Determinants of Anabolic-Androgenic Steroid Risk Perceptions in Youth Populations: A Multivariate Analysis*

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Grounded conceptually in social cognitive theory, this research examines how personal, behavioral, and environmental factors are associated with risk perceptions of anabolic-androgenic steroids. Ordinal logistic regression and logit log-linear models applied to data gathered from high-school seniors (N = 2,160) in the 2005 Monitoring the Future study showed significant explanatory effects for sex, race, exposure to drug spots, steroid availability, peer use of steroids, sensation-seeking, depression, and self-esteem. Females, African Americans, and those who had seen drug spots the most frequently estimated higher levels of risk associated with steroid use, while those who indicated ease in obtaining steroids and those with close friends who had used the drugs estimated lower risk. Also estimating lower levels of risk were sensation seekers, those who appeared depressed, and those with low levels of self-esteem. Analyses reveal how steroid risk determinants may differ from those related to methylenedioxymethamphetamine (i.e., MDMA, ecstasy) and marijuana use.

While social scientists have developed a significant body of research addressing risk perceptions of alcohol consumption and tobacco use (Dillard, McCaul, and Klein 2006; Hampson et al. 2001; Johnson, McCaul, and Klein 2002), in addition to multiple forms of cancer and disease (Hughes, Lerman, and Lustbader 1996; Jones, Denham, and Springston 2007; Moore and Rosenthal 1991; Morton and Duck 2001; Zajac, Klein, and McCaul 2006), the scholarly literature includes relatively few studies addressing perceived risks of using anabolic-androgenic steroids (AAS). Analyses of risk perceptions associated with AAS use stand to make an important contribution to the behavioral science literature, given that adolescents, in particular, continue to use the substances for both athletic and nonathletic purposes (National Institute on Drug Abuse 2006). Athletes seek increases in speed and strength, while nonathletes seek increases in muscularity and greater physical appeal; both types of users tend to acquire the drugs illegally, relying on the Internet and word-of-mouth for information on dosages and coping with potentially serious side effects. Recent studies also suggest that adolescents who use AAS may be more likely to continue using the drugs—and coping with adverse effects—in young adulthood (see Wichstrom 2006).

In addition to informing scholarship on risk perceptions, the present study aspires to inform attitudinal research methods, applying ordinal logistic regression and logit log-linear models to data gathered from high school seniors (N = 2,160) in the 2005 Monitoring the Future study (Johnston et al. 2005). Used in a complementary fashion, these multivariate techniques stood to (1) identify significant personal, be-

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havioral, and environmental influences on AAS risk perceptions, given a conceptual framework in social cognitive theory (Bandura 2002); and (2) indicate whether determinants of perceived risk differed from those associated with substances such as methylenedioxymethamphetamine (MDMA, ecstasy) and marijuana. The article begins with an overview of AAS use among adolescents and then situates AAS risk perceptions within a social cognitive model, positing multiple influences on assessments of risk.

BACKGROUND ON ANABOLIC-ANDROGENIC STEROIDS

Anabolic-androgenic steroids are synthetic derivatives of the male hormone testosterone, and as a class of drugs they function by converting protein into muscle at an accelerated rate (Yesalis, Courson, and Wright 2000). Their anabolic properties assist in cases of muscle deterioration and anemia, and their androgenic, or masculinizing, properties assist in cases of delayed puberty and hypogonadism. In the United States, the Anabolic Steroid Control Act of 1990 classified AAS as a Schedule III Controlled Substance, to be regulated by the federal government under the Omnibus Controlled Substances Act (Denham 1997). Despite the 1990 legislation, use of the drugs increased among adolescents during that decade and into the twenty-first century (Denham 2006) as individuals continued to acquire AAS from each other, from steroid dealers, or by simply walking into drug stores in places such as Tijuana, Mexico (George 2003). As Internet technology emerged, adolescents also began to purchase AAS online.

The National Institute on Drug Abuse (NIDA) estimates that between 1 and 6 percent of all adolescents use AAS at a given point (National Institute on Drug Abuse 2006), and scholars have discussed at length the potential side effects of these drugs (Bahrke 2000; Elliot and Goldberg 2000; Friedl 2000). Rather than review all of the physical and psychological problems that can occur, the current article acknowledges their potential severity and observes that both males and females, athletes and nonathletes, stand to be affected (Cafri, Van den Berg, and Thompson 2006; Labre 2002; Miller et al. 2002; Parkinson and Evans 2006). The article observes that AAS use tends to be associated with the use of narcotics and with behaviors such as truancy, promiscuity, and episodic violence (DuRant, Escobedo, and Heath 1995; Kindlundh et al. 1999; Klotz et al. 2006; Miller et al. 1998; Miller et al. 2005).

Perceptions of the risks associated with AAS may differ from perceptions of other drug risks because of differences in how the respective knowledge bases have evolved. For several decades, the American Medical Association did not acknowledge the potential of AAS to enhance athletic performance, and among the body builders and athletes who had experienced the effectiveness of AAS, this stance by the AMA appears to have detracted from the credibility of medical professionals (Pope et al. 2004). One consequence has been a longstanding reliance on self-declared experts and "gurus" (Duchaine 1989) for advice on what drugs to take, how to stack the drugs, what to do in the event of side effects, and so forth (Monaghan 1999). As adolescents continue to follow this pattern, acquiring information about AAS from their friends and "informed" acquaintances (Alaranta et al. 2006; Pallesen et al. 2006), in addition to the print and electronic media (Denham 2006), they risk the onset of adverse effects. As information sources, interpersonal and mass communication can be problematic in that the former may be grounded in medical ignorance and the latter in drama, hyperbole, and inaccurate portrayals of the problem (Wiegman and Gutteling 1995).

