a compound used in fertility medicine, to increase endogenous testosterone production through increases in follicle-stimulating hormone and luteinizing hormone, thereby limiting the recovery time of natural testosterone regulation in the body. Informed steroid users are aware of the discomfort associated with suppressed endogenous testosterone production and use drugs from other areas of medicine to limit the impact of AAS cycles.

The online instrument also assessed androgen blockers (e.g., Aldactone [spironolactone]), anxiolytics, antidepressants, antihypertensives, herbal remedies, sleeping pills, hair loss prevention drugs (e.g., Propecia [finasteride]), and sexual functioning aids (e.g., Viagra [sildenafil citrate], Cialis [tadalafil]). Compensatory aids like antihypertensives might be taken by AAS users while on cycle to normalize increased blood pressure, a known side effect of AAS use.

Analgesics were the final category of ancillary drugs assessed and included ibuprofen, Nubain (nalbuphine HCL), Vicodin (hydrocodone/acetaminophen), Diluadid (hydromorphone), morphine, heroin, and oxycodone. Because of lack of endorsement we excluded Diluadid, morphine, and heroin from the ancillary scale. Nubain, Vicodin, and oxycodone were collapsed into a single item because they can be used interchangeably for treating pain among AAS users, to deal with the discomfort associated with

Table 1
Sample Demographics

Domain	<i>N</i>	%
Marital status		
Married	174	34.8
Living as married	42	8.4
Divorced	17	3.4
Widowed	0	0
Single	267	53.4
Education level		
Some high school	4	0.8
High school	44	8.8
Trade school	14	2.8
Some college	197	39.4
College degree	146	29.2
Some graduate school	28	5.6
Graduate degree	57	11.4
Employment		
Full time	328	65.8
Part-time	51	10.1
Homemaker	1	0.2
Student	90	18.0
Retired	4	0.8
Unemployed	25	5.0
Disabled	1	0.2
Race		
White	451	90.2
Hispanic/Latino	18	3.6
African American	8	1.6
Native American	14	2.8
Asian	9	1.8
Sexual orientation		
Heterosexual	489	97.8
Homosexual	6	1.2
Bisexual	5	1.0

post-cycle crashes, or for other psychological side effects such as excess energy. A pharmacological treatment variable, ancillaries, was created by summing the total number of ancillary drugs used (Cronbach's $\alpha = .81$) and measured the degree to which AAS users addressed side effects with ancillary drugs.

Satisfaction with AASs. Satisfaction with AAS cycles was measured on a 5-point Likert-type scale (range = 0 to 4) from *very dissatisfied* (0) to *extremely satisfied* (4). Participants were asked to report "in general, how satisfied were/are you with the effects of your cycles of steroidal or nonsteroidal anabolics" for their first ever AAS cycle and their usual cycle. To establish a measure of overall satisfaction, we calculated an average AAS satisfaction score using the following equation:

$$OS = (FCS + [(TCYC - 1) \times UCS]) / TCYC,$$

where OS is overall satisfaction, FCS is first cycle satisfaction, UCS is usual cycle satisfaction, and TCYC is the total number of AAS cycles completed. Satisfaction from the usual cycle and first cycle was combined to increase the variability in overall satisfaction, and the total number of cycles was included to obtain an accurate measure of satisfaction across the duration of AAS use.

Intentions for future use. Participants indicated on a 5-point ordinal scale their intentions for future AAS and other performance-enhancing drug use. The scale provided participants with the options: "I will not use [AASs] again, 0–5 years, 5–10 years, more than 10 years but not forever, and for the rest of my life."

Procedure

Data were collected over the Internet in an effort to obtain a large data set of AAS users, who are often secretive about their use and difficult to recruit through conventional data collection procedures. Online research has received support as a valid method of data collection with similarity to questionnaire data collected in person when precautions are taken to ensure confidentiality and eliminate bogus or false data (Gosling, Vazire, & John, 2004) and is considered an ethically appropriate avenue of psychological research (Kraut et al., 2004).

