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Conditional Effects of Appearance and Performance Enhancing Drugs (APEDs) Use on Mood in Powerlifters and Bodybuilders

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Abstract

Risk factors for steroid mood effects are unclear and few studies have examined drugs used concurrently with steroids (e.g., stimulants) or emotion regulation deficits that may have unique mood effects. We examined effects of steroid use, stimulant use, and history of mood, trauma, or anxiety disorders on mood in 130 men via online survey. Both steroid and stimulant use had few unique effects on mood. However, stimulant use was associated with increased negative affect and decreased automatic positive thoughts among individuals with a history of mood, trauma, or anxiety disorders. Results highlight the importance of patient differences in steroid effects.

Keywords

Anabolic-Androgenic Steroids; Appearance and Performance Enhancing Drugs; Thermogenic Ergogenic Drugs; Stimulants; Mood

INTRODUCTION

Appearance and performance enhancing drugs (APEDs) include a range of illicit, prescription, and over-the-counter drugs used to increase lean body-mass and/or oxygen availability to attain an idealized physique and/or improved athletic performance (Hildebrandt, Langenbucher, Carr, & Sanjuan, 2007). Anabolic Androgenic Steroids (AAS) include testosterone derivatives and analogues. AAS have not only received the most research and legislative attention (Daly et al., 2003; Kanayama, Hudson, & Pope, 2009; Pagonis, Angelopoulos, Koukoulis, & Hadjichristodoulou, 2006; Su et al., 1993; Yates,

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Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Perry, & Murray, 1992), but also significant media attention where they are considered the culprit of “roid rage,” an episode of anger and violence presumably caused by AAS use (Chantal, Soubranne, & Brunel, 2009). However, research suggests that such mood effects of AAS are idiosyncratic and uncommon (Hildebrandt et al., 2007; Kanayama et al., 2009; Pope, Kouri, & Hudson, 2000; Rubinow & Schmidt, 1996; Yates, Perry, MacIndoe, Holman, & Ellingrod, 1999).

Global prevalence rates of AAS use range from 6.4% of adult males, 13.4% of athletes, to 18.4% among recreational sports people (Sagoe, Molde, Andreassen, Torsheim, & Pallesen, 2014). Thermogenic/Ergogenic Drugs (TEDs) are another class of APEDs, frequently used in conjunction with AAS, which include stimulants with fat-burning and energy-boosting properties (Coffey, Steiner, Baker, & Allison, 2004). Common TEDs include liothyronine (thyroid hormone), clenbuterol (illicit in the U.S.), synephrine, ephedra, ephedrine, theophylline, and caffeine (Hildebrandt, Harty, & Langenbucher, 2012; Hildebrandt et al., 2007). The calculation of TED prevalence rates is more complicated as TEDs include common substances (e.g. caffeine) in addition to prescription medications. Rates of TED use are higher among users of other APEDs (Buckman, Farris, & Yusko, 2013) ranging from 28% to 56% compared to non-APED users (8%–23% depending upon substance category, caffeine defined as “multivitamin with caffeine”). Other research has found rates ranging from 25% for ephedrine (Kanayama, Gruber, Pope, Borowiecki, & Hudson, 2001) to 58% for ephedrine, pseudoephedrine, or amphetamine (Bents, Tokish, & Goldberg, 2004) among athletes and 7% for non-prescription weight-loss products in the general population (Blanck, Khan, & Serdula, 2001).

Despite high prevalence of TED use, most studies examining the effects of AAS on mood have failed to account for concurrent TED use (Dodge & Hoagland, 2011). Most APED users are polypharmacy users who concurrently or sequentially take drugs from different categories over 2–28 week time periods (Hildebrandt et al., 2007; Pagonis et al., 2006; Pope & Katz, 1994). Thus, it is important to control for TED use when examining the effects of AAS use on mood. Additionally, the possible role of emotion regulation deficits has remained unexamined in the APED research. Emotion regulation deficits associated with mood, trauma, or anxiety disorders (Gross & Muñoz, 1995; Weiss, Tull, Anestis, & Gratz, 2013) may instigate, motivate, or perpetuate APED use (i.e., self-medication). Alternatively, such emotion regulation deficits may change how APED use affects mood-related outcomes.