Additionally, because adolescent steroid users often acquire AAS from their peers, who themselves may acquire the drugs from individuals they barely know, users run the risk of acquiring counterfeit and potentially toxic substances (George 2003). In fact, in recent years, retired athletes have reported injecting themselves with vegetable oil and Armor All upholstery protectant, among other substances, believing the fluids to have been AAS. When users share needles for such injections, they risk transmission of hepatitis and HIV (Aitken, Delalande, and Stanton 2002), in addition to the possibility that a needle may break off in the body. They also risk arrest for possession of a controlled substance.

In studying the development of AAS risk perceptions, it is important to note that perceptions of risk, in general, have consistently been associated with behavioral intentions, as proposed in models such as the theory of reasoned action (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980). Dodge and Jaccard (2007), for instance, studied intent to use legal perfor-

mance-enhancing substances, finding attitudes and subjective norms to predict behavioral intentions, which then predicted actual substance use. Given the findings of their research, studies such as the current one seek to identify the populations most at risk for using—and experiencing the potentially adverse effects of—anabolic-androgenic steroids.

CONCEPTUAL FRAMEWORK

In advancing social cognitive theory, Bandura (2002) posited that individuals learn by observing others, especially their peers and those they admire. He also stressed that such learning takes place within biological limits. The social cognitive model is an instructive framework for studying adolescent risk perceptions, given that a combination of personal, behavioral, and environmental factors may impact learning (Greening et al. 2005; Millstein and Halpern-Felsher 2001). As Bandura (2002) explained, social cognitive theory proceeds from an agentic perspective, with individuals considered to be self-organizing, proactive, and self-regulating. In reviewing theories associated with adolescent risk behaviors, Irwin et al. (1997) noted that adolescents, like adults, possess such agency and can make "differential assessments" of risk (p. 27). The current study examines influences on those assessments.

From the standpoint of biological influence, Steinberg (2008) recently explained how, at the onset of puberty, the brain undergoes socioemotional change, leading to increases in reward-seeking, especially in the presence of peers. Behaviors associated with reward-seeking often involve risk, which Steinberg suggested is not the result of "ignorance, irrationality, delusions of invulnerability, or faulty calculations" (p. 80). In fact, in the Steinberg model, cognitions play a relatively minor role, with biological change, influenced by environment, conceived as a primary risk determinant. Moving one step beyond the uniform treatment of socioemotional change, some adolescents tend to score higher than others on measures of sensation-seeking, which is associated with lower levels of dopamine in the brain, and need for arousal (Stephenson and Southwell 2006). Conceivably, risk perceptions may differ, in part, because of this determinant. Similarly, as Irving et al. (2002) and others have noted, those who show signs of depression and lower levels of self-esteem also may report lower risk perceptions, with some individuals looking to substances, such as AAS, as a means of improving their social status, confidence, and outlook.

In combination with biological determinants, adolescent males, in particular, may offer lower estimates of AAS risk based on socially constructed conceptions of masculinity and what it means to be "a man" (Harris and Miller 2000; Morrongiello and Rennie 1998; Wiegman and Gutteling 1995). Because males may seek to enhance their social status and win peer approval by increasing their muscularity and physical strength (Irwin et al. 1997), they also may discount the risks associated with achieving those ends. Given the proactive and self-regulating aspects of social cognitive theory, they may surround themselves with those who support their attitudes and behaviors (Irwin et al. 1997). Self-regulation, in particular, stems from perceived consistency with socially acceptable standards (Bandura 2002), and adolescents can be considered proactive to the extent that they seek attitudinal and behavioral approval from those closest to them. White males, in particular, consistently offer lower risk estimates (see Finucane et al. 2000), and the current study considers peer groups and environment to be significant determinants.

Indeed, peer networks may show especially strong effects in regard to AAS, as adolescents "in the know" will have learned to discount the views of physicians and authority figures (Pope et al. 2004). Anabolic-androgenic steroids use may appear routine among certain individuals (Alaranta et al. 2006), and unless one of those individuals encounters a serious side effect, risk perceptions may be relatively low. Greening et al. (2005) observed the importance of negative consequences in the formation of risk perceptions, noting the propensity of those who had not experienced such consequences to maintain what Weinstein (1980) termed "unrealistic optimism."

As additional support for peer influence, the most effective AAS deterrence programs at the adolescent level have relied on peer education and the development of self-efficacy as opposed to warnings from authority figures and the use of fear appeals. Goldberg and colleagues (1996), for instance, developed the Adolescents Training and Learning to Avoid Steroids (ATLAS) program, while Elliot and associates (2004) advanced the Athletes Targeting Healthy Exercise and Nutrition

Alternatives (ATHENA) approach. In both programs the scholars reasoned that shared goals and interests among adolescents stood to enhance source credibility and thus overall effectiveness, and in both instances they found support for their hypotheses.

In the context of social cognitive theory, Bandura (2002) posited that individuals use a natural capacity for symbolization in comprehending and regulating their daily environments. In the case of adolescents—especially adolescent athletes—they may learn about professional athletes using the likes of AAS and conclude that drug use is prevalent in the professional ranks of sport where adolescent athletes dream of competing. Regarding attitudes about AAS, Bandura would perhaps apply the term "vicarious verification," which occurs when individuals compare certain attitudes and behaviors with the actions and behaviors of those they admire; use of AAS might be considered a rite of passage.