Participants entered the study through a Web link (<http://websurvey.rutgers.edu/steroids/>) directing them to a statement of informed consent, where they indicated that they were at least 18 years of age and were informed that they need not take performance-enhancing aids to participate. Nonusers were gated out of sections not applicable to performance-enhancing drug use. All participants provided informed consent before accessing the online survey. Participants clicked a "submit" button upon completion of the instrument, and only those who submitted their surveys were included in the data analysis. Data collection is ongoing; although, changes were made to the online survey after the current data set was

collected. The current sample represents the first valid 500 male AAS users who had evidence of distinct AAS cycles (less than 52 weeks).

Data Analysis

Pearson product-moment correlations were used to assess the relationship between positive and negative effects of AAS use and overall satisfaction and intentions for future AAS use (see Table 2). Data were evaluated for outliers with box plots and Mahalanobis distance within path analyses. A total of 33 cases were dropped from the original sample on the basis of box plots, and an additional 19 cases were dropped on the basis of Mahalanobis distance, which yielded a total of 448 cases for the final analysis. For variables that were not normally distributed (overall satisfaction, usual strength increase, and discomfort with post-cycle crash), log transformations were used to normalize the data before analyses. All variables, after transformations, had kurtosis and skewness of ± 1.0 , suggesting appropriate distributions for covariance structure modeling. Future use was found to have a bimodal distribution and was therefore split into a dichotomous variable (short-term use and long-term use). Missing data were replaced with the missing-at-random function described in Muthén and Muthén (2004), but there was very little missing data (0%–4.3% for individual variables).

A path analysis was used to evaluate the degree to which a hypothesized model and more parsimonious models accounted for the relationships between positive and negative AAS effects, ancillary drug use, AAS satisfaction, and intentions for future AAS use. The original hypothesized model is depicted in Figure 1, and the final model is shown in Figure 2. Path analyses were completed with *Mplus* 3.12 (Muthén & Muthén, 2004), and a mean- and variance-adjusted weighted least squares estimator was used. Models were initially tested for model fit with nonsignificant chi-square tests used to indicate an appropriate fit to the data. Root mean square error of approximation (RMSEA) and comparative fit index (CFI; Bentler, 1990) were used to compare models. Recent evidence suggests that a RMSEA below .05 indicates an appropriate fit (Hu & Bentler, 1999) and a CFI (range 0–1) closer to 1 indicates a better fit (Bentler, 1990).

Individual effects were assessed for significant contribution and those independent variables containing direct effects without any significant contributions to either dependent variable were consequently removed from the subsequent models. The full model in Figure 1 was compared with the reduced, more parsimonious models by removing paths (setting the direct effects between identified variables to zero). Chi-square difference tests were calculated between full and restricted models to determine if the restricted model significantly worsened the fit. Effects reported in the final model (see Figure 2) are in standardized coefficients (beta coefficients), such that the coefficient indicates the amount of change in the dependent variable associated with one unit of change in the independent variable

Table 2
Correlations Between Anabolic–Androgenic Steroid Effects, Overall Satisfaction, and Intentions of Future Steroid Use

Variable	1	2	3	4	5	6	7	8	9
1. Positive psychological effects	—	.317**	.382**	.115**	.275**	.132**	.061	.103*	.186**
2. History of side effects		—	.150**	.027	.675**	.081	.248**	.296**	.301**
3. Overall satisfaction			—	.152**	.428**	.122**	.017	.273**	.274**
4. Muscle mass				—	.009	.459**	.022	-.064	.011
5. Ancillaries used					—	.073	.186**	.307**	.331**
6. Strength gained						—	.097*	-.038	-.017
7. Discomfort with post cycle crash							—	.076	-.021
8. Number of AAS cycles								—	.350**
9. Intended future use ^a									—

Note. $N = 467$. Muscle mass and strength gained represent that gained during a usual anabolic–androgenic steroid (AAS) cycle.

^a Intended future use was dichotomized on the basis of distribution, and correlations are reported in Spearman's rho.

* $p < .05$. ** $p < .01$.