The purpose of the present study is to examine the main and interactive effects of AAS use, TED use, and history of mood, trauma, or anxiety disorders on both positive and negative mood-related outcomes. Given the scarcity of research examining both AAS and TED use, we considered these analyses exploratory. Thus, we did not have specific *a priori* hypotheses; we simply wanted to explore whether the effects of APED use on mood-related outcomes may be dependent on history of mood, trauma, or anxiety disorders (a proxy for underlying emotion regulation deficits).

Method

Participants and Procedures

Participants were 130 male weightlifters and bodybuilders, mean age of 32 (19–57, $SD = 8.76$), who completed an anonymous survey following completion of an electronic informed consent. A web-accessible survey was linked from the Rutgers University website to internet bodybuilding, weightlifting, and AAS websites and indexed under search engines. Females were targeted as well as males, but only 5 women responded, thus only males were included in analyses. Although use of APEDs was not an inclusion criterion, use was high given that the survey was linked to some websites with AAS-related content.

Measures

APEDs—A questionnaire designed for the current study asked participants details regarding their use of APEDs. First, participants were asked if they had ever used anabolic steroids; if yes, they were then asked when was the last time they used them (1= today, 2=yesterday, 3=2–4 days ago, 4=5–7 days, 5=a little over a week ago, 6= about two weeks ago, 7=more than two weeks ago, 8=two to twelve months ago, 9=over a year ago). Similarly, participants were asked if they had taken “fat burners or endurance boosters in the last 24 hours.” All participants that answered yes to either the AAS or TED entry question were then queried about which specific substances they had used. Given the generally longer half-lives of AASs compared to TEDs, we considered current AAS use as taking an AAS within the past 2 weeks, whereas current TED use was assessed as taking TED within the past 24 hours.

History of mood/anxiety disorder—A single mental health item asked, “Have you ever been diagnosed with any of the following conditions? (Check all that apply).” A dichotomous item was created to indicate presence or absence of a mood, trauma, or anxiety disorder including Anxiety, Posttraumatic Stress Disorder, Depression, Phobia (fear of heights, crowds, flying, etc.), Obsessive Compulsive Disorder, Bipolar Disorder (manic-depression), or Mania or Hypomania. For the purpose of simplicity, we will refer to this as mood/anxiety disorder throughout this paper.

Mood—All mood assessments queried mood states in the past 24 hours. Anger was assessed with the Revised State-Trait Anger Expression Inventory (STAXI-2; Spielberger, 1998), which includes 3 subscales: Feelings, Verbal, and Physical anger. The Profile of Mood States – Brief (POMS-B; McNair & Heuchert, 2005) was used to assess six moods: tension/anxiety, depression/dejection, anger/hostility, vigor/activity, fatigue/inertia, and confusion/bewilderment. Positive self-relevant cognitions were assessed with the Automatic Thoughts Questionnaire – Positive (ATQ-P; Ingram & Wisnicki, 1988). Positive and negative affect were assessed with the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988).

Data Analysis

To explore the main and interactive effects of AAS use, TED use, and mood/anxiety disorder on mood-related outcomes, we conducted hierarchical regression analyses. Initially, we

entered AAS, TED use, and mood/anxiety disorder as predictors of each mood-related outcome in block 1, followed by all two-way interactions in block 2, and the three-way interaction in block 3. Across all models, none of the two- or three-way interactions with AAS use were significant (analyses available from authors). Therefore, we present our trimmed model with the effects of AAS use, TED use, and mood/anxiety disorder in block 1, and the interaction of TED use with mood/anxiety disorder in block 2. To probe interaction effects, we examined the simple slopes to investigate the predictive effects of TED use on each outcome for individuals with and without a mood/anxiety disorder.

Results

Table 1 shows that many of the mood measures were correlated with each other, as expected. The results of the regression analyses are reported in Table 2. For individuals who did not report current TED use or a mood/anxiety disorder, current AAS use predicted significantly less vigor/activity, but did not predict any of the other mood-related outcomes. For individuals who did not report current AAS use or a mood/anxiety disorder, current TED use predicted increased vigor/activity and decreased overall negative affect, but did not predict any of the other mood-related outcomes. For individuals who did not report current AAS or TED use, mood/anxiety disorder was associated with less vigor/activity, less positive automatic thoughts, and less overall positive affect, but was not related to any of the other mood-related outcomes. Importantly, the two-way interaction between current TED use and mood/anxiety disorder was significant for seven of our twelve mood-related outcomes including tension/anxiety, depression/dejection, anger/hostility, fatigue/inertia, confusion/bewilderment, positive automatic thoughts, and overall negative affect (See Table 2).