Apart from adolescents who participate in sports and follow media reports of professional athletes, one might expect exposure to mediated communication and anti-drug messages, in particular, to increase AAS risk perceptions. Irwin et al. (1997) referred to the mass media as an "exosystem" in the context of adolescent risk behaviors, and those who do not engage in athletics may view the use of performance-enhancing substances as a health risk and moral failure. Denham (2006), in fact, found relationships between media exposure and attitudes toward AAS, based largely on the tendency of the media to uphold dominant conceptions of morality.

Anticipated Relationships in the Social Cognitive Model

Guided conceptually by social cognitive theory, and drawing on the extant literature related to the illicit use of anabolic-androgenic steroids, the current study anticipates lower risk perceptions among males, whites, and those who (1) participate in school-sponsored sports at the highest levels, (2) report the highest numbers of friends who use AAS, (3) report relative ease in obtaining AAS, and (4) estimate the highest percentage of professional athletes who use illicit drugs. Given the manner in which the mass media tend to characterize illicit drug use, the study anticipates higher estimates of risk among those who had read newspapers the most frequently and those who had seen or heard anti-drug spots at higher levels. Among ordered factors, I also anticipate interactive effects between sports participation and newspaper exposure, as well as sports participation and estimated drug use in professional sports. Individuals who participate in school-sponsored sports and who are most frequently exposed to media representations can be expected to report lower AAS risk perceptions than those who do not participate in sports but have high media-exposure levels. Similarly, those who participate in sports and estimate the highest numbers of professional athletes using illicit drugs can be expected to report lower risk estimates, as AAS may be considered a requisite for success in the professional ranks.

Given the biological dimension of social cognitive theory, the study anticipates significant covariation for indices measuring sensation-seeking, depressive attitudes, and self-esteem, with sensation seekers, depressed individuals, and those with lower levels of self-esteem estimating lower levels of risk associated with AAS use. Finally, I anticipate differing determinants of risk estimates across AAS, MDMA, and marijuana, with steroid risk determinants reflecting more concerted efforts to learn about the drugs from peers. The following section discusses the methods used in examining the relative contributions of personal, behavioral, and environmental factors and covariates on AAS risk perceptions.

DATA AND METHODS

Sample

Funded by the National Institute on Drug Abuse and administered by the Inter-university Consortium for Political and Social Research (ICPSR) at the University of Michigan, the Monitoring the Future (MTF) study enters the field each spring, seeking to identify "values, behaviors, and lifestyle orientations of contemporary American youth" (Johnston et al. 2005:3). The current study is based on a subsample of the 2005 MTF FORM 6 data set (number 7), a national probability sample of high school seniors made available to scholars in October 2006.

The subsample consisted of 2,160 (85%) of the 2,542 original sample cases, the result of filtering the entire sample through the MTF race demographic, as collapsed by MTF investigators (Johnson et al. 2005). The collapsed race measure included 272 African Americans,

1,606 whites, and 282 Hispanics, inclusive of Mexican Americans/Chicanos, Cuban Americans, Puerto Ricans, and other Latin Americans. Not included in this subsample of 2,160 respondents were Asians, Native Americans, those who indicated belonging to more than one race, and those who indicated belonging to a race other than those mentioned here. In regression analyses, the study included dummy variables for both African Americans and Hispanics, allowing the study to test explanatory effects across the three groups included in the MTF data set. As Table 1 indicates, most of the explanatory measures included in the present study contained at least 90 percent of the 2,160 subsample cases.

Explanatory Measures

In addition to three covariate indices—measuring sensation-seeking, depression, and self-esteem—the current study included measures of sex, race, newspaper and drug spot exposure, participation in school-sponsored athletics, ease of obtaining AAS, peer AAS use, and illicit drug use by professional athletes. As indicated, race included African Americans, whites, and Hispanics. Regarding newspaper exposure, an MTF item asked respondents about the frequency with which they had read a newspaper, including the following response options: "never," "a few times per year," "once or twice per month," "once per week," and "near daily." Additionally, an item asked respondents whether they had seen or heard drug spots, with response options including "not at all," "less than one per month," "one to three per month," "one to three per week," and "daily."

Next, a measure addressing school-sponsored athletic participation indicated whether respondents had participated to the following extents: "not at all," "slight," "moderate," "considerable," or "to a great extent." An item addressing the difficulty/ease by which AAS could be obtained included the response options "probably impossible," "very difficult," "fairly difficult," "fairly easy," and "very easy." Regarding peer use of steroids, the MTF survey asked respondents to indicate whether "none," "a few," "some," "most," or "all" of their friends took steroids. Because relatively few indicated some, most, or all, those categories were collapsed, resulting in a three-level measure. The final explanatory measure asked respondents to estimate the percentage of professional athletes who, at a given point, use illicit drugs, with options including "0–10," "11–30," "31–50," "51–70," "71–90," and "91–100 percent," and "no idea." Because few individuals indicated 91–100 percent, the measure was collapsed into 71–90 percent, creating a five-level explanatory measure, with "no idea" omitted.

Sensation-seeking index. Six items formed an index measuring sensation-seeking, including the following statements, adapted from Zuckerman (1979): "I get a kick out of doing things that are a little dangerous"; "I like to test myself every now and then by doing something a little risky"; "I would like to explore strange places"; "I like to do frightening things"; "I like new and exciting experiences, even if I have to break the rules"; and "I prefer friends who are exciting and unpredictable." Each item included the following response options: "disagree," "mostly disagree," "neither," "mostly agree," and "agree." The six-item sensation-seeking index (N = 1,918; 88.8% of subsample) yielded a Cronbach's alpha score of .849 (M = 20.22, SD = 5.691).