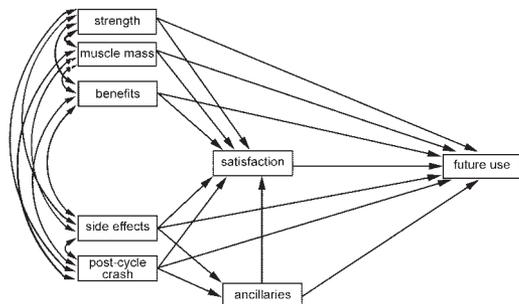


Figure 1. The hypothesized path model including positive and negative effects of anabolic-androgenic steroids (AASs) as predictors of satisfaction with AAS use and intentions for future use. Benefits represent psychological benefits of AASs.

where standard deviation is the unit of change. However, because future use was dichotomized, probit regression coefficients were calculated for variables regressed on future use, which can be interpreted as the amount of change in the probit latent variable (i.e., future use) for a one-unit change in the predictor variable.

Covariance structure modeling allows for the simultaneous calculation of indirect and direct effects. A model for indirect effects includes an independent variable that causes an intervening variable, which in turn causes the dependent variable. This relationship is termed *mediation* in psychological research, with the intervening variable termed a *mediator* (Baron & Kenny, 1986; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). *Mplus* allows for the calculation of indirect effects and estimation of standard errors using bootstrap resampling methods. The bias-corrected bootstrap method for calculating 95% confidence limits, using 1,000 resamples, was used to evaluate the significance of indirect effects as recommended by MacKinnon, Lockwood, and Williams (2004). Confidence limits that did not include zero were interpreted as evidence of mediation (MacKinnon et al., 2002). Results of a simulation study of

resampling methods (MacKinnon et al., 2004) suggest that the study design was adequately powered to detect small effects with low Type I error.

Results

Pearson correlations indicated that both positive and negative consequences were significantly related to overall satisfaction (see Table 2). Psychological benefits of AAS use were common ($M = 3.53, SD = 1.52$) with enhanced self-esteem (88.1%), more power over others (64.6%), and better concentration (55.4%) endorsed most frequently. Only 11 (2.2%) participants reported no psychological benefits from AAS use. Side effects were also common ($M = 5.83, SD = 3.59$), with water retention (60.1%), excessive sex drive (58.7%), acne (58.5%), testicular shrinkage (57.5%), and difficulty sleeping (46.8%) receiving the highest endorsement. Participants were moderately uncomfortable with their post-cycle crash ($M = 4.07, SD = 2.63$). Most (99.8%) participants reported using some form of ancillary drug, with the average number of drugs used being 4.01 ($SD = 1.96$). The most commonly used ancillaries included Nolvadex (72.2%), clomiphene citrate (69.8%), antiaromatase drugs such as anastrozole or letrozole (56.7%), and ibuprofen (38.0%). Overall satisfaction with AAS use was high ($M = 3.01, SD = 0.92$), and participants retained approximately 11.41 lb (5.18 kg; $SD = 5.39$ lb [2.45 kg]) of muscle mass with a 28.0% ($SD = 10.94$) increase in strength after a typical AAS cycle.

The original model (see Figure 1) did not provide a good fit to the data, $\chi^2(3, N = 448) = 10.3, p < .01, CFI = .967, RMSEA = .092$. To improve fit and simplify the model, we improved independent variables with insignificant direct effects on overall satisfaction; strength retained, $\beta = .024, t(447) = .681, p = .50$; and post-cycle crash, $\beta = .087, t(447) = .991, p = .32$. Direct effects of ancillaries, $\beta = .008, t(447) = .710, p = .48$; muscle mass retained, $\beta = .006, t(447) = 1.70, p = .09$; and psychological