To examine the nature of each interaction, we examined simple slopes for each model with a significant interaction. Every interaction could be described by TED use having no effect or a positive effect on mood among individuals *without* a mood/anxiety disorder (i.e., decreased negative mood, increased positive mood), but a negative effect for individuals *with* a mood/anxiety disorder such as higher negative affect (tension/anxiety, depression/dejection, anger/hostility, fatigue/inertia, confusion/bewilderment, and overall negative affect) and lower positive automatic thoughts. Figure 1 provides illustrations for three of these interactions (tension/anxiety, confusion/bewilderment, and positive automatic thoughts). For example, there was no significant association between TED use and tension/anxiety among individuals without mood/anxiety disorder ($b = -.11$, $p = .870$); however, there was a significant positive association between TED use and tension/anxiety among individuals with a mood/anxiety disorder ($b = 2.52$, $p = .025$; see Figure 1a). There was no significant association between TED use and confusion/bewilderment among individuals without a mood/anxiety disorder ($b = -.06$, $p = .900$); however, there was a significant positive association between TED use and tension/anxiety among individuals with a mood/anxiety disorder ($b = 2.22$, $p = .011$; see Figure 1b). For positive self-relevant cognitions, there was a significant positive association between TED use and automatic positive thoughts among individuals without a mood/anxiety disorder ($b = 5.92$, $p = .044$); however, there was only a nonsignificant trend towards a negative association between TED use and automatic positive thoughts among individuals with a mood/anxiety disorder ($b = -9.26$, $p = .067$; see Figure 1c). Therefore, among individuals who *did not* report TED use, there

were relatively small differences on mood-related outcomes among individuals with or without a mood/anxiety disorder. However, among individuals who *did* report TED use, there were significant differences on mood-related outcomes among individuals based on whether or not they had a mood/anxiety disorder. In other words, participants who did not use stimulants had similar levels of negative and positive mood outcomes regardless of having been previously diagnosed with a mood or anxiety disorder. However, among participants who did use stimulants, those who had a previous diagnosis of a mood or anxiety disorder reported significantly worse current mood than those participants who had not been previously diagnosed with a mood or anxiety disorder.

Discussion

The present study examined the relationships between AAS use, TED use, history of having been diagnosed with a mood, trauma, or anxiety disorder, and multiple positive and negative mood-related outcomes. Consistent with some previous research (Kanayama et al., 2009; Pope et al., 2000; Yates et al., 1999), we found very few direct effects of AAS use on mood-related outcomes. Similarly, TED use did not have a direct effect on mood-related outcomes in any consistent manner. However, TED use had a rather consistent conditional effect on mood-related outcomes. Specifically, TED use appeared to have mood-enhancing properties (i.e., increased positive emotions, decreased negative emotions) among individuals who reported no history of mood, trauma, or anxiety disorder. On the other hand, TED use seemed to have mood-worsening (i.e., decreased positive emotions, increased negative emotions) effects among individuals who did report such a history.

This study highlights the importance of examining mental health differences among APED users when attempting to parse the effects that these drugs have on emotional and behavioral outcomes. We found that the associations between TED use and emotional outcomes were in opposing directions for those with versus without a history of mood, trauma, or anxiety disorder for most of the emotional outcomes. Thus, it is important for future research to explain how TED use may contribute to mood-worsening among some individuals. For example, research indicates that individuals with a mood, trauma, or anxiety disorder diagnosis likely have specific deficits in emotional regulation. Emotion regulation deficits have been posited as an important contributor to a range of psychopathology including substance use (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Gross & Muñoz, 1995; Weiss et al., 2013). However, we are unaware of any studies examining emotion regulation deficits among APED users. Use of TEDs may further perturb an already disordered emotion regulation system in some APED users, resulting in worsening emotional problems by leading to the selection of ineffective emotion regulation strategies (e.g., avoidance, rumination, or suppression; Aldao et al., 2010). Alternatively, these emotion regulation deficits may also be associated with increased body dissatisfaction, increasing the likelihood of TED use and heavy polypharmacy. In a sample of college men (Lavender & Anderson, 2010), emotion regulation deficits were found to predict disordered eating and body dissatisfaction above and beyond the effects of negative affect and body mass index.