Depression index. Five items formed an index measuring depression (or a proclivity to be depressed at certain times), including the following statements, as adapted from Newcomb, Huba and Bentler (1986): "Life often seems meaningless"; "I enjoy life as much as anyone"; "The future often seems hopeless"; "I feel that life is not very useful"; and "It feels good to be alive." Response options included "disagree," "mostly disagree," "neither," "mostly agree," and "agree." With two items reverse-coded, the five-item depression index (N = 1,928; 89.2% of subsample) yielded a Cronbach's alpha score of .823 (M = 9.47, SD = 4.186).

Self-esteem index. Six items formed an index measuring self-esteem, including the following statements adapted from Rosenberg (1965): "I take a positive attitude toward myself"; "I feel I do not have much to be proud of"; "I feel I am a person of worth, on an equal plane with others"; "Sometimes I think that I am no good at all"; "I am able to do things as well as most other people"; and "I feel that I can't do anything right." The six-item self-esteem scale (N = 1,931; 89.4% of subsample) yielded a Cronbach's Alpha score of .810 (M = 24.05, SD = 4.710).

TABLE 1. Filtered Variable Frequencies

Dependent Measures	Categories	*N*	Percent	Filter Percent	*Independent Measures*	Categories	*N*	Percent	Filter Percent
AAS risk perceptions	Little risk	218	11.0		Athletic participation	None	918	42.8	
	Moderate risk	533	26.8			Slight	176	8.2	
	Great risk	1,238	62.2			Moderate	200	9.3	
	Total	1,989	100	92.1		Considerable	228	10.6	
						Great	624	28.9	
MDMA risk perceptions	Little risk	259	13.3			Total	2,146	100	99.4
	Moderate risk	379	19.5						
	Great risk	1,305	67.2		Ease obtaining AAS	Impossible	251	11.8	
	Total	1,943	100	90.0		Very difficult	275	13.0	
						Fairly difficult	540	25.5	
Marijuana risk perceptions	Little risk	417	20.3			Fairly easy	575	27.1	
	Moderate risk	507	24.6			Very easy	478	22.6	
	Great risk	1,133	55.1			Total	2,119	100	98.1
	Total	2,057	100	95.2					
Independent Measures					Peer AAS use	None	1,522	80.0	
						A few	295	15.5	
Sex	Male	1,030	48.8			> A few	85	4.5	
	Female	1,082	51.2			Total	1,902	100	88.1
	Total	2,112	100	97.8					
					AAS use by pro athletes	0–10%	624	35.2	
Race	Black	272	12.6			11–30%	534	30.1	
	White	1,606	74.4			31–50%	259	14.6	
	Hispanic	282	13.0			51–70%	180	10.1	
	Total	2,160	100	100		> 71%	177	10.0	
						Total	1,774	100	82.1
Newspaper exposure	None	242	11.2						
	Yearly	396	18.4		Drug spot exposure	None	253	12.6	
	Monthly	547	25.4			< 1 per month	300	15.0	
	Weekly	598	27.7			1–3 per month	592	29.5	
	Daily	373	17.3			1–3 per week	511	25.5	
	Total	2,156	100	99.8		1 per day	349	17.4	
						Total	2,005	100	92.8

Note: Filter Percent reflects the total number of variable respondents relative to the filtered national probability sample ($N = 2,160$).

Response Measures

The following item measured perceived risks of using anabolic-androgenic steroids: "How much do you think people risk harming themselves (physically or in other ways) if they take steroids for body-building or improved athletic performance?" Response options included "no risk," "slight risk," "moderate risk," "great risk," and "can't say." With "can't say" responses omitted, the four-level ordered response variable contained 1,989 cases, 92.1 percent of the 2,160 cases in the subsample. Because the "no risk" category contained few responses, it was collapsed with "slight risk," resulting in a three-level measure, where level one equaled "little risk" (N = 218), two equaled "moderate risk" (N = 533), and three equaled "great risk" (N = 1,238).

The study used ordinal logistic regression and logit log-linear models to examine factor and covariate determinants of AAS risk perceptions, and the study also used those same multivariate techniques to test whether significant determinants of perceived AAS risk showed consistency with determinants of MDMA (i.e., ecstasy) and marijuana risk.[1] On a pragmatic level, the study included MDMA and marijuana because the MTF survey included comparable questions regarding (1) perceived risk, (2) ease of obtaining the drugs, and (3) peer use of the substances. Given the more common use of marijuana among adolescents, the study anticipated differences in determinants of risk perceptions, shedding light on AAS risk.

Analytic Strategy

A rigorous test of the social cognitive model requires multivariate statistical analyses that evidence relationships between personal, behavioral, and environmental factors in the formation of attitudes and risk perceptions. Analyses should demonstrate that variables representing each dimension make unique contributions, and to that end the present study employed ordinal regression analyses in testing for significant determinants of AAS risk perceptions and logit log-linear analyses in identifying the most parsimonious models associated with the assessment of risk.

Ordinal logistic regression analysis. As extensions of generalized linear models, ordinal logistic regression analyses test the explanatory power of both categorical factors and continuous covariates on a categorical dependent measure (Norusis 2009). Unlike logit log-linear procedures, ordinal regression techniques take advantage of order among categories in a response variable; the models are thus well-suited for evaluating predictors of a three-level risk-perception measure. Ordinal regression defaults to a logit link function in most statistical software programs (O'Connell 2006), and a fundamental assumption is that relationships between the independent variables and the logits will be consistent across all levels; that is, a series of parallel lines should form in relation to the dependent measure. A failure to meet, or at least evaluate, the "parallel lines" assumption may result in a loss of information, such as potential interactions among the explanatory measures. Ordinal regression analyses yield parameter estimates in the form of log-odds, the exponentiation of which results in the more interpretable odds ratio. Beginning with the sex and race variables, the current article entered potential determinants of AAS risk systematically and incrementally, retaining those that showed significance and could be fit to the data without generating an excessive number of zero-count cells.