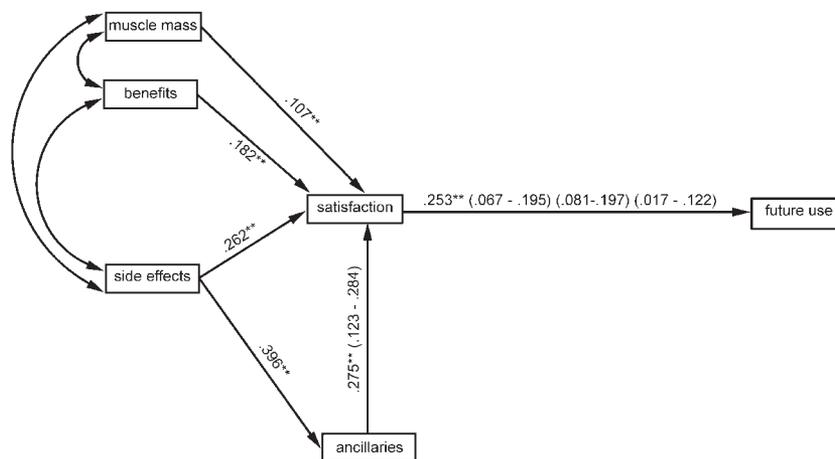


Figure 2. The final path model with beta or probit coefficients reported between independent and dependent variables. Probit regression coefficients are reported on the path between satisfaction and future use. Beta or probit coefficients in parentheses reflect indirect effects and are reported as bias-corrected bootstrapped 95% confidence limits. The first significant indirect effect on future use represents the indirect effect of side effects on future use via ancillaries and satisfaction. The second indirect effect indicates the effect of psychological benefits on future use via satisfaction. The third indirect effect indicates the effect of muscle mass on future use via satisfaction. $^{**}p < .01$.

benefits, $\beta = .010$, $t(447) = .747$, $p = .46$, on future use were not statistically significant and were consequently set to zero.

The revised path model presented in Figure 2 fit the data well, $\chi^2(6, N = 448) = 10.15$, $p = .12$, CFI = .988, RMSEA = .037. To evaluate the ordering of variables in the proposed model, we tested a contrasting model with satisfaction as the independent variable and positive and negative effects as mediating variables and found that it did not fit the data well, $\chi^2(6, N = 448) = 131.83$, $p < .01$, CFI = .652, RMSEA = .205. The revised model in Figure 2 was compared with a model with all paths estimated, and the revised model did not significantly worsen the fit, $\chi^2(4, N = 448) = 6.27$, $p = .18$. Standardized regression coefficients are reported in Figure 2 for all direct effects. Significant indirect effects (reported within parentheses in Figure 2) indicated that positive and negative effects of AASs indirectly contributed to intentions for future AAS use through satisfaction with AASs. The direction of these effects also suggests that increased muscle mass and psychological benefits, in conjunction with an increased number of side effects treated with ancillary drugs, predicted greater AAS satisfaction and, consequently, intentions to use AASs for a longer duration.

The indirect effects suggest that ancillary drug use did act as a partial mediator of the effect between side effects and satisfaction. Furthermore, side effects had a significant indirect effect on intentions for future use, via ancillary drug use and overall satisfaction (see Figure 2). In addition, psychological benefits and muscle mass had an indirect effect on intentions for future AAS use.

In terms of overall variance explained, psychological benefits, muscle mass retained, side effects, and ancillary use explained an estimated 44.9% ($r^2 = .449$) of the variance in overall satisfaction. Furthermore, the final model explained an estimated 29.0% ($r^2 = .290$) of the variance in intentions for future AAS use.

Discussion

In the current study we proposed a model of the relationships among commonly experienced positive and negative AAS effects, satisfaction with regular AAS cycles, and intentions for future AAS use. The data suggest that positive and negative effects of AAS indirectly affect intentions for future AAS use through AAS cycle satisfaction. However, this model is more consistent with distal mediation processes (see Shrout & Bolger, 2002) whereby the effect between predictor and outcome variables is likely eroded by other processes, causes, and random factors (e.g., changes in body image or personality) that occur between the predictor and outcome variables. The relationship between side effects and satisfaction with AAS use was also found to be partially mediated by ancillary drug use, suggesting that pharmacological treatment of side effects is a mechanism by which the experience of AAS side effects, and their successful control by the use of ancillary drugs, leads to overall satisfaction with AAS cycles.