Limitations

Although we replicated interaction effects of TED use and mood/anxiety disorder on several mood-related outcomes, we are unable to demonstrate temporal precedence. Thus, our cross-sectional survey design prevents us from making strong causal inferences (i.e., that TED use and/or mood/anxiety disorder is causally related to mood-related outcomes). We used a self-report measure of whether one had received a diagnosis for a mood, trauma, or anxiety disorder (i.e., mood/anxiety disorder) as a proxy variable for underlying emotional regulation deficits. Considering low rates of mental health treatment utilization, this measure lacks precision in that it likely has high sensitivity (i.e., individuals diagnosed with mood, trauma, or anxiety disorder have emotional regulation deficits) but lower specificity (i.e., individuals not diagnosed with mood, trauma, or anxiety disorders do *not* have emotional regulation deficits). Although there are pharmacological reasons for grouping APEDs into discrete categories of AASs and TEDs, our relatively small sample size precluded an adequately powered examination of specific APEDs or subcategories of AASs or TEDs. Similarly, we recognize that there are varying half-lives among these substances within AAS and TED groups, so that the definition of “current” as 2 weeks versus 24 hours, respectively, is a rough accommodation for half-life effects.

Conclusions

The finding that TED use was associated with negative mood side-effects only in those users who reported having been previously diagnosed with a mood, trauma, or anxiety disorder adds to prior research suggesting that negative mood associated with AAS is idiosyncratic (Kanayama et al., 2009; Pope et al., 2000; Yates et al., 1999). Indeed this research adds to findings previously reported by members of this team where a membership in a latent class labeled as “heavy polypharmacy” was associated with the highest mood and physiological impairments (Hildebrandt et al., 2007). Our results suggest that TED use combined with prior emotion regulation difficulties may underlie the mood impairments associated with heavy polypharmacy. Body image is likely intertwined with these factors, and longitudinal research with this population will help disentangle the directions of these associations as well as identify long-term clinical implications. APED users with a history of mood, trauma, or anxiety disorders who are using TEDs as part of their body-altering regimen appear to be at particular risk for negative outcomes and may especially benefit from clinical interventions.

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Figure 1.

Simple slopes showing the association between TED use and emotional outcomes (a = tension/anxiety; b = confusion/bewilderment, c = automatic positive thoughts) for individuals with (Mood/Anxiety Disorder +) and without (Mood/Anxiety Disorder –) mood, trauma, or anxiety disorder diagnosis. Error bars represent standard errors. *Note.* POMS = Profile of Mood States; ATQ = Automatic Thoughts Questionnaire; TED = Thermogenic/Ergogenic drug use.

Table 1

Descriptive statistics and bivariate correlations of all study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	M	SD
1. AAS Use	---																.50	.50
2. TED Use	.07	---															.37	.59
3. Mood/anxiety Disorder	.08	-.02	---														.26	.44
4. Tension/Anxiety	.02	.08	.31	---													3.05	3.27
5. Depression/Dejection	.04	.06	.36	.77	---												2.23	3.60
6. Anger/Hostility	.02	-.08	.14	.65	.63	---											3.08	3.70
7. Vigor/Activity	-.21	.16	-.31	-.03	-.20	.04	---										9.57	4.53
8. Fatigue/Inertia	.04	-.08	.20	.54	.55	.46	-.24	---									4.56	3.92
9. Confusion/Bewilderment	-.00	.10	.14	.61	.67	.55	.18	.44	---								3.34	2.43
10. Total Mood Disorder	.09	-.04	.36	.82	.88	.74	-.38	.77	.66	---							6.68	14.94
11. Pos. Auto. Thoughts	-.12	.06	-.38	-.46	-.51	-.36	.42	-.38	-.23	-.58	---						111.4	15.38
12. State Anger-Feelings	.07	-.07	.22	.46	.49	.76	.02	.25	.37	.52	-.32	---					7.40	2.73
13. State Anger-Verbal	-.09	-.05	.15	.37	.34	.60	.08	.18	.26	.38	-.17	.76	---				7.30	3.34
14. State Anger-Physical	-.03	-.09	.17	.40	.49	.68	.07	.18	.36	.46	-.32	.68	.64	---			5.83	2.51
15. State Anger Overall	-.02	-.07	.20	.46	.48	.76	.07	.22	.36	.50	-.29	.91	.92	.85	---		20.53	7.66
16. Positive Affect	-.11	.08	-.37	-.20	-.29	-.03	.66	-.17	.00	-.36	.63	-.04	.02	-.01	-.01	---	35.36	6.40
17. Negative Affect	.03	-.05	.27	.70	.74	.59	-.12	.43	.58	.72	-.55	.49	.38	.45	.49	-.18	16.68	7.13

Note. AAS = Anabolic Androgenic Steroids; TED = Thermogenic/Ergogenic Drug; Pos. Auto. = Positive Automatic. Cronbach's alpha is shown on the diagonal for multi-item inventories. Significant effects ($p < .05$) are in **bold** typeface for emphasis.