Logit log-linear analysis. Knoke and Burke (1980) described logit log-linear analysis as a "categorical variable analog" to ordinary least squares (OLS) regression (p. 24), noting that logit analyses explore the effects of categorical factors and continuous covariates on the behavior of a categorical dependent measure. As Knoke and Burke explained, parameter estimates in logit models can be interpreted similarly to additive coefficients in OLS regression, with positive estimates increasing the odds of a specific response and negative estimates decreasing the odds. Log-linear models, in general, are robust to distribution abnormalities, do not make assumptions about the population from which a sample is drawn (Agresti 1990; Tansey et al. 1996), and can distinguish between structural and sampling zeroes (ordinal logistic regression does not). Still, log-linear models can be susceptible to problems with zero-count cells, and the present research addressed this issue by adding a small amount to each cell in both ordinal regression analyses and subsequent logit log-linear models; more specifically, the study set the value of delta in SPSS to .5, assuring relatively conservative parameter estimates (Denham 2006; Knoke and Burke 1980).[2]

As indicated, for purposes of the current study, the logit log-linear approach determined the most parsimonious representations of variable relationships, recognized as models in which the fewest number of parameters reproduced original cell frequencies in a statistically acceptable manner, consistent with theorized relationships. In testing model fit, the chi-square significance level for a model log-likelihood value had to range between $p > .10$ and $p < .35$ (Knoke and Burke 1980). When more than one model met that criterion, the study considered likelihood values and degrees of freedom across competing models (Agresti 1990). If the difference in likelihood values and associated degrees of freedom was not statistically significant, based on a chi-square test, then a model with fewer parameters was assumed to provide the more parsimonious representation of variable relationships. In keeping analyses systematic, all three-way combinations of the factors that showed significance in regression equations were tested for fit with the inclusion of each covariate index. For each three-way combination that fit the data (i.e., reproduced cell frequencies in the dependent measures), the study also examined reduced two-way models, reporting those that fit the data as well.

Missing values. Consistent with recent research by Haas and Fosse (2008), the current study used multiple imputation for missing values. As Rubin (1987) explained, multiple imputation replaces missing values with two or more acceptable values from an assumed underlying distribution. The procedure has proven especially useful in survey research, and as Rubin noted, it stands to improve the efficiency of parameter estimates while facilitating complete-data inferences. In SPSS 17.0, the missing values add-on module computes a user-specified number of data sets (five in the current study) and then produces pooled results from those analyses (SPSS 2008).

While ordinal regression analysis can be performed with imputed data, logit log-linear analyses cannot, thus requiring a separate approach for missing values. The present study used listwise deletion, given the difficulty of replacing values for heavily skewed two- and three-level categorical measures (e.g., AAS risk perceptions, peer use of AAS). With this strategy, most of the log-linear models included between 75 and 90 percent of subsample cases (N = 2,160), and the approach appeared consistent with the advice of Allison (2002); that is, listwise deletion often proves more reliable and less arbitrary than other approaches for replacing missing values.[3]

RESULTS

Ordinal Logistic Regression Analyses

Table 2 displays seven ordinal logistic regression models testing explanatory measures of anabolic-androgenic steroids risk perceptions. Analyses reported in the table included multiple imputation of missing values, and each model includes pooled estimates and their standard errors. As the table indicates, sex appeared relatively consistent as an explanatory control, with males expressing lower levels of perceived risk than females. In the first regression equation (Table 2, model 1), the negative log-odds parameter estimate of –.225 yielded an odds ratio of 1.25; in statistical terms, the odds of a male appearing at or below a given level of the dependent measure were 1.25 times the odds of a female appearing at the respective level.[4] African American respondents also estimated greater levels of risk associated with AAS use, with the parameter estimate –.471 translating into an odds ratio of 1.60. Given the indicator coding, the odds of a respondent apart from an African American appearing at or below a given level of the dependent measure were, on average, 1.6 times the odds of an African American appearing at or below the respective level. In looking across the models reported in Table 2, the indicator variable for African Americans showed significance in each analysis, while parameter estimates for Hispanic respondents did not indicate significance. Minorities thus differentially associated with AAS risk perceptions, with African Americans estimating higher risk than both whites and Hispanics.

In terms of mass communication (see Table 2, model 2), newspaper exposure did not show significance at $p < .05$, although it did at $p < .10$; those who read the newspaper more frequently expressed slightly higher levels of risk associated with AAS use. As a risk determinant, drug-spot exposure showed significance at $p < .05$ (Table 2, model 3), with those who reported seeing more spots also reporting higher levels of AAS risk. Both measures of mass communication paled in comparison to peer use of AAS as a risk determinant, as indicated in the fourth model of Table 2. With sex, the two race measures, and drug-spot exposure in

TABLE 2. Ordinal Logistic Regression Models Measuring Determinants of AAS Risk Perceptions