AAS users reported high levels of satisfaction with their AAS use. About 80% of the sample reported being at least "satisfied" with regular AAS use, which has theoretical implications for substance use research because of its relationship to intended future AAS use. More satisfied AAS users were more likely to plan on long-term AAS use; thus, this group deserves specific attention in determining whether long-term use is evidence of a substance use disorder or if only a certain percentage of long-term

users actually develop symptoms indicative of abuse or dependence. The satisfied, long-term AAS user may in fact derive functional as well as psychological benefits from AAS use, and without any longitudinal data on AAS use outcomes, valid definitions of abuse or dependence in this population are unavailable.

It is not surprising that muscle mass retained and psychological benefits had a direct effect on AAS satisfaction, as these drugs are effective at increasing lean muscle mass and strength (Bhasin et al., 1996; Woodhouse et al., 2003). Steroid users also desire appearance and functional changes associated with increased lean muscle mass (Blouin & Goldfield, 1995; Peters et al., 1999; Schwerin et al., 1996), so the link between these positive AAS effects and satisfaction is intuitive. In addition to the physical benefits of AAS use, there are also distinct psychological processes that are associated with regular AAS use, namely better goal achievement, greater self-esteem, and ability to attract romantic partners (Peters et al., 1999). Furthermore, positive mood effects of AASs are well established (Pope et al., 2000), suggesting that the psychological effects of AASs are in need of further evaluation. The current data also suggest that users experience a range of psychological benefits, including gains in self-esteem, more power over others, greater sex drive, more calm, more energy, and better concentration. It is unclear whether these benefits occur during acute AAS administration or continue beyond the presence of exogenous testosterone in the blood.

In addition to the effects of positive consequences on continued AAS use, the current data indicate that negative consequences contribute to intentions for future AAS use via ancillary drug use and satisfaction with AASs. Commonly experienced side effects in this study were mainly transitory and potentially treatable through other pharmacological agents, which is consistent with previous descriptions of AAS use (Evans, 1997, 2004). This finding has important implications for understanding the mechanisms by which AAS users develop intentions to be long-term users. Ancillary drug use, a phenomenon rarely described in AAS users, potentially provides a source of negative reinforcement. This symptom management model offers a mechanism by which AAS use may create a sense of control and mastery. Thus, these data are consistent with ancillary drug use providing an avenue to test knowledge and master the effects of AASs. This mastery hypothesis is also consistent with findings by Pope et al. (2004) and Monaghan (2002) that suggest AAS users believe their knowledge of AAS to be greater than that of the medical community. Thus, it appears that side effects may be reinforcing in that they provide an opportunity for an AAS user to remove or prevent their occurrence with ancillary drug use (i.e., side effects are a form of negative reinforcement). Furthermore, the use of these drugs in conjunction with side effects predicts intentions for longer term AAS use.

This negative reinforcement model could also be extended to the contribution of other variables associated with continued AAS use, such as body dissatisfaction, appearance anxiety, and potential psychopathology (Blouin & Goldfield, 1995; Mangweth et al., 2001; Pope, Gruber, Choi, Olivardia, & Phillips, 1997; Schwerin et al., 1996). Although these were not evaluated in the current model, having negative moods and/or body image partially removed by the use of AASs would be a logical hypothesis for future model testing of continued and potentially problematic AAS use.

The current study provided an initial attempt to model intended future AAS use through complementary processes of positive and

negative reinforcement. This model of operant behavior implies that psychological and physical gains expected from AASs yield increased satisfaction and ultimately likelihood for continued use. Furthermore, a second mechanism, indicative of negative reinforcement, suggests that pharmacological aids are used to remove undesired physical and psychological states related to AASs, and this process leads to greater satisfaction with AASs. Because the data indicate that both operant models resulted in greater overall satisfaction with AAS use and predicted duration of intended use, it is worthy of further investigation in research on AAS use.