Table 2

Main and interactive effects of AAS use, TED use, and history of mood/anxiety disorder on mood-related outcomes

Tension/Anxiety				Depression/Dejection				Anger/Hostility				
<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	
AAS Use	-0.04	-0.01	0.936	-0.01	0.10	0.01	0.862	0.01	0.10	0.01	0.881	0.01
TED Use	-0.11	-0.02	0.870	-0.01	-0.59	-0.08	0.401	-0.07	-1.46	-0.19	0.064	-0.16
Mood/anxiety Disorder	1.34	0.18	0.087	0.15	1.41	0.17	0.090	0.14	-0.05	-0.01	0.959	0.00
Mood/anx Disorder X TED Use	2.63	0.24	0.045	0.17	4.17	0.34	0.003	0.25	3.35	0.27	0.029	0.19
Vigor/Activity				Fatigue/Inertia				Confusion/Bewilderment				
<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	
AAS Use	-1.75	-0.19	0.021	-0.19	0.24	0.03	0.724	0.03	-0.08	-0.02	0.849	-0.02
TED Use	2.08	0.22	0.022	0.19	-1.60	-0.20	0.051	-0.17	-0.06	-0.01	0.900	-0.01
Mood/anxiety Disorder	-2.20	-0.22	0.039	-0.17	0.40	0.04	0.679	0.04	-0.01	0.00	0.985	0.00
Mood/anx Disorder X TED Use	-2.25	-0.15	0.201	-0.11	3.84	0.29	0.017	0.21	2.26	0.27	0.025	0.20
Total Mood Disorder				Positive Automatic Thoughts				State Anger-Feelings				
<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	
AAS Use	2.07	0.07	0.393	0.07	-3.11	-0.10	0.214	-0.10	0.34	0.06	0.471	0.06
TED Use	-5.91	-0.19	0.044	-0.16	5.92	0.19	0.050	0.16	-0.92	-0.16	0.110	-0.14
Mood/anxiety Disorder	5.29	0.16	0.122	0.13	-7.39	-0.21	0.037	-0.17	0.54	0.09	0.417	0.07
Mood/anx Disorder X TED Use	18.49	0.36	0.001	0.26	-15.2	-0.29	0.010	-0.21	2.12	0.23	0.059	0.17
State Anger-Verbal				State Anger-Physical				State Anger Overall				
<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	
AAS Use	-0.65	-0.10	0.271	-0.10	-0.16	-0.03	0.712	-0.03	-0.48	-0.03	0.724	-0.03
TED Use	-0.63	-0.09	0.380	-0.08	-0.72	-0.14	0.180	-0.12	-2.26	-0.14	0.164	-0.12
Mood/anxiety Disorder	0.73	0.10	0.382	0.08	0.58	0.10	0.355	0.08	1.85	0.11	0.329	0.09
Mood/anx Disorder X TED Use	1.33	0.12	0.341	0.08	1.07	0.12	0.308	0.09	4.51	0.17	0.155	0.13

	Tension/Anxiety			Depression/Dejection			Anger/Hostility					
	<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>	<i>b</i>	β	<i>p</i>	<i>pr</i>
Positive Affect												
Negative Affect												
AAS Use	-1.16	-0.09	0.279	-0.09	0.16	0.01	0.893	0.01				
TED Use	1.58	0.12	0.220	0.10	-3.39	-0.23	0.018	-0.20				
Mood/anxiety Disorder	-4.32	-0.30	0.005	-0.24	0.40	0.03	0.809	0.02				
Mood/anx Disorder X TED Use	-2.31	-0.11	0.357	-0.08	10.66	0.44	0.000	0.32				

Note. *pr* = partial correlation coefficient; anx = anxiety. Significant effects ($p < .05$) are in **bold** typeface for emphasis. Negative *pr* values indicate a negative correlation and positive *pr* values indicate a positive correlation.