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Threshold														
Level 1	−2.730***	.225	−2.505***	.273	−2.470***	.246	−2.933***	.255	−3.521***	.262	−3.167***	.246	−3.036***	.258
Level 2	−1.134***	.216	−.906**	.268	−.873***	.240	−1.334***	.248	−1.921***	.252	−1.570***	.237	−1.442***	.250
Factors														
Sex	−.225*	.091	−.250**	.090	−.229*	.091	−.182*	.091	−.168	.091	−.178*	.091	−.177*	.090
Black	−.471**	.163	−.453**	.163	−.491**	.162	−.379*	.156	−.336*	.155	−.353*	.156	−.320*	.155
Hispanic	−.117	.141	−.132	.140	−.121	.140	−.073	.135	−.027	.136	−.062	.137	−.043	.136
Covariates														
Newspaper exposure			.074	.040										
Drug-spot exposure					.089*	.036	.084*	.035						
Friends who use AAS							−.581***	.081	−.459***	.083	−.518***	.082	−.522***	.079
Ease obtaining AAS									−.136***	.038				
Sports participation											.007	.027		
Drug use by pro athletes													.044	.039
Number of respondents	2,160		2,160		2,160		2,160		2,160		2,160		2,160	

Note: Data imputed with SPSS 17.0 Missing Values add-on module. Logit link function with delta value set at .5 in each model. Black and Hispanic factors entered as indicator variables. Significant ordered covariates also showed significance as categorical factors.

*** $p < .001$; ** $p < .01$; * $p < .05$

the equation, peer AAS use yielded an estimate of –.581, with an odds ratio of 1.79; higher estimates of peer AAS use were associated with significantly lower levels of perceived risk.

Model 5 in Table 2 is perhaps the most telling of all regression equations reported in the current study. In this model, with both a measure of peer AAS use and a measure of the ease through which AAS could be obtained entered as covariates, sex became statistically insignificant.[5] African Americans expressed significantly higher levels of risk, consistent with previous models, but it appeared to matter little whether a respondent was a male or female—only whether anabolic-androgenic steroids were readily accessible and whether peers had used them.

Finally, as the sixth and seventh models in Table 2 indicate, participation in school-sponsored athletics and estimated use of drugs among professional athletes did not show significance as determinants of AAS risk perceptions. Anticipated interactions involving these measures also did not appear significant in the ordinal regression analyses.

Logit Log-linear Analyses

To examine the relationships identified in Table 2 more closely, and to test the assertion that AAS risk perceptions would be explained most parsimoniously by a combination of personal, behavioral, and environmental measures, I used logit log-linear analyses to test the fit of significant regression determinants from Table 2 with the addition of more abstract indices measuring sensation-seeking, depression, and self-esteem.

In Table 3, in the section addressing risk perceptions of AAS, three three-factor models and two two-factor models fit the data when analyses included sensation-seeking as a covariate. The first three-factor model (Table 3, model 1) contained sex, exposure to drug spots, and ease of obtaining AAS, but the first two-factor model (Table 3, model 4) fit the data equally well. The difference in likelihood scores (48.671 with 48 degrees of freedom) was not statistically significant, and thus sex could be omitted without a loss of information. Similarly, the

TABLE 3. Logit Log-Linear Models of Significant Risk Determinants Fitted with Sensation-Seeking, Depression and Self-Esteem Indices

Risk perceptions of anabolic-androgenic steroids					Risk perceptions of MDMA (Ecstasy)					Risk perceptions of marijuana				
Models	Index	Likelihood	df	Sig.	Models	Index	Likelihood	df	Sig.	Models	Index	Likelihood	df	Sig.
1. {S} {A} {E}	{SS}	85.979	77	.227	11.{S}{A}{E}	{SS}	90.394	77	.141	20.{R}{A}{F}	{SS}	80.736	69	.158
2. {S} {A} {F}	{SS}	45.060	41	.306	12.{S}{R}{E}	{SS}	44.826	41	.314	21.{A}{F}	{SS}	16.226	13	.237
3. {S} {R} {F}	{SS}	24.544	21	.267	13.{S}{A}	{SS}	6.069	5	.300					
4. {A} {E}	{SS}	37.308	29	.139										
5. {R} {F}	{SS}	6.604	5	.252										
6. {R} {A} {E}	{D}	138.693	125	.190	14.{S}{A}{E}	{D}	89.414	77	.158					
7. {S} {A} {F}	{D}	48.520	41	.196	15.{S}{R}{E}	{D}	47.836	41	.215					
8. {A} {E}	{D}	31.146	29	.359	16.{S}{A}	{D}	6.575	5	.254					
9. {R} {E}	{D}	18.847	13	.128	17.{S}{R}	{D}	1.540	1	.215					
10. {S} {A} {F}	{SE}	42.850	41	.392	18.{S}{A}{E}	{SE}	84.034	77	.273	22.{R}{A}{F}	{SE}	79.735	69	.177
					19.{S}{A}	{SE}	7.622	5	.178	23.{A}{F}	{SE}	18.658	13	.134

S = Sex
E = Ease obtaining drug
SS = Sensation-Seeking
SE = Self Esteem
R = Race
F = Friends who use drug
A = Anti-drug spot
D = Depression

third three-factor model (Table 3, model 3) contained sex, race, and use of AAS by close friends, but the second two-factor model (Table 3, model 5), which included race and AAS use by close friends, fit the data equally well. The difference in likelihood values (17.940 with 16 degrees of freedom) was not significant. Once again, sex could be eliminated without a loss of information. Health practitioners might interpret these findings in the following manner: Given the presence of a sensation-seeking personality, risk perceptions of AAS may be explained by combinations of (1) measures of drug-spot exposure and the ease with which AAS could be obtained, and (2) measures of race and the extent to which close friends use anabolic-androgenic steroids. As an abstract personality trait, sensation-seeking appears to have greater explanatory power than the sex demographic.