There are limitations to the current study. There was a potential selection bias in the sample; participants originated from anabolic, bodybuilding, and power lifting discussion boards where knowledge about AASs and overall satisfaction is potentially higher than in the greater population of AAS users. Also, reported levels of education were relatively high (approximately 40% had some secondary education), and a vast majority of participants identified themselves as Caucasian. In addition, it is possible that those who were willing to complete the survey were invested in a lifestyle that includes use of AASs. Thus, this model may not generalize to other groups such as professional athletes or novice users (e.g., adolescent users), where motivations, expectations, and knowledge about AAS use may differ (Komorski & Rickert, 1992; NCAA Research Staff, 2002; Tanner, Miller, & Alongi, 1995). However, this group does represent a group likely to continue AAS use and is thus adequate for a preliminary model of continued AAS use. Furthermore, the demographics of the current sample are similar to other general descriptive or comparative studies of male AAS use in terms of age, race or ethnicity, and educational level (Copeland et al., 2000; Evans, 1997; Lindstrom, Nilsson, Katzman, Janson, & Dymling, 1990; Porcerelli & Sandler, 1995; Tricker et al., 1989; Wagman, Curry, & Cook, 1995; Yesalis et al., 1988), suggesting that the current sample is similar to those recruited through more traditional methods such as paper advertisements or recruitment from various weight lifting competitions and facilities.

There were also limitations to the measures of positive and negative effects. It is unclear whether the total number of side effects, as opposed to the specific type of side effects, is a good measure of negative consequences to AAS use. It is likely that different side effects have different impacts upon users. For example, persistent gynecomastia is more impairing and difficult to treat than is water retention. Thus, future research should evaluate these side effects along a continuum of severity, rather than simply on the basis of presence or absence. In a similar fashion, the number of benefits is limited because of the categorical distinctions used and would benefit from a continuous measure of frequency or intensity of the psychological benefit.

The current study used a cross-sectional design, and it is possible that equivalent models could explain the current data, including models in which the ordering of variables differs from the current model. There are also other variables that potentially contribute to continued AAS use that are worthy of further investigation. These include social influences (Peters et al., 1999), personality traits (Kanayama, Pope, Cohane, Hudson, 2003), and body image disturbance (Olivardia, Pope, & Hudson, 2000). These factors likely have a significant effect on sustained AAS use, and further testing of the current model would benefit from evaluating the differential effects of these variables to the positive and negative effects evaluated in this model. It is possible that psycholog-

ical variables such as personality interact in meaningful ways with the experience of positive and negative AAS effects and have a unique contribution to continued AAS use.

Implications of these findings for understanding AAS use are threefold. First, it is unlikely that education about AAS side effects will deter use among those who report satisfied AAS use. Evidence from AAS use prevention research in adolescents supports this assumption, suggesting that knowledge of side effects does not lead to negative attitudes toward use (Goldberg, Bents, Bosworth, Trevisan, & Elliot, 1991). Furthermore, as indicated in other samples (Evans, 1997), the most common side effects reported were treatable and transitory and are thus unlikely to deter AAS use. Second, both physical and psychological gains appear to play an important role in AAS satisfaction, although it is unclear how these two variables interact to affect satisfaction. It is possible that psychological benefits are a direct result of the physical gains associated with AAS use. Thus, changing appearance through muscle gain potentially leads to more satisfaction, indicative of both improved perception of appearance changes and enhanced ability to achieve these changes. More research is necessary to determine if psychological and physical benefits have acute reinforcing value or whether they have other functional properties that persist beyond acute administration that contribute to sustained use (e.g., greater job performance, more acceptance from peers, alleviation of body image disturbance). Finally, the increased satisfaction created by use of pharmacological aids to treat side effects suggests a level of sophistication among AAS users that has not previously been understood. Thus, the operant behavior represented in satisfied and continued AAS use may be partially attributed to successful removal of negative consequences, and overall more indicative of attempted self-efficacious behavior than impulsive behavior suggestive of a substance abuse disorder. Further research is needed to distinguish highly controlled and self-efficacious AAS use from patterns indicative of abuse or dependence.

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