In the second set of models addressing risk perceptions of AAS, depression replaced sensation-seeking as a covariate. Here, a three-factor model that included race, exposure to drug spots, and the ease through which AAS could be obtained (Table 3, model 6) fit the data in a statistically acceptable manner, as did two of its reduced models (Table 3, models 8 and 9). As with sensation-seeking, one reduced model included exposure to drug spots and ease of obtaining AAS, while the second two-factor model (Table 3, model 9) included race and the ease through which AAS could be obtained. Both reduced models fit the data as well as the three-factor model did (see Table 3, model 6), and thus one may conclude that depressed individuals, who estimate comparatively low levels of risk associated with AAS, might be slightly more inclined to experiment with the drugs, given their race, the availability of AAS, and a lack of exposure to drug spots.

Finally, a three-factor model including sex, exposure to drug spots, and use of AAS among close friends fit the data with each of the three covariates entered (Table 3, models 2, 7, and 10). Although the significance level of the self-esteem model slightly eclipsed the maximum level (p = .35, per Knoke and Burke 1980), it is notable that the three factors consistently fit the data given the presence of covariate indices. In addition, the models did not reduce in a statistically acceptable manner. These models lend a degree of support to social cognitive theory insofar as they contain personal, behav-

ioral, and environmental elements and reproduce frequencies of the dependent variable in the presence of sensation-seeking, depression, and self-esteem indices. As with previous models, health practitioners might consider these variable representations as indicative of those most likely to express lower risk estimates, with risk estimates often associating with behavioral intentions.

MDMA risk perceptions. As a means of shedding additional light on AAS risk perceptions, the present study included assessments of risk associated with MDMA (i.e., ecstasy), a synthetic "club drug" associated with raves (i.e., all-night dance parties). In studying the nine models that appear in the second column of Table 3, readers will note the presence of the sex measure in each model. While AAS risk perceptions could be explained by models that did not include a measure of sex, MDMA perceptions could not. Additionally, inspection of the race demographic revealed that both African American and Hispanic respondents estimated greater risk associated with MDMA, whereas only African Americans tended to estimate higher risk associated with AAS. Absent in MDMA models is the influence of close friends who use the substance.

As with models of AAS risk, one three-factor combination explained MDMA risk with the presence of each covariate. Models including sex, exposure to drug spots, and the ease through which MDMA could be obtained fit with the inclusion of sensation-seeking, depression, and self-esteem indices (Table 3, models 11, 14, and 18), but reduced models that include sex and exposure to drug spots fit the data equally well (Table 3, models 13, 16, and 19); ease of obtaining MDMA dropped out as a central factor. Additionally, two three-factor models including sex, race, and the ease through which MDMA could be obtained fit the data with the inclusion of sensation-seeking and depression indices (Table 3, models 12 and 15), and ease of obtaining MDMA dropped out in one of the two cases. Thus, males, whites, and those who reported little exposure to drug spots indicated lower levels of risk associated with MDMA, as did sensation seekers, depressed individuals, and those with lower levels of self-esteem. Factors for ease of obtaining the drug and use of MDMA by close friends did not appear to be as important as they did in AAS analyses.

Marijuana risk perceptions. Moving to the third column in Table 3, only one three-factor model and one reduced model explained marijuana risk perceptions, given the inclusion of sensation-seeking and self-esteem covariates. The three-factor model included race, exposure to drug spots, and use of marijuana by close friends. Inspection of the race measure revealed higher risk estimates among Hispanics and lower risk estimates among African Americans, a pattern opposite AAS risk perceptions. The reduced model included exposure to drug spots and the extent to which close friends used marijuana; those who had seen more drug spots and those who did not have friends who used marijuana estimated higher levels of risk. As an explanatory measure, ease of obtaining marijuana showed a heavy skew relative to AAS and MDMA, and it appears that the ease through which marijuana could be obtained nullified the variable as a risk determinant.

DISCUSSION

Illicit use of anabolic-androgenic steroids by adolescents warrants attention not only from medical professionals, but also from social scientists, whose work stands to inform practitioners with the National Institute on Drug Abuse, the Centers for Disease Control and Prevention, and other organizations about the motivations and behaviors of at-risk populations. Consistent with assertions Bandura (2002) made in advancing social cognitive theory, the current study identified a series of personal, behavioral, and environmental influences on AAS risk perceptions. In logit log-linear analyses, risk estimates consistently resulted from a combination of these influences, and the study also observed differential explanatory effects across AAS, MDMA, and marijuana.

Beginning with demographic measures, the study found male and white respondents to report lower risk estimates, in general. Interestingly, minority attitudes appeared to vary across AAS, MDMA, and marijuana, with African Americans reporting significantly higher AAS risk perceptions. African Americans and Hispanics estimated similar risks associated with MDMA, and in analyses involving marijuana Hispanics estimated much higher levels of risk than did whites and African Americans. Attitudinal differences across minority respondents might be explored further in future research, as patterns observed

in the present study may relate to social stereotypes and a determination on the part of survey respondents not to perpetuate them.

Regarding the effect of sex, although males consistently estimated lower levels of risk, inclusion of the sensation-seeking index reduced the importance of sex as an AAS risk determinant. In analyses of MDMA, while sensation-seeking contributed to statistical models, sex remained a central factor. As a mind-altering "club drug," MDMA has been linked with other illicit substances, such as Rohypnol (i.e., "roofie"), a date-rape drug. Conceivably, females may find "club drugs" especially dangerous, associating them with sexual vulnerability and predatory behavior. With sex proving less important in AAS and marijuana models, future research might explore in greater depth attitudinal differences across different types of illicit substances.

Analyses of MDMA, which did not identify drug use by close friends as a central determinant of risk perceptions, helped to illustrate the importance of friends and acquaintances in the formation of AAS risk perceptions. Peer networks have proven important in the development of AAS attitudes, given social processes that encourage would-be AAS users to discount the views of physicians and privilege the advice of self-declared experts and gurus. Pope and his colleagues (2004) reported that when it came to seeking steroid advice, the AAS users they interviewed tended to ascribe medical professionals no more credibility than peer groups, those who trafficked in AAS, and Internet sites. Adolescents, like many adults who use AAS without being supervised by a qualified physician, thus may proceed based on "knowledge" they have acquired from individuals without medical training (Monaghan 1999; Pope et al. 2004). Adolescents may learn from their peers where to secure syringes for injecting steroids, but they may not learn of documented cases in which body builders have contracted HIV by sharing syringes. Likewise, adolescents may learn where to acquire steroids, but they may not learn that counterfeit substances are ubiquitous in the underground drug trade. In fact, when estimating risk associated with the use of AAS, respondents may not realize that one of the most serious risks is whether the substances used are steroids at all.

To some extent, findings from the present study appear consistent with recent research on obesity reported in the *New England Journal of Medicine.* In that study, Christakis and Fowler (2007) examined an interconnected social network of 12,067 individuals and, conceptualizing obesity as a biologic and behavioral trait, concluded through longitudinal statistics that obesity tended to spread by way of social ties. The authors observed that friends and siblings of the same sex had more influence than did members of the opposite sex, a finding that "provides support for the social nature of any induction of obesity, since it seems likely people are influenced more by those they resemble than by those they do not" (p. 377). Interestingly, overweight adolescents may hear of AAS as a kind of "fat burner" and decide to experiment with the drugs, again with the hope, or expectation, of a better body and a more positive outlook on life.

Indeed, because adolescents often seek popularity among their peers, they may use AAS in attempting to build muscular physiques, which, they assume will command respect and admiration. As the present study has demonstrated empirically, depressed individuals and those with low levels of self-esteem may be more willing to experiment with AAS, given lower risk perceptions. They may ask themselves questions: "What have I got to lose?" "How dangerous could steroids really be? People I know use them, and they're doing just fine." As indicated, serious side effects can occur, and even more serious effects may result from bogus and toxic substances sold to naïve adolescents.

As an explanatory measure, exposure to drug spots showed consistent effects in the current study, with those exposed to messages more frequently estimating higher levels of risk. This finding lends support to the public service announcements developed by Major League Baseball in the aftermath of Congressional hearings on steroid use in the professional ranks. If spots continue to appeal to self-efficacy and the successes young people can realize without using AAS, they stand to contribute to risk perceptions, which may relate to behavioral intentions and actual behavior (Dodge and Jaccard 2007).

In future research, should the opportunity arise to include college students in a study of AAS risk perceptions, it might prove informative to contrast their attitudes with those of high school students. When 18-year-olds arrive on campus, they sometimes become intimidated by thousands of fellow students. As a result,

some college students opt to use anabolic-androgenic steroids to set themselves apart from their peers, seeking to be the most muscular and, in some cases, the most popular. College students may actually be more inclined to experiment with steroids, given that many may have been athletic stars in high school, only to become relatively anonymous in the university environment. While it would be ideal to conduct interviews with actual steroid users, researchers should realize that both the law and social desirability stand to impact survey respondents. Given such constraints, risk perceptions will likely prove integral to continued studies on drug use and social behavior.

Regarding limitations and additional recommendations for future research, the MTF variable measuring race included African Americans, whites, and Hispanic respondents. With African Americans and Hispanics differing in their assessments of risk, future scholarship might examine the factors that lead members of differing racial minorities to report differing attitudes. In addition, while the present study examined the influence of peer groups in the formation of risk attitudes, how might family structures stand to influence perceptions? Are there additional exogenous variables that might advance the knowledge base? In expanding the number of variables to be considered in future analyses, scholars will likely need to work with expanded sample sizes, such that rigorous statistical analyses can be conducted. In addition to the Monitoring the Future studies, scholars also may look to the National Survey on Drug Use and Health and the General Social Survey. These data sets often include questions about recreational activities and sports participation, allowing scholars to test relationships that may not have been captured in the present study.

NOTES

1. The MDMA response measure asked survey participants, "How much do you think people risk harming themselves (physically or in other ways) if they take MDMA once or twice?" Response options included "no risk," "slight risk," "moderate risk," "great risk," and "can't say." With the same response options, the marijuana item asked respondents, "How much do you think people risk harming themselves (physically or in other ways) if they smoke marijuana regularly?" Both items were collapsed to reflect the response measure associated with AAS risk.
2. In the present study, because the three covariate indices measuring sensation-seeking, depression, and self-esteem contained as many as 30 levels (i.e., six Likert statements measured on five-point scales), the study included them only in its logit log-linear analyses. A much larger sample would have been necessary to include them in ordinal regression models with multiple explanatory measures. In logit log-linear modeling, a covariate is not applied on a case-by-case basis, but rather a weighted covariate mean is applied to respective cells (SPSS 2007).
3. Regression analyses showed consistent results between listwise deletion of missing cases and multiple imputation techniques. Given those consistencies, the listwise approach appeared reasonable for logit log-linear models.
4. By convention, the ordinal model fit through SPSS estimates the cumulative logit by subtracting each corresponding variable's parameter estimate from the appropriate thresholds (see O'Connell 2006); thus, – (–.225) is the differential effect for males relative to females. The exponentiated value of – (–.225) is 1.25, indicating that males were 1.25 times as likely as females to indicate a lower risk category.
5. Because of a rapid increase in cells with each explanatory measure, not all determinants could be tested in one model. Attempting to include too many variables in one equation moved the goodness-of-fit statistic to a saturation point (i.e., 1.0).